2nd Annual Meeting of the NEES Consortium
San Diego, California - May 20-23, 2004

Early Research Usage - UCLA

John W. Wallace, Jonathan Stewart, Ertugrul Taciroglu
Steve Kang, Ying Lei, Daniel Whang
Eunjong Yu, Derek Skolnik, William Elmer

nees@UCLA
The George E. Brown, Jr. Network for Earthquake Engineering Simulation

Field Testing
Performance of Structural & Geotechnical Systems

- **Vibration equipment**
- **Data acquisition & sensors**
- **CPT Truck & RSA**
- **High performance mobile network**

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Research Usage: nees@UCLA

- Completed Projects
  - UCSD Phase I & II (NSF)
  - UCLA Imperial Valley CPT (PEER)
  - USC/UCSD Carquinez Bridge
  - SUNY Buffalo @ Marina Del Rey (FHWA)
- Ongoing
  - UCLA Forced Vibration 4-story building (NSF)
- Upcoming
  - BYU/UCSB/USC & UCLA/UT Garner Valley (NSF, IRIS, USGS)

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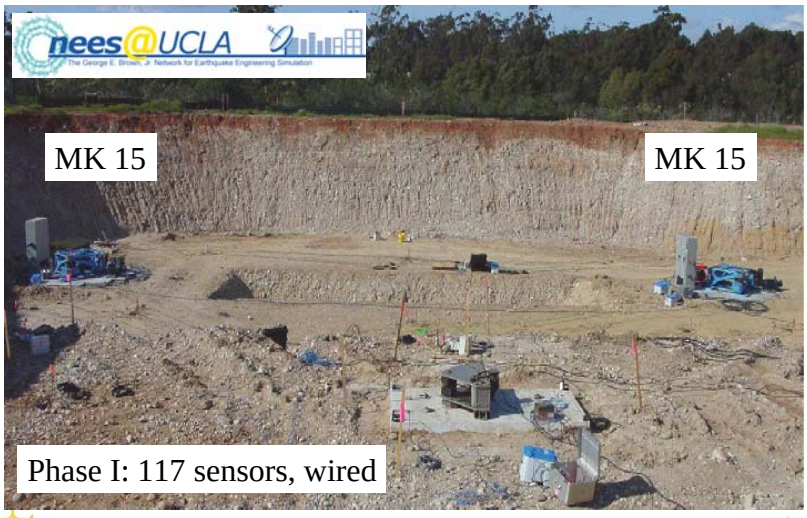
UCSD Camp Elliott Phase I



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UCSD Camp Elliot Phase II

UCSD Camp Elliot Project

- UCSD Obtained funding (NSF)
  - PIs: Enrique Luco and Joel Conte
  - Characterize the Camp Elliot Site – Virtual model
- UCLA subcontract
  - Provided the equipment and personnel
  - Phase I (April 03), Phase II (Oct 03)
  - Benefits to UCLA
    - Full-capacity test of shakers, shaker synchronization
    - DAQ – wired/wireless, Experience
- 1st NEES Shared-Use Project?

I80 - Carquinez Bridge

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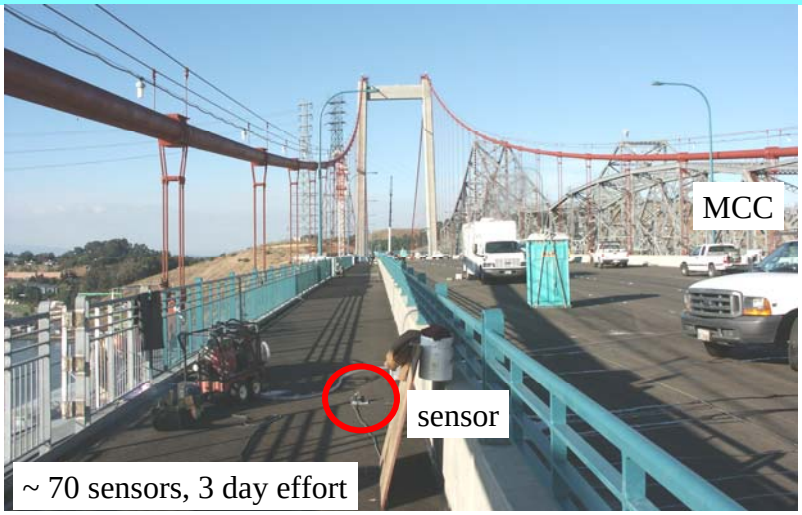
I80 - Carquinez Bridge



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Carquinez Bridge Project

- **UCSD/USC Project**
  - PIs: Joel Conte, Ahmed Elgamal, Sami Masri
  - Vibration data for system identification
    - Ambient, truck induced
  - November 3 – 5, 2003
- **UCLA Subcontract**
  - Equipment and personnel (shared-use)
  - Benefits to UCLA
    - Limited (wireless system problem), more experience
  - Societal Benefits
    - Rare opportunity – Bridge opening: Sat, Nov. 8, 2003
    - Rapid deployment – value of the equipment and trained personnel

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Marina Del Rey CPT/RSA Project

- SUNY Buffalo
  - PI: S. Thevanayagam
  - Objectives were to obtain ground vibration and pore pressure measurements near a stone column installation
  - UCLA – Shared Use
  - CPT Truck & RSAs (2 day)
- UCLA Imperial Valley CPT
  - PI: J. Stewart
  - CPT measurements at liquefaction / non-liquefaction sites from Imperial Valley earthquake
- Benefits UCLA ES
  - RSA data, retrievable
  - CPT Truck use and training

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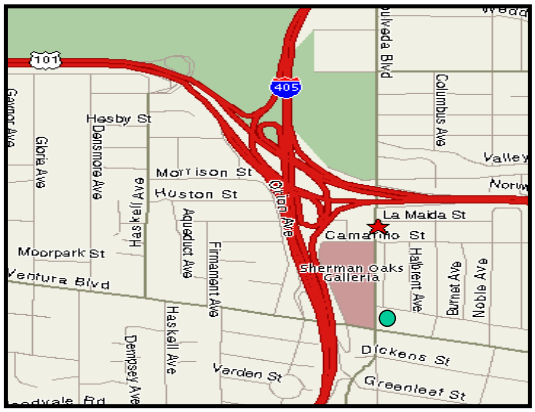
UCLA Four Seasons Project

- Forced-Vibration Testing
  - Sherman Oaks, California
  - 4-story RC Building (1977)
- Damaged (yellow tag) in Northridge earthquake
  - Empty, to be demolished
- Complete System Test
  - Shakers/Sensors & DAQ
  - Mobile command center
  - Satellite, Tele-presence
  - SI Collaboration tools
  - User manuals and safety requirements

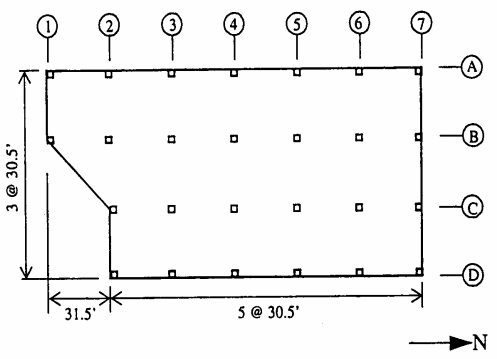
Building Location



● TransWorld/CalFed/Citibank Bank (instrumented)

Building Description

- Perimeter Moment Resisting Frame
  - Beam : 24”x30”
  - Column : 24”x24”
- Gravity Load :
  - Post-tensioned slab with drop panels (8 ½”)
  - interior columns
- Bell caisson foundation



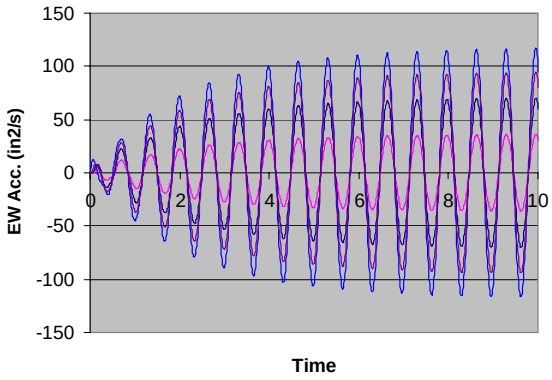
Typical Floor Plan

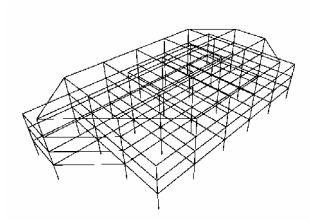
Building Damage – Northridge (1994)

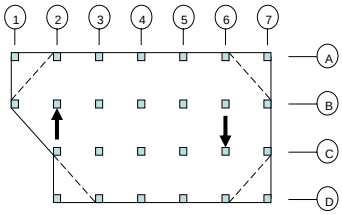
- Punching shear failure at interior floor slab – column connections
- Minor damage reported at perimeter frame
  - Spalling beams/columns
  - Diagonal joint cracks
- Prior studies
  - Limited success in identifying reasons for damage

Punching shear failure at slab-column connection

Pre-Test Modeling







T = 0.66 sec; F = 92.4 k; A_{max} = 0.30g

Summary of Expected Work

- Forced-vibration testing with linear inertial shaker
  - Broadband excitation - Use records from Northridge earthquake
  - Diagonal excitation (LSSS method – modified/filtered roof motion)
- Forced-vibration testing with eccentric mass shakers
  - N-S, E-W translational vibrations and torsional vibration
  - Induce some damage and retest
- Instrumentation
  - Measure ~200 response quantities (CENS – 50 to 70 sensors)
  - Column, beam, slab, partitions, piping
- Post-testing numerical modeling and system identification studies
  - Evaluate modal properties of building, damage detection
  - Numerical simulation of tests, model improvement
  - Start with model of undamaged building and subject it to Northridge motions

Four Seasons Building - Benefits

- First Field Use
  - Linear Shaker
  - NI DAQ System
- Center for Embedded Networked Sensing (CENS) – NSF STC
  - MEM Sensors
  - Network Time Protocol
  - Additional Sensors/DAQ
- User requirements
  - Safety requirements

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Four Seasons Building - Payload

- Payload or “Piggyback” Project
- T. Hutchinson, UC Irvine
  - NSF Funded Project
  - Performance of laboratory equipment
  - Install equipment on the 4th floor and monitor responses
  - Objectives: Simulation, Multi-axis data (torsion), Field deployment
- 1st NEES Payload Project?

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Early Use - Observations

- Shakers Installation
  - Scheduling, crane
  - Waterproofing membrane
- Sensor Installation
  - Challenge (strain, displ.)
  - Demolition required for partitions, floor tiles, plaster
- Environment - challenging
  - No electricity (generators), plumbing
  - Broken glass, dust, ??
  - Transients

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Early Use - Observations

- Security
  - Secure rooms on each floor
  - Sensors, wires (wireless)
  - Costly (time and personnel)
- Risk Management
  - HazMat Survey ($5600)
  - Mold, asbestos, lead
  - Safety training & equipment
- Field locations
  - Travel costs & time
- University barriers
  - Willing and cooperative owner
  - Lease agreement (12 months)
  - UCOP policies

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Early Use - Observations

- Interactions – Researchers and ES
  - SOC Users Guide, ES web sites, Training
  - Successful projects
    - Careful and thoughtful planning
    - Detailed and frequent communications
    - Reasonable expectations
    - Patience and flexibility (particularly in the early stages)
  - NEES Shared-use model (SOC)
    - Schedule, Budget, Scope of work
    - Optimistic schedule, more sensors, more tests ($$)
    - Objective – High quality research
  - Early nees@UCLA use has been extremely helpful in developing our ES, and very positive experience

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