January 16-17, 2014
Northridge20.org

Summary of Preliminary Recommendations

The 1994 Northridge earthquake drew attention to the vulnerability of the built environment. The lessons learned in that earthquake led to two decades of dedicated research, seismic public policy development, building code development, and seismic rehabilitation. The Northridge earthquake set the City of Los Angeles and many other communities in California on a trajectory to increase seismic resiliency.

The topics scheduled for the Northridge 20 symposium are broken down into various disciplinary areas and the recommendations in each of these fields are shown below. While the recommendations for buildings are divided into three categories of structural systems and materials, the broader lessons can be extrapolated to the more tangible categories of occupancy: police stations, hospitals, schools, office buildings, residential high rises, apartment buildings, and single family houses. The structures that were damaged on January 17, 1994 were places were people slept, ate, worked, and studied.

During the Northridge 20 Symposium the following eight speakers will highlight what happened during the earthquake, what we have learned and accomplished since then, and where we need to go to become resilient to the damaging effects of earthquakes. These speakers will be followed by policy maker discussion panels and small group discussions that further explore how to achieve these next steps. On Friday breakout sessions will combine expert speakers and audience discussion to help refine these recommendations and begin to prioritize future actions. The final updated and refined recommendations of the Symposium will be summarized in a white paper that will be widely distributed during the months following the conference.

EARTH SCIENCE AND SEISMOLOGY

Lucy Jones, US Geological Survey

Dr. Lucy Jones has been a seismologist with the US Geological Survey and a Visiting Research Associate at the Seismological Laboratory of Caltech since 1983. She currently serves as the USGS Science Advisor for Risk Reduction while also leading the SAFRR Project: Science Application for Risk Reduction, to apply USGS science to reduce risk in communities across the Nation. Authoring over 100 papers on research seismology with primary interest in earthquake statistics and integrated disaster scenarios, Dr. Jones is most recently known for creating and leading innovative research projects like ShakeOut Earthquake Scenario and the Great ShakeOut. She serves on the California Earthquake Prediction Evaluation Council and was a Commissioner of the California Seismic Safety Commission from 2002 to 2009. Dr. Jones received a Bachelor of Arts degree in Chinese Language and Literature from Brown University and a Ph. D. in geophysics from MIT.

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Key Recommendations & Next Steps:

- Create operational earthquake early warning for the western U.S. For another $18 M/yr (in addition to the $25M/yr already spent by the USGS for earthquake monitoring), the existing Advanced National Seismic System of the USGS could be expanded to give effective earthquake early warning for the whole western US. The science has been done, the prototype developed and we are waiting solely for operational funds to create a robust, reliable system.
- Earthquake professionals all need to communicate more effectively. We need to find ways to describe our work and analyses that non-earthquake professionals can understand. Public officials should have tools beyond PSHA to understand the hazard they face. Our communities can make informed decisions about their risk when we make sure they are informed.
- Earthquake clustering (many earthquakes within a short duration) needs to be included in our hazards assessments and other tools for earthquake risk management.

GROUND MOTIONS AND GROUND FAILURE

Jonathan P. Stewart, University of California, Los Angeles

Jonathan P. Stewart, PhD, PE, is Professor and Chair of the Civil & Environmental Engineering at UCLA. His technical expertise is in geotechnical earthquake engineering and engineering seismology, with emphases on seismic soil-structure interaction, engineering characterization of earthquake ground motions, seismic performance of levees and other embankments, and seismic ground failure. Results of work by his research group are widely utilized in engineering practice, including the NEHRP Provisions, ASCE-7, and ASCE-41. He is a former Chief Editor for the ASCE Journal of Geotechnical and

Geoenvironmental Engineering and is the current Editor of Earthquake Spectra. His research team has produced 19 Ph.D. graduates since 2001 and over 70 journal articles since 1995.

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Key Recommendations & Next Steps:

- Periodic updating of GMPEs to incorporate new data and apply lessons learned from validated simulations. This is especially critical for Pacific Northwest and Central-Eastern US
- Next-generation ground failure models including fine-grained materials and effects of ground failure on structures
- More complete seismic hazards mapping to include liquefaction, landslides, and surface fault rupture
- Sustained funding for ground motion research including maintenance of arrays, updating of databases, and periodic development of improved GMPEs (ground motion prediction equations)
- Develop community ground failure database & models
- Renew funding for CGS seismic hazards mapping

LIFELINES AND UTILITIES

Craig Davis, Los Angeles Department of Water and Power

Craig A. Davis, PhD, PE, GE, is the Geotechnical Engineering Manager for the Los Angeles Department of Water and Power, Water System and is responsible for managing geotechnical and earthquake engineering, and overseeing nearly a billion dollars in the dam and reservoir development and Water System seismic improvement programs. He is a California licensed Civil and Geotechnical Engineer and received a B.S. from the California Polytechnic State University in San Louis Obispo, CA, and a Ph.D. from the University of Southern California. He has worked for the LADWP since 1987. Dr. Davis serves on the National Earthquake Hazards Reduction Program (NEHRP) Advisory Committee on Earthquake Hazards Reduction (ACEHR). He is the Executive Committee Chair for the ASCE Technical Council on Lifeline Earthquake Engineering.

Media Contact: Brooks Baker (213-367-8722) and Jane Galbraith (213-367-8721)

Key Recommendations & Next Steps:

- Southern California Water Supply is too critical to fail, aqueduct water losses for minimum 12 to 18 months is too long! A Water Supply Task Committee (WSTC) needs to be formed by the supply agencies (LADWP, MWD, DWR)
- Greater integration of system modeling with participation of critical infrastructure operators is needed. Visualization of results is critical for communicating to decision makers, city councils, and local governments

- Improved assessment of regional economic impacts from lifeline system disruption is needed, especially for interdependencies. Initiate research and implementation on utility sector level.
- Consistent lifeline system performance and restoration goals need to be created
- An interdisciplinary “council” for addressing potential for post-earthquake ignitions, firefighting capabilities, and firefighting water supply is needed
- Lifeline specific guidelines and standards for community resilience need to be developed
- Telecommunication systems need to standardize methods to ensure post-earthquake cell site power
- Maps identifying potential ground displacements need to be prepared and available for all to use. Ground Failure causes the greatest lifeline disruption – to all lifeline pipes and cables
- Emergency Action Plans are need to be prepared by Dam owners
- Research is needed in the area of dam safety and how utilities interact to make resilient communities
- All Lifelines and utilities need to collaborate in Earthquake Early Warning development and implementation

TRANSPORTATION SYSTEMS

Tom Ostrom, Caltrans

Thomas A. Ostrom, MS, PE, has been employed with Caltrans Division of Engineering Services (DES) for 26 years. He has held various positions in the field of bridge design, construction and engineering management. He currently manages the Office of Earthquake Engineering, Analysis and Research. His responsibilities include; leading the Caltrans seismic research program, managing the development, implementation, and training of the earthquake engineering guidance and policy and managing the development and maintenance of Caltrans bridge engineering software. Prior to his current position, Mr. Ostrom has managed the bridge design work on the state highway system in the 22 Northern California counties from the San Francisco Bay Area north and east to the Nevada and Oregon borders.

Media Contact: Mark Dinger, Caltrans Media Relations Manager, 916.654.3145, mark.dinger@dot.ca.gov

Key Recommendations & Next Steps:

- Regularly reassess the seismic hazard and engineering performance of the State’s bridges including existing, retrofitted, and new structures.
- Continue to develop performance based earthquake engineering methods that looks at bridges as part of an interconnected system.

- Regularly review and revise bridge seismic design criteria to reflect the latest seismology, geotechnical and structural research findings.
- Continue to develop and implement expedited seismic design and construction techniques that allow for faster recovery from major seismic events.

RESIDENTIAL WOOD-FRAME AND SOFT STORY BUILDINGS

John W. van de Lindt, Colorado State University

Dr. John W. van de Lindt is the George T. Abell Distinguished Professor in Infrastructure in the Department of Civil and Environmental Engineering at Colorado State University. Professor van de Lindt has led more than 30 research projects with many focused on seismic wood research and performance-based seismic design. As a result of these projects he has published 275 technical publications including more than 100 peer reviewed journal papers and 30 reports. He served as the Project Director for the NEESWood Project from 2005-2009 including leading the planning and testing of the full-scale six-story Capstone building on Japan's E-Defense shake table in Miki, Japan. Currently, Professor van de Lindt serves as the Project Director for the NEES-Soft Project whose full title is "Seismic Risk Reduction for Soft-Story Woodframe Buildings."

Media Contact: Kortny Rolston, Public Relations for Colorado State University Engineering, kortny.rolston@colostate.edu, 970-491-5349

Key Recommendations & Next Steps:

- Continue to move toward comprehensive seismic risk reduction through soft-story woodframe retrofitting. It will be necessary to clarify to stakeholders that retrofits do not necessarily protect their interests and safety at code-level.
- Extend retrofitting to other locations based on risk rankings and to other woodframe building types, such as single-family dwellings
- Facilitate taller resilient wood buildings with advanced technologies such as cross laminated timber, etc.

  Engineering Recommendations:
- Further codify performance-based seismic design including simplified rules for designers.
- Better guidance for seismic evaluations and retrofits
- More comprehensive testing of archaic building materials
- Testing of floor diaphragms and systems
- Better loading protocols that focus on collapse risk
- Simplified mechanisms for force distribution.

CONCRETE BUILDINGS

Michael Mehrain, URS Corporation

Dr. Mehrain has 40 years of experience in structural design, seismic evaluations and retrofit design of buildings and industrial structures. He has performed sophisticated state of the art analysis and laboratory testing for performance evaluation and retrofit design of major concrete structures. He has expertise in the application of the latest research in efficient and economical design and retrofit construction of buildings. This includes the use of new technology such as base isolation and energy dissipation systems. Dr. Mehrain has participated in the development of numerous "performance based" engineering guidelines and standards including ASCE 31, ASCE 41 and ATC78. He has a PhD degree from University of California at Berkeley.

Key Recommendations & Next Steps:

- Support current efforts on preparation of seismic evaluation standards. This includes research/development activity for simplified building evaluation (ATC 78) to estimate collapse probability.
- Prepare concrete building inventory.
- Continue development of concrete building seismic retrofit standards including improved ASCE 41 focused on concrete buildings.
- Prepare standards for "limited" or "incremental retrofit" (most bang for the buck solutions) by allowing deficiency-only retrofit of the most vulnerable building elements, such as wrapping of moment frame columns, strengthen columns under discontinuous walls, and retrofit of weak first story conditions.
- Promote a program of "Building Rating System" similar to LEED certification, to be used for property transfer, insurance, mortgage, building users and tenants. Provide education and awareness campaign for public, business and community leaders.
- Establish deadlines for completion of "limited" and "full" retrofit construction.
- Look for financial incentives, such as tax relief and zoning incentives; eliminate requirement for ADA and other building improvements as part of seismic retrofit.

STEEL BUILDINGS

Thomas A. Sabol, Englekirk Institutional

Since 1985, Adjunct Professor Tom Sabol has been on the faculty of UCLA's Department of Civil and Environmental Engineering where he teaches courses in earthquake engineering, tall building design and structural steel. He is also a principal of Englekirk, a Los-Angeles based firm focusing on structural, earthquake and wind engineering. Tom received his B.S. in Architectural Engineering from Cal Poly, San Luis Obispo, his MS and PhD in Structural and Earthquake Engineering from

UCLA, and his MBA in finance from Loyola Marymount. He is a professional or structural engineer in several states and is a registered architect in California.

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Key Recommendations & Next Steps:

- Reconsider the waiver of steel inspection requirements for seismic force resisting systems now permitted in 2012 *International Building Code* (2013 *California Building Code*)
- Improve understanding of seismic behavior correlation between individual components and actual structures
- Improve understanding of tall steel buildings and steel buildings with heavily loaded columns during earthquakes
- Improve understanding of multi-tier braced frame behavior
- Develop reliable seismic performance standards for steel structures

BUSINESS, INSURANCE, AND FINANCIAL IMPLICATIONS

Glenn Pomeroy, California Earthquake Authority

Glenn Pomeroy is the Chief Executive Officer for the California Earthquake Authority (CEA), which is dedicated to helping California homeowners prepare for damaging earthquakes through education, mitigation and insurance. During his first five years as CEO, he led a bipartisan legislative effort before the U.S. Congress to help reduce the cost of earthquake insurance, and worked to help further diversify and expand its claim-paying resources through the first earthquake-only catastrophe bond issued without involvement of traditional reinsurers. He also facilitated the introduction of CEA's new Homeowners Choice product line offering consumers greater control over their earthquake premium, implementation of a statewide average rate reduction, and the creation of research-based marketing and mitigation programs.

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Key Recommendations & Next Steps:

- Develop tools to help renters and homeowners understand and evaluate their risk of loss from damaging earthquake
- Continue to increase the awareness, affordability and value of earthquake insurance.
- Develop mitigation opportunities for California homeowners, including structural and non-structural retrofits.