

THE NATIONAL ACADEMIES

Advisers to the Nation on Science, Engineering, and Medicine

The NRC Committee on Geological and Geotechnical Engineering
and a proposed study

State of the Art and Practice in Seismically Induced Soil Liquefaction Assessment

Presentation to the Advisory Committee on Earthquake Hazards Reduction
March 10, 2011

Edward Kavazanjian, Chair
NRC Committee on Geological and Geotechnical Engineering



COGGE Members

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COGGE Mission Statement



- Identify, investigate, and report on questions relating to geological and geotechnical engineering to government, industry, academia, and the public;
- Inform public policy on geological and geotechnical engineering issues;
- Identify new technologies and potential applications; and
- Promote the acquisition and dissemination of knowledge.

COGGE Sponsors

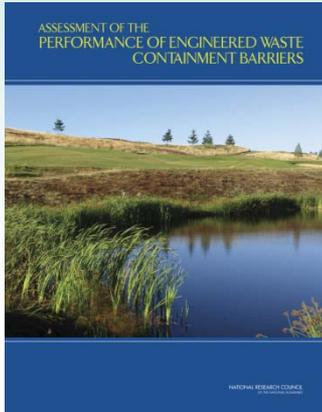


- National Science Foundation
- US Nuclear Regulatory Commission
- NIOSH Mining Safety and Health Research Program

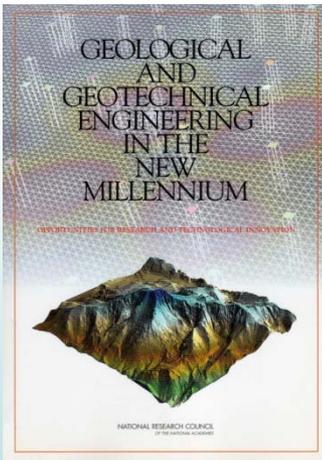
Present and Past Study Sponsors

FEMA, EPA, NSF, USNRC, DoD, DoE, BLM, Bureau of Reclamation, Federal Transit Administration, Gas Research Institute, Dowell-Schlumberger, Inc.

Recent Reports



Assessment of the Performance of Engineered Waste Containment Barriers (2007)



Geological and Geotechnical Engineering in the New Millennium: Opportunities for Research and Technological Innovation (2006)



Current Activities



Studies

- Underground Engineering for Sustainable Development
- Integrating Dam and Levee Safety and Community Resilience
- Induced Seismicity in Energy Applications

In Development

- The Role of Geotechnology in Sustainable Energy Production
- Subsurface Characterization, Modeling, Monitoring, and Remediation of Fractured Porous Rocks

Today's proposal



State of the Art and Practice in Earthquake Induced Soil Liquefaction Assessment

Concept Inception



August 2010

- EERI issued final report: Technical Issues in Dispute (with reference to EERI MNO-12, *Soil Liquefaction During Earthquakes*)
- Recommended a NRC activity to *“consider the current state of knowledge and practice in liquefaction hazard evaluation”*

December 2010

- After discussions with EERI, held roundtable to outline issues and identify community needs
- Developed draft statement of task iteratively with roundtable participants over the next months

21 February 20011



Source: www.nzherald.co.nz/accessed March 8, 2011

Source: familynews.net/ accessed March 8, 2011



The Christchurch, New Zealand, suburb of Bexley is flooded following an earthquake, Tuesday, Feb. 22, 2011. (AP Photo/New Zealand Herald, Mark Mitchell) # □

Statement of Task



- Lead community-wide examination of state-of-the-art and practice in earthquake induced soil liquefaction:
 - Sufficiency, quality, and uncertainties associated with testing and modeling;
 - Methods to collect, interpret, and analyze data;
 - Methods, data gaps, and uncertainties for evaluating consequences of liquefaction;
- Assess state-of-art and practice and address future directions for research and practice

Sufficiency, quality, and uncertainties associated with testing and modeling



- Laboratory and in situ field tests
- Case histories
- Physical model tests

To develop and assess methods for determining

- Excess pore pressure build-up
- Liquefaction triggering
- Resulting loss of soil strength and its consequences

Methods to collect and analyze data



- Laboratory and physical model testing
- Field case history data
 - Excess pore pressure buildup
 - Triggering
 - Post-liquefaction soil behavior (e.g. strength loss, dilation and hardening)

Methods, data gaps, uncertainties for evaluating consequences of liquefaction



What are the impacts of liquefaction (and how good are we at evaluating them)?

Deformations (Vertical and Lateral)

Site Response

Lateral Earth Pressures

Study Focus



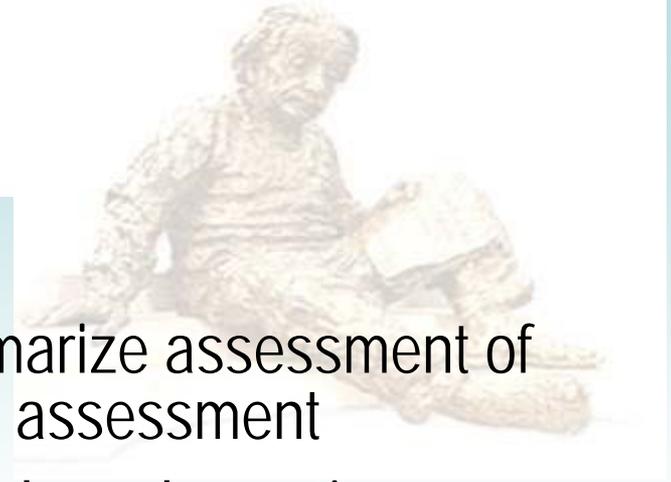
- Developments since 1996 NCEER and 1998 NSF/NCEER workshops on liquefaction issues
- Consider data including
 - Soil properties
 - Site characterization
 - Ground motions
 - Observations and measurements of soil response
- Identify inherent data characteristics (scarcity, uneven distribution, uncertainty)

Community Input



- Study committee will convene a community workshop
 - Approximately 80-100 people
 - Seek broad input on the issues
- The committee may convene a second smaller workshop
 - More detail on specific topics
 - Fill information gaps
- Additional information may be sought through invitation of speakers or panels at committee meetings

Committee Report



- Committee consensus report will summarize assessment of state-of-art and practice of liquefaction assessment
- Address future directions for research and practice related to
 - Collecting, reporting, and assessing the sufficiency and quality of field case history observations and in situ field, laboratory, and model test data
 - Addressing spatial variability and uncertainty of these data
 - Developing improved tools for assessing pore pressure generation, liquefaction triggering, and consequences of liquefaction

Study Logistics



- **10 committee members**
 - Nominations sought from many sources (sponsors, NAE/NAS members, geotechnical and earthquake engineering community broadly)
 - Expertise in appropriate engineering disciplines from private sector, academe, government
- **Committee selected by NRC**
 - Carefully vetted by NRC staff; selection approved by the President of the National Academies
 - Free from conflicts of interest, too much bias in any direction
 - Committee selection publicly posted—public invited to comment

Report Peer Review



- Rigorous internal and external process
- External independent reviewers with appropriate expertise (adding more expert input)
 - Assist in making report accurate, effective, and objective
 - Anonymous to committee until report publicly released
 - Report modified in response to reviews if appropriate
- Overseen by report coordinator and monitor
 - Ensures appropriate committee responses to reviewers
 - Recommends when report ready for release

Work Plan

24-month activity including

- 2 public workshops
- 6 committee meetings
- Delivery of consensus report



<u>Projected Date</u>	<u>Activity</u>
August 2011	Initiation of Contract
November, 2011	Committee approved by NRC
April, 2012	Large community workshop
September, 2012	Smaller community workshop
April, 2013	Report goes into review
August, 2013	Prepublication draft of report to sponsors, publicly released
December, 2013	Final version of report delivered to sponsors

Budget



- NRC does not provide detailed budget estimates until formal request for study proposal received
- Estimated cost of 2-year activity plus workshops:
\$800,000
- Approximately \$200,000-\$300,000 of support committed to date

Avoiding Bias



NRC policies ensure studies free from bias and conflict of interest

- Rigorous committee selection and approval processes
 - Public comment sought before final committee approval
- FACA compliance
 - Information gathering sessions open to the public
 - Information gathered available for public scrutiny
- Internal and external review processes ensure report is consistent with statement of task, objective, grounded in evidence, complete.

Interested Agencies



Importance recognized by earthquake engineering, emergency management, homeland security, water management, and energy communities

Support informally committed as of March 10, 2011 by

- California Seismic Safety Commission
- Pacific Earthquake Engineering Research Center
- California Department of Transportation
- California Department of Water Resources
- Los Angeles Department of Water & Power

Interest expressed to date by

- Nuclear Regulatory Commission
- Department of Homeland Security
- FEMA
- Various agencies in Washington State

Actively pursuing potential partners at federal, state, and local levels

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