NEES@UCLA: Field Testing for Structural and Geotechnical Research

Concept: Advanced Dynamic Field Testing of Civil Structures
NEES@UCLA Equipment

Equipment
- 4 large mobile shakers
- Extensive field-deployable monitoring instrumentation system
- CPT truck for research use

Uses
- Large-amplitude excitation of structures
- Field testing/temporary monitoring of structures
- Site characterization and installation of subsurface sensors using CPT

Large Unidirectional Eccentric Mass Shaker

Qty: 2
Freq: 0-25Hz
Force: 100kip each
Omnidirectional Eccentric Mass Shaker

Qty: 1  
Freq: 0-4Hz  
Force: 15kip

15kip Linear Hydraulic Shaker

Qty: 1  
Freq: 0-20Hz  
Force: 15kip  
Waveform: Arbitrary, digitally-controlled force or displacement
Data Loggers

**Kinematics Quanterra**
**Q330 6 Channel (20x)**

- Standard in seismology
- True 24-bit A/D
- \(~145\) dB dynamic range
- GPS time synchronization (< 1 ms accuracy)
- TCP/IP protocol enables wireless telemetry
- Low power (0.5 W) for long-term deployments

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Accelerometers

**Kinematics Force Balanced Accelerometers**

- 55 Uniaxial & 15 Triaxial Episensors
  - \(\pm 2g\) & 0-200 Hz
  - \(> 155\) dB dynamic range
  - Low noise (< 1 \(\mu g\))
  - < 1% cross-sensitivity
Mobile Command Center

Self-Contained Panel Truck
- Generator power
- Satellite Uplink
  - 1.8m dish
  - T1 speed
- WiFi/LAN Hardware
- NEESpop/Data Turbine
- Data and analysis computers

Wireless Network Topography

Data Concentrator
- Sensor stations
- Access points
- Workgroup
- Wireless Backbone
CPT Truck

- Vendor: Hogentogler, Inc.
- **Site characterization**
  - Tip resistance
  - Sleeve resistance
  - Inclination
  - Pore pressure
  - Geophone for downhole shear wave velocity

Retrievable Subsurface Accelerometer

- Insert with CPT truck
- Compatible with Q330 data loggers
- Retrievable with winch
- Silicon Designs MEMS triaxial accelerometer
- Downhole signal conditioning to reduce noise contamination
- Micro-controller for built in sensor intelligence
RSA Installation

Past & Current Research Use

- **Some Completed Projects**
  - UCSD Phase I & II (NSF, 2003)
  - UCLA Imperial Valley (PEER, 2003)
  - USC/UCSD Carquinez Bridge (Caltrans, 2003)
  - SUNY Buffalo @ Marina Del Rey (2004)
  - UCLA Forced Vibration 4-story Building (NSF, 2004)

- **NEESR Projects**
  - BYU Dynamic + Static Foundation Impedance Study (2005-6)

- **Other Projects**
  - ANSS Sensor Testing (ongoing)
  - Caltrans Pile Testing (ongoing)
  - Shear Wall Tests for Private Firm (ongoing)
Project Examples: Four Seasons

- "Four Seasons" building
  - Four-story with penthouse
  - Reinforced Concrete building
  - Damaged beyond repair in 1994 Northridge Earthquake

- Structural system
  - Lateral Load:
    - Perimeter ductile moment resisting frame
  - Gravity Load:
    - Post-tensioned flat slab + interior column

Excitation: NEES@UCLA Shakers

- Eccentric Mass Shakers (two on roof)

- Linear Shaker
  - Arbitrary forces; sine-sweep, white noise, earthquake-type loading
Instrumentation

- Accelerometers (100 ch)
- Strain Gauges (96 ch)
- DCDT (drift, 20 ch)

Payload projects
- Nonstructural (UCI)
- Advanced sensors (CENS/UCLA)

Project Examples: Carquinez Bridge
Opportunities

- Building/Bridge/Dam structural response and performance studies
- Health monitoring and sensor network studies
- Response and performance studies for geo-structures and soil deposits
- Soil-Structure Interaction Studies

Personnel

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