EERI Ad Hoc Committee Report on Soil Liquefaction During Earthquakes

T.D. O'Rourke

Thomas R. Briggs Professor

Cornell University

LIQUEFACTION

- **Transformation of Granular Soil from a Solid to Softened or Liquid-Like Material during Earthquake Ground Shaking**

IMPORTANCE OF LIQUEFACTION

- Waterfront Structures
- Earth Dams & Embankments
- Nuclear Power Plants
- Levee Systems
- Foundations of Buildings & Facilities
- Underground Lifelines

BRIEF HISTORY OF LIQUFACTION ASSESSMENT

- *Ground Motions & Soil Liquefaction During Earthquakes*, EERI MNO-5 (Seed & Idriss, 1982)
- NRC Workshop (1985)
- NSF/NCEER Workshops (1996, 1998)
- Liquefaction & Undrained Strength Strength Assessment (Seed et al., 2003)
- *Liquefaction During Earthquakes*, EERI MNO-12 (Idriss & Boulanger, 2008)

CONCERNS & CONTROVERSIES

- **Strong Objections Raised About *Liquefaction During Earthquakes* by R.B Seed, UC Berkeley**
- **Strong Differences of Opinion, Often Personalized & Polarized**
- **Important Ramifications for Critical Infrastructure and Cost of Infrastructure Projects**

AD HOC COMMITTEE ON SOIL LIQUEFACTION DURING EARTHQUAKES

- W.D. Finn, University of British Columbia (Emeritus)
- S.L. Kramer, University of Washington
- T.D. O'Rourke (Chair), Cornell University
- T.L. Youd, Brigham Young University (Emeritus)

COMMITTEE OBJECTIVES

- **Review Technical Issues in Dispute with *Soil Liquefaction During Earthquakes***
- **Advise EERI Board of Directors on Ways to Resolve Technical Issues**
- **Review & Advise on ERRI Monograph Preparation & Review Process**

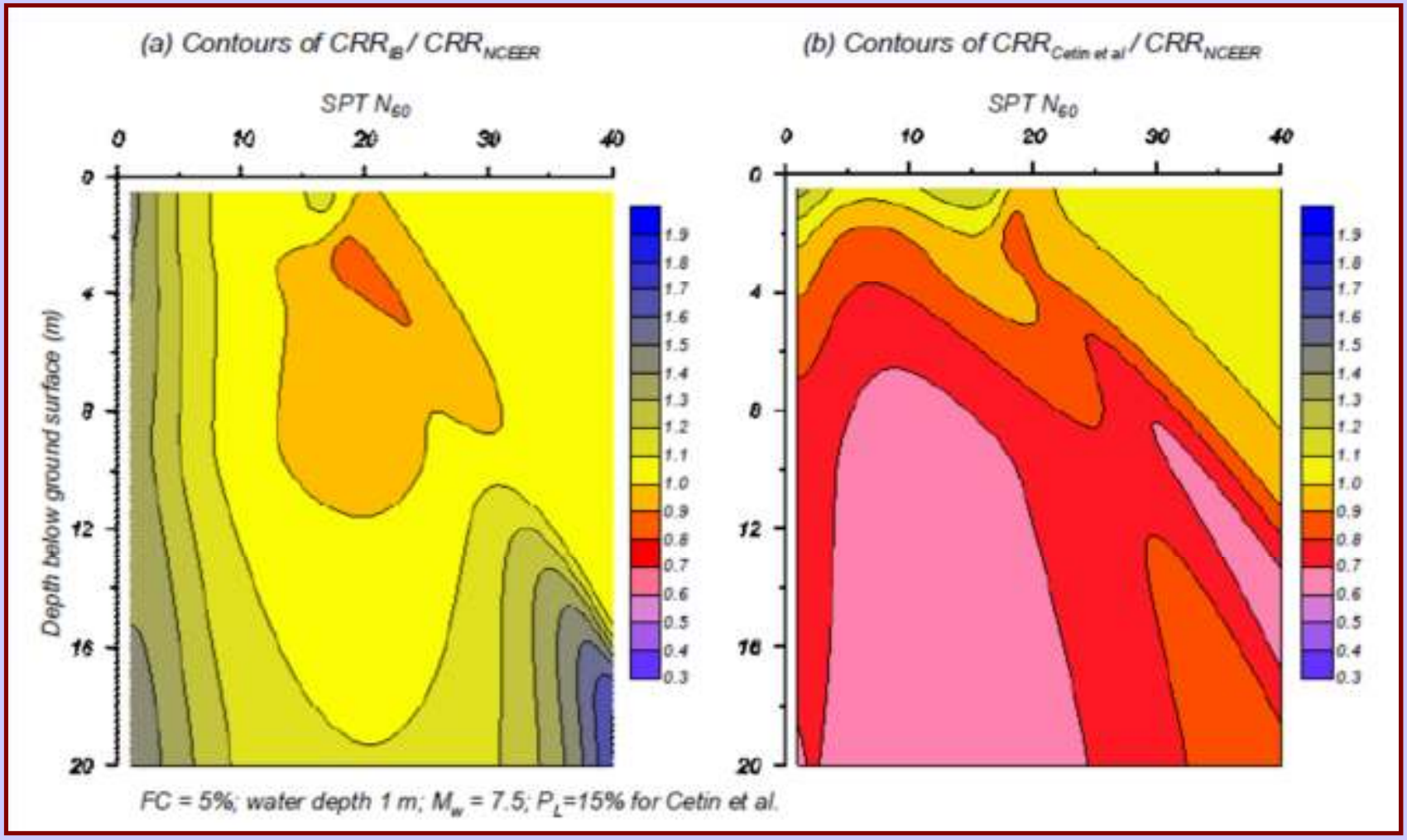
KEY ASPECTS OF LIQUEFACTION ASSESSMENT

- Relies Heavily on Empirical Evidence through Case Histories and Interpretations of Past Performance
- Variable Soil & Groundwater Conditions
- Complex Processes are Simplified
- Variability and Uncertainties Associated with Assessment Procedures

DIFFERENCES AMONG LIQUEFACTION ASSESSMENTS

- Considerable Differences, Especially for Earth Dams Where Depths of Liquefiable Zones May Be Considerable
- Differences May Affect Scores of $ Millions on Yearly Basis

DIFFERENCES AMONG LIQUEFACTION ASSESSMENTS



TECHNICAL ISSUES IDENTIFIED BY COMMITTEE

- **Liquefaction Triggering**
  - **Definition of liquefaction, plasticity effects, depth-dependent factors (r_d, K_0, etc.), silts, SPT/CPT procedures, dense soil behavior**
- **Liquefaction Consequences**
  - **Post liquefaction strength, lateral spread, & settlement**
- **Liquefaction Modeling**
  - **Data, documentation, & treatment of data**

COMMITTEE OBSERVATIONS

- EERI Monograph Does Not Represent Consensus; It Represents Authors' Views
- Geotechnical Earthquake Community has Good Record in Convening for Consensus Views on Liquefaction
- 1996/1998 NSF/NCEER Workshop Was Last General Consensus of Community (Youd, et al, 2001)

THE WAY FORWARD
(MAIN COMMITTEE RECOMMENDATIONS)

- **Provide Forum for Discussion of Alternate Views, Consensus Development Where Possible, and Presentation & Comparison of Differing Approaches**
- **3rd Major Liquefaction Workshop and Report on Engineering Practices**
- **Workshop Organized through National Academies**

THE WAY FORWARD
(OTHER COMMITTEE RECOMMENDATIONS)

- **Organizing Committee Screened to Promote Constructive Interaction and Avoid Conflicts of Interest**
- **Interim Measure: Invitation to Publish 1 or 2 Papers in *Earthquake Spectra* to Seed & Coworkers and Idriss & Boulanger**
- **Reviewers Carefully Chosen and Discussions & Closure Published**