

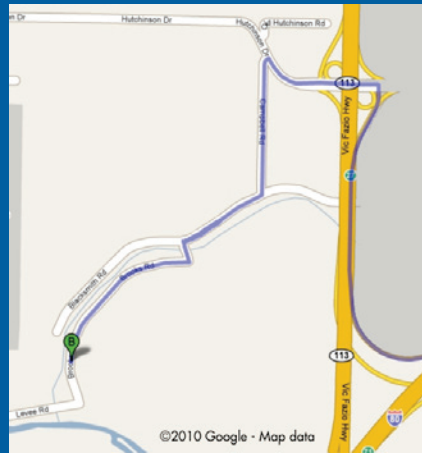
## CENTRIFUGE MODELING

A geotechnical centrifuge is used to perform model tests to study geotechnical issues such as foundations for bridges and buildings, settlement of embankments, stability of slopes, earth retaining structures, tunnel stability, and seawalls. Geotechnical materials such as soil and rock have nonlinear mechanical properties that depend on the effective confining stress and stress history. The centrifuge creates prototype stress levels in a reduced-scale model. The one-to-one scaling of stress enhances the similarity of geotechnical models and makes it possible to obtain accurate data to help solve complex problems such as earthquake-induced liquefaction, soil-structure interaction and underground transport of pollutants. Centrifuge model testing provides data to improve our understanding of basic mechanisms of deformation and failure and provides benchmarks useful for verification of numerical models.



## HISTORY

<b>1978</b>	UC Davis collaborated with NASA in a successful NSF proposal to develop a geotechnical centrifuge facility
<b>1984</b>	9.1-m radius geotechnical centrifuge first operated at NASA Ames Research Center
<b>1987</b>	Centrifuge moved to UC Davis
<b>1988</b>	Centrifuge operated in an open pit at UC Davis, peak acceleration 19 g
<b>1990</b>	NSF-funded enclosure and rotunda installed, peak acceleration now 50 g
<b>1995</b>	Earthquake simulation capability established with funding from NSF, Caltrans, the Obayashi Corporation, and the University of California
<b>2000</b>	UC Davis selected as a NSF - NEES host site. \$5.1M invested in upgrading the UC Davis centrifuge facilities
<b>2004</b>	NEES operations begin



## DIRECTIONS

UC Davis is on I-80 about 75 mi (120 km) east of San Francisco and 15 mi (25 km) west of Sacramento.

- From I-80 in Davis, take Hwy 113 North (exit 70)
- Exit at Hutchison Dr. (exit 27) and bear left at split
- Left (west) at the stop sign onto Hutchison Dr.
- Left (south) at Campbell Rd. after about ½ mi (2/3 km)
- Right (west) where Campbell ends at Garrod Rd.
- Bear left, pass Agricultural Services, follow the blue and white signs for "Hydraulics Lab and Centrifuge"
- Right (west) on Brooks Rd. and go about ½ mi (2/3 km)
- Right onto gravel drive (watch for signs)

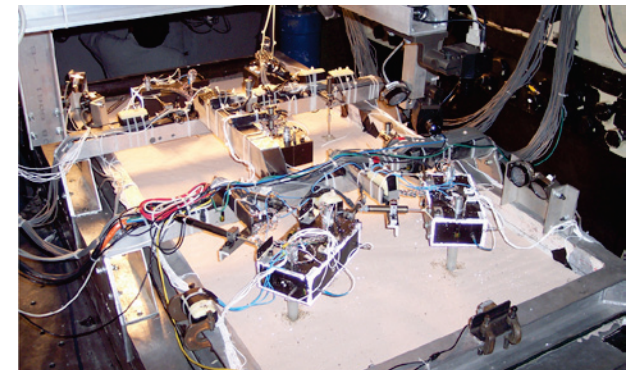
## CONTACT INFORMATION

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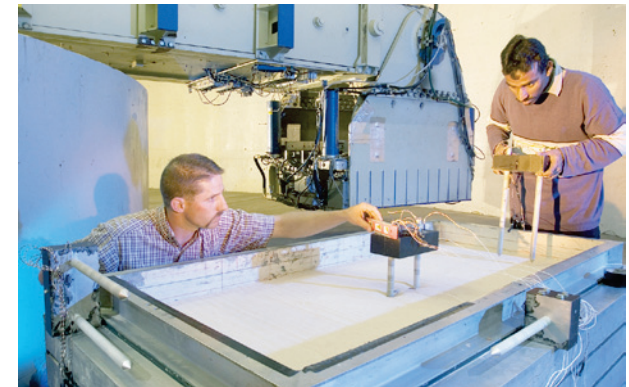
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**The Center for Geotechnical Modeling  
Civil & Environmental Engineering  
UC Davis**



**The Center for Geotechnical Modeling advances the knowledge and practice of geotechnical and earthquake engineering by:**

- Performing and hosting fundamental and applied research for industry, government, and academic organizations, with collaborations ranging from small groups to multi-national teams
- Maintaining a world-class centrifuge facility with advanced equipment, modeling techniques, instrumentation, and networking
- Training researchers and engineers
- Archiving and sharing data and disseminating research findings.

## RECENT RESEARCH PROJECTS

**Properties of Cohesionless Soil Subsequent to Liquefaction and Resedimentation.** Borja (Stanford), NSF NEESR 2009

**Topographic Effects in Strong Ground Motion - From Physical and Numerical Modeling to Design.** Rodriguez-Marek (Virginia Tech), NSF NEESR 2009

**Seismic Earth Pressures on Retaining Structures.** Sitar (UC Berkeley), NSF NEESR 2009

**Design of Soil and Structure Compatible Yielding to Improve System Performance.** Kutter (UC Davis), NSF NEESR 2009

**Shallow Bridge Foundations in Liquefying Soils.** Kutter (UC Davis), PEER 2009

**Biological Improvement of Sands for Liquefaction Prevention and Damage Mitigation.** DeJong (UC Davis), NSF NEESR-II 2008

**Understanding and Improving the Seismic Behavior of Pile Foundations in Soft Clays.** Muraleetharan (Oklahoma), NSF NEESR-SG 2008

**Seismic Performance Assessment in Dense Urban Environments.** Bray (UC Berkeley), NSF NEESR-SG 2008

**Evaluation of Nonlinear Site Response of Soft Clay Using Centrifuge Models.** Brandenberg (UCLA), USGS NEHRP 2007

**Modeling the Nonlinear, Effective Stress Seismic Response of Deep Silt Deposits.** Dickenson (Oregon State), USGS NEHRP 2007

**Centrifuge Testing for Seismic Retrofit of BART Offshore Transbay Tube.** Kutter (UC Davis), Fugro West / BART 2007

**Innovative Economical Foundations with Improved Performance that is Less Sensitive to Site Conditions.** Kutter (UC Davis), Caltrans 2007

**Seismic Risk Mitigation for Ports.** Rix (GaTech), NSF NEESR-GC 2006

**Development of Improved Procedures for Seismic Design of Buried or Partially Buried Structures.** Sitar (UC Berkeley), BART / VTA 2006

## THE NEES PROJECT AT UC DAVIS



The George E. Brown, Jr., Network for Earthquake Engineering Simulation (NEES) is the National Science Foundation's fourteen-year investment in the earthquake engineering research community. This ambitious project aims to reduce the vulnerability of our civil infrastructure to the damaging effects of earthquakes by accelerating the rate at which research discoveries are made and integrated into technologies and products for engineering practice. UC Davis is a host facility on the NEES network. Please refer to: <http://www.eng.nsf.gov/nees/> and <http://www.nees.org> for more information.



The NEES program is authorized by an act of congress under the National Earthquake Hazard Reduction Program (NEHRP). Operation of NEES@UCDavis is supported by NEEScomm at Purdue University through National Science Foundation award CMMI-0927178.

## CENTRIFUGE AND SHAKER CAPABILITIES

Radius	9 m	
Centrifugal acceleration	75 g	
Sensors per experiments	50 to 400	
Container dimensions (typical)		
	1.7m x 0.7m x 0.6m horizontal	
	1.0m x 0.5m x 0.4m biaxial (horizontal/vertical)	
Maximum model mass (soil + structures)	1350 kg	
Shaker performance	Horizontal	Vertical
Peak acceleration (+/- g)	25	21
Absolute velocity (+/- m/s)	0.7	0.7
Displacement (+/- mm)	12.5	7.5
Frequency range (Hz)	30-300	40-400



## SPONSORS

The following sponsors have provided support for the development, operation, and ongoing research at the UC Davis centrifuge.

