Erol Kalkan, Ph.D, P.E.

National Strong Motion Network - Manager

U.S. Geological Survey, Menlo Park

USGS Alaska Volcanic Observatory,
Anchorage, Feb. 24, 2011
NSMP Has Over 1300 Seismic Recorders
NSMP PARTNER AGENCIES

- Department of Veterans Affairs (VA)
- Army Corp of Engineers (ACOE)
- Oregon Department of Transportation (ODOT)
- Los Angeles Department of Public Works (LDPW)
- Metropolitan Water District of Southern California (MWD)
- University of Puerto Rico (UPR)
- Seattle City Light
- U.S. General Services Administration (GSA)
- NASA, Jet Propulsion Laboratory (JPL)
- California Department of Water Resources (CDWR)
- Imperial County (CA) Landfill (ICL)
- County and City of San Francisco (CCSF)
- University of Alaska (UAA and UAF)
- Utah, Salt Lake City Corporation (SLCC)
- Utah State Capitol
- University of California, Los Angeles (UCLA)
- Utah Department of Transportation (UDOT)
- Brigham Young University (BYU)
- Utah Geological Survey (UGS)
- Washington Department of Natural Resources (WDNR)

REINBURSABLE CONTRACTS

(Major source of funding for NSMP)
National Strong Motion Arrays in Alaska

- Anchorage to Palmer
- Valdez to Cordova
- Kodiak Isl.
- Kayak Isl. to Juneau
- Denali to Fairbanks
NSMP Projects in Alaska (2010-Present)

• UGSG/VA: Structural Instrumentation of Veteran Administration – Anchorage New Hospital and Regional Office Building + Free-field (Done)

• USGS/ANSS: Re-instrumentation of the Downtown Hilton and Alaska Regional hospital (in progress)

• USGS: Upgrading 36 channel recorder at the Port Access Bridge + Freefield (Done)

• USGS: Upgrading 36 channel recorder at the Atwood Building with additional GPS and rotational sensors (early April)

• USGS/UAA/ADOT: Structural Instrumentation of Base-Isolated (Retrofitted) Bridge in Kodiak Island and its Free-Field site. (Project pending)

• USGS: New free-field sites at Sitka and Kodiak Isl. (this week)
NSMP Partner Agencies in Alaska

- University of Alaska
- U.S. Army Corp of Engineers
- U.S. Department of Veterans Affairs
- Alaska Department of Transportation

... More needed
NSMP Products

Time series
- Corrected (baseline removal, acausal bandpass filter)
  - Acceleration
  - Velocity
  - Displacement
  - Angular acceleration, velocity and tilt

Peak motions
- PGA, PGV, PSA at 0.3, 1 and 3 sec

Response Spectra

ShakeMaps
Distribution of shaking from an earthquake anywhere in the world within minutes.
http://earthquake.usgs.gov/shakemap/

ShakeCast
Automated ShakeMap delivery, damage assessment, and notification for critical lifeline operators.
http://earthquake.usgs.gov/resources/software/shakecast/
• Center for Engineering Strong Motion Data (CESMD)
  Cooperative effort with the CGS Strong Motion Instrument Program
  (http://www.strongmotioncenter.org)

• National Engineering Strong Motion Program
  (http://nsmp.wr.usgs.gov)
Instrumentation of Medical Centers
## VA Instrumentation Project: Status Update

- Total budget is $6.5 million
- Project has a total of 27 medical centers for seismic instrumentation
- Instrumentation of 13 hospitals is completed

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- Completed
- Underway
Instrumentation Details

- **Structure**: KMI IP-based multi-channel 24 bit recorder (min. 12 ch., max. 39 ch.)
- **Free-field**: KMI IP-based 3ch. recorder
- +/- 4g Episensors
- Telemetry via DSL-line, T1 line or GSM-modem
- Timing via GPS for synchronization
- Local IBM server for structural health monitoring and automated damage detection
Future Additions

- Geotechnical downhole arrays for select medical centers
- Recording roof displacement through real-time GPS (current GPS systems have 10 Hz. sampling rate at the Caltech Millikan Library and 1 Hz. at the UCLA Factor Building)
- Rotational sensors to record rotational components of motion (e.g., Millikan Library)
Automated Damage Detection System
Automated Damage Detection System

Project Milestones & Progress

- FY09: Software design was completed
- FY11: ISTI was contracted for *Earthworm*-based software development, so far
  - Real-time WWS feed module (done)
  - Real-time MatLAB feed module (done)
  - Real-time displacement module (done)
  - Inter-story drift module (done)
  - FFT module (underway)
  - Alarm and alerting module (underway)
Automated Damage Detection System

Project Milestones

- FY11-12: Shaketable testing of software modules using a small-scale nonlinear 2D-frame structure (underway)
- FY12: Mendenhall Post-Doc is pending for testing and implementation/development of system identification algorithms for robust and reliable damage detection
- Collaboration with NEES and/or E-Defense for final testing using a large-scale structure(s) (FY-13)
Instrumented Tall Buildings by NSMP

Transamerican Pyramid
- General information
  - Location: 600 Montgomery Street, San Francisco
  - Coordinates: 37° 39' 42" N, 122° 28' 24" W
  - Status: Complete
  - Groundbreaking: December 1969
  - Construction: Summer 1972
  - Use: Commercial offices
  - Height: 260 m (850 ft)
  - Floor count: 40
  - Floor area: 500,000 sq ft (46,500 m²)
  - Elevators: 10
  - Cost: $322,000,000
- Technical details
  - Companies involved:
    - Architect(s): William L. Pereira
    - Structural engineer: Varin & Hermes, Inc.
    - Contractor: Dewidde Construction Co.
    - Owner: Transamerica Corporation

1100 Wilshire
- General information
  - Location: 1100 Wilshire Boulevard, Los Angeles, California
  - Coordinates: 34° 05' 22" N, 118° 28' 38" W
  - Status: Complete
  - Construction: 1987
  - Opening: 1987
  - Use: Residential
  - Height: 400 ft (120 m)
  - Roof: 406 ft (123 m)
  - Technical details
- Companies involved
  - Architect(s): AC Martin Partners

Century Plaza Towers I & II
- General information
  - Location: 2029 and 2049 Century Park East, Century City, California
  - Status: Complete
  - Groundbreaking: 1969
  - Construction: 1975
  - Opening: 1975
  - Height: 571 ft (174 m)
  - Roof: 517 ft (157 m)
  - Technical details
- Companies involved
  - Architect(s): Minoru Yamasaki

One AT&T Center
- General information
  - Location: 909 Chestnut Street, St. Louis, Missouri
  - Coordinates: 38° 6' 7" N, 90° 19' 46" W
  - Status: Complete
  - Construction: 1986
  - Use: Office
  - Height: 176 m (577 ft)
  - Roof: 179 m (586 ft)
  - Technical details
  - Floor count: 44
  - Floor area: 1,400,000 square feet (130,000 m²)
  - Cost: $1 billion
  - Companies involved
    - Architect(s): Hallmuth, O'Brady & Kasebaum
    - Owner: Inland Real Estate Group
One Rincon Hill Tower, San Francisco

- Residential condominiums
- 54-story above ground, 7-story below ground
- Lateral force resisting system consists of concrete-core and outrigger columns.
- BRBs and coupling beams provide the first line of energy dissipation
- 12’ thick massive foundation embedded deep into serpentine rock
- At the top of the building is a large water tank as a tuned-mass damper
- Design is based on nonlinear RHAs
LA Live Ritz Carlton Hotel, Downtown LA

- 54-story above ground
- Lateral force resisting system consists of steel-shear walls (light-weight)
- Nonlinear RHAs were used for performance-based design
The Century, Century City

- Residential condominiums
- Completed in 2009
- 478’ in height
- 41-story above ground, 3-story below ground
- Nonlinear RHAs were used for performance-based design of the structure
Other Candidate Buildings in Seattle


Free-Field Instrumentation
Monitoring Elsinore Fault

7 new free-field stations along the Elsinore Fault to monitor the increased seismic activity after the El-Mayor Cucapah earthquake.