



Geo-Engineering Earthquake Reconnaissance

Turning Disaster into Knowledge

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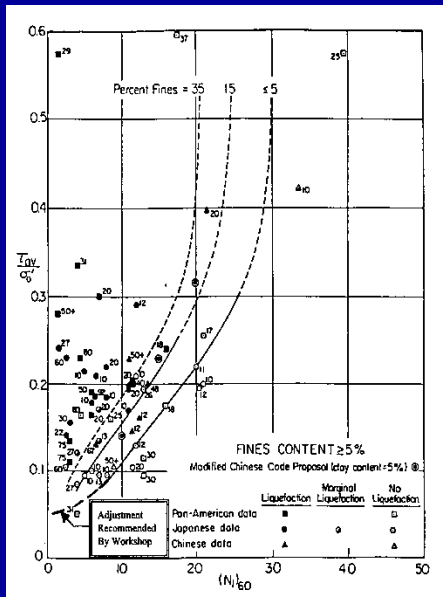
NSF-Sponsored GeoEngineering Post-Earthquake Reconnaissance

NEED

Earthquake engineering is an experience-driven field.

The importance of detailed mapping and surveying of damaged areas relative to general surveys cannot be overemphasized.

They provide the hard data of the well-documented case histories that drive the development of many of the empirical procedures used in practice and shape our understanding.



OBJECTIVES

GEER is developing a systematic approach to conducting NSF-sponsored post-EQ reconnaissance efforts.

Develop and implement new technologies

Document the geo-engineering effects of earthquakes to advance the profession's understanding





Geo-Engineering Earthquake Reconnaissance
Turning Disaster into Knowledge

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GEER RECORDER: Ben Mason, UCB



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& YOU

<http://research.eerc.berkeley.edu/projects/GEER/index.html>

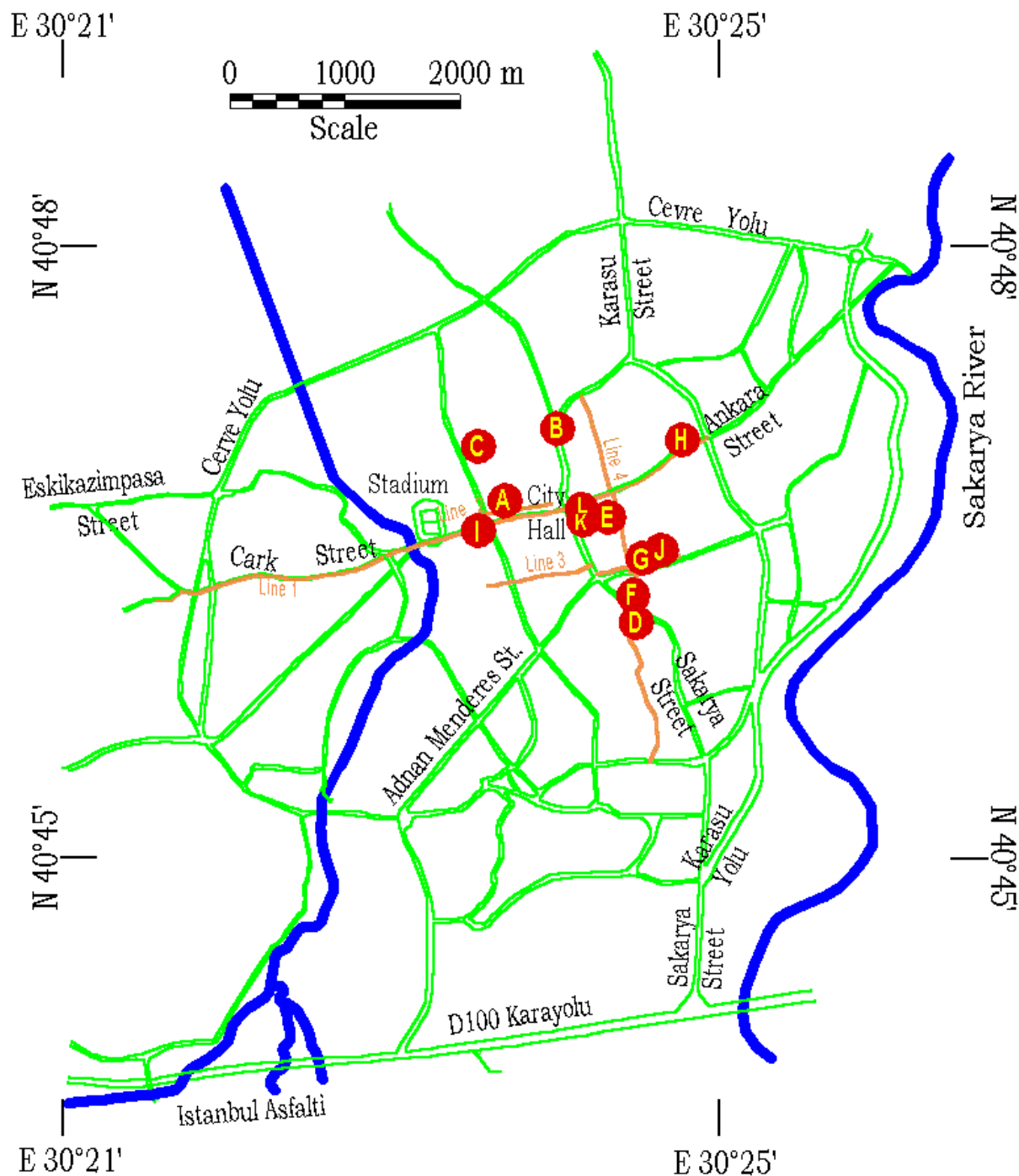
Recent Geotechnical Engineering Earthquake Reconnaissance Efforts

(sponsored by the NSF)

- 1995 Kobe, Japan EQ (e.g. Akai et al. 1995)**
- 1999 Central Mexico EQ (e.g. Pestana et al. 1999)**
- 1999 Kocaeli, Turkey EQ (e.g. Ansal et al. 1999)**
- 1999 Chi-Chi, Taiwan EQ (e.g. Abrahamson et al. 2001)**
- 1999 Duzce, Turkey EQ (e.g. Ansal et al. 1999)**
- 2001 Bhuj, India EQ (e.g. Jain et al. 2002)**
- 2001 Nisqually EQ (e.g. Bray et al. 2001)**
- 2001 Southern Peru EQ (e.g. Wartman et al. 2002)**
- 2002 Denali EQ (e.g. Kayen et al. 2003)**
- 2003 Tecoman, Mexico EQ (e.g. Wartman et al. 2003)**
- 2004 Niigata-ken Chuetsu, Japan EQ (e.g., Bardet et al. 2004)**
- 2006 Island of Hawaii, EQ (e.g, Medley 2006)**
- 2007 Niigata-Chuetsu Oki, Japan EQ (e.g., Kayen et al. 2007)**
- 2007 Ica-Pisco, Peru EQ (e.g., Rodriguez-Marek et al. 2007)**

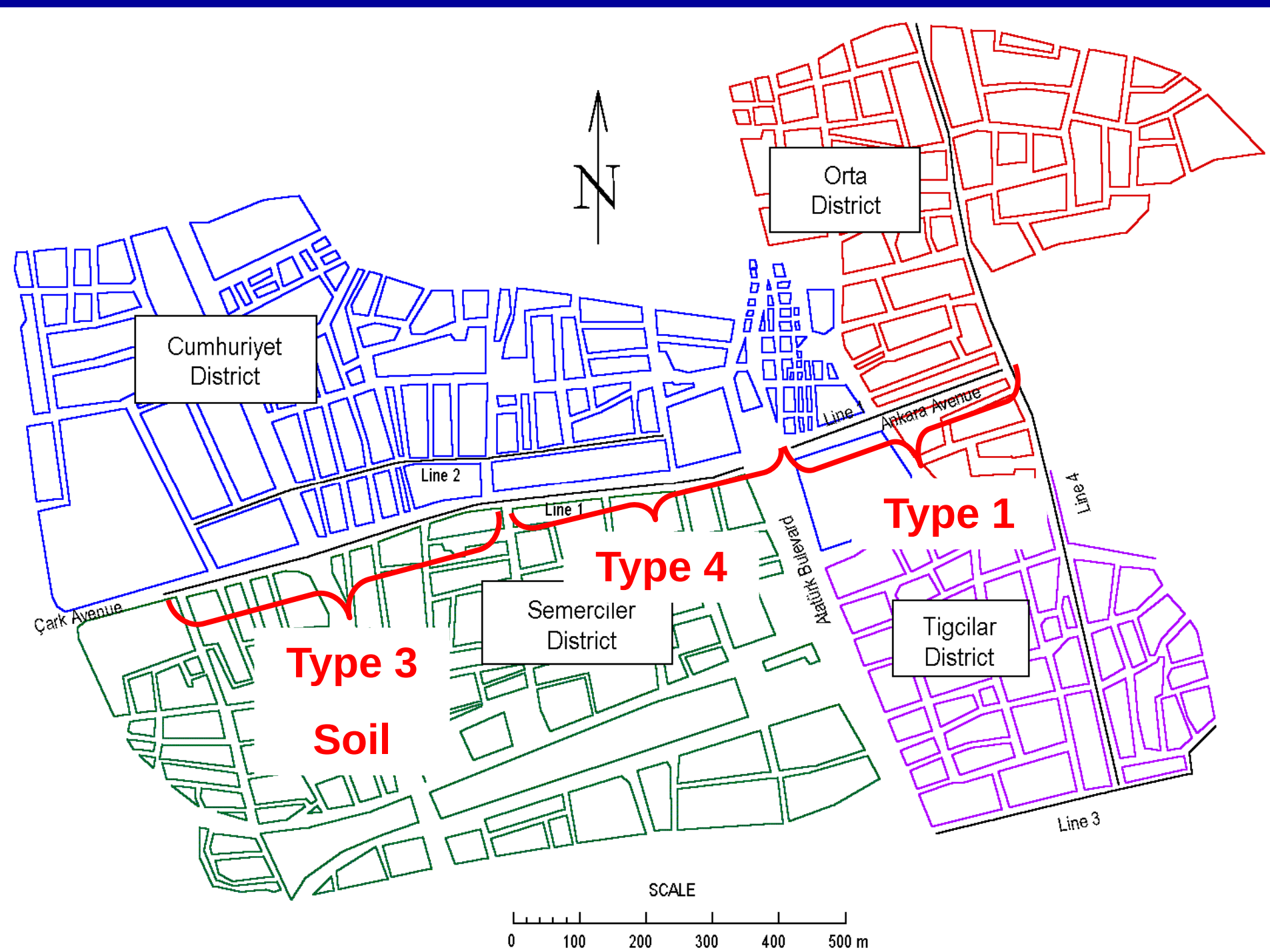


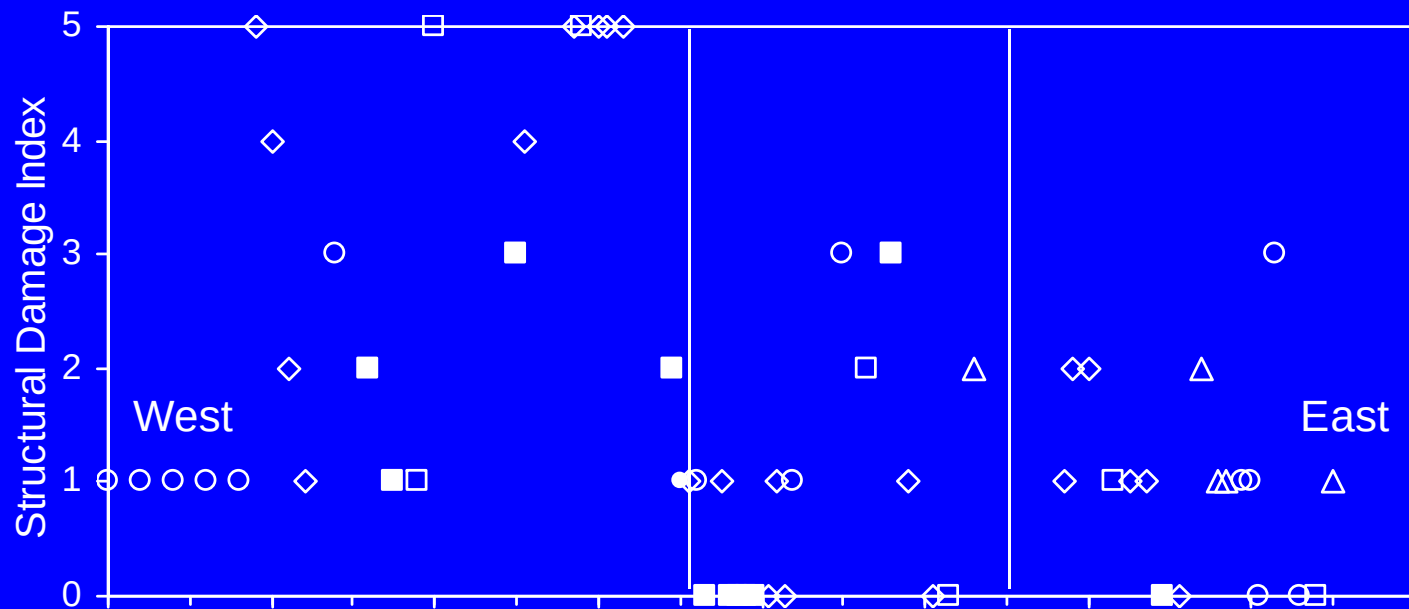
1999 Kocaeli Earthquake: A. Ansal, N. Abrahamson, J. Bachuber, J. P. Bardet, A. Barka, M. Baturay, M. Berilgen, R. Boulanger, J. Bray, O. Cetin, L. Cluff, T. Durgunoglu, D. Erten, M. Erdik, D. Frost, I. M. Idriss, T. Karadayilar, A. Kaya, W. Lettis, J. Martin, J. Mitchell, G. Olgun, A. Onalp, T. O'Rourke, W. Paige, E. Rathje, C. Roblee, R. Sancio, W. Savage, R. Seed, P. Somerville, J. Stewart, B. Sunman, B. Swan, C. Synolakis, S. Toprak, D. Ural, R. Witter, M. Yashinski, T. Yilmaz, L. Youd



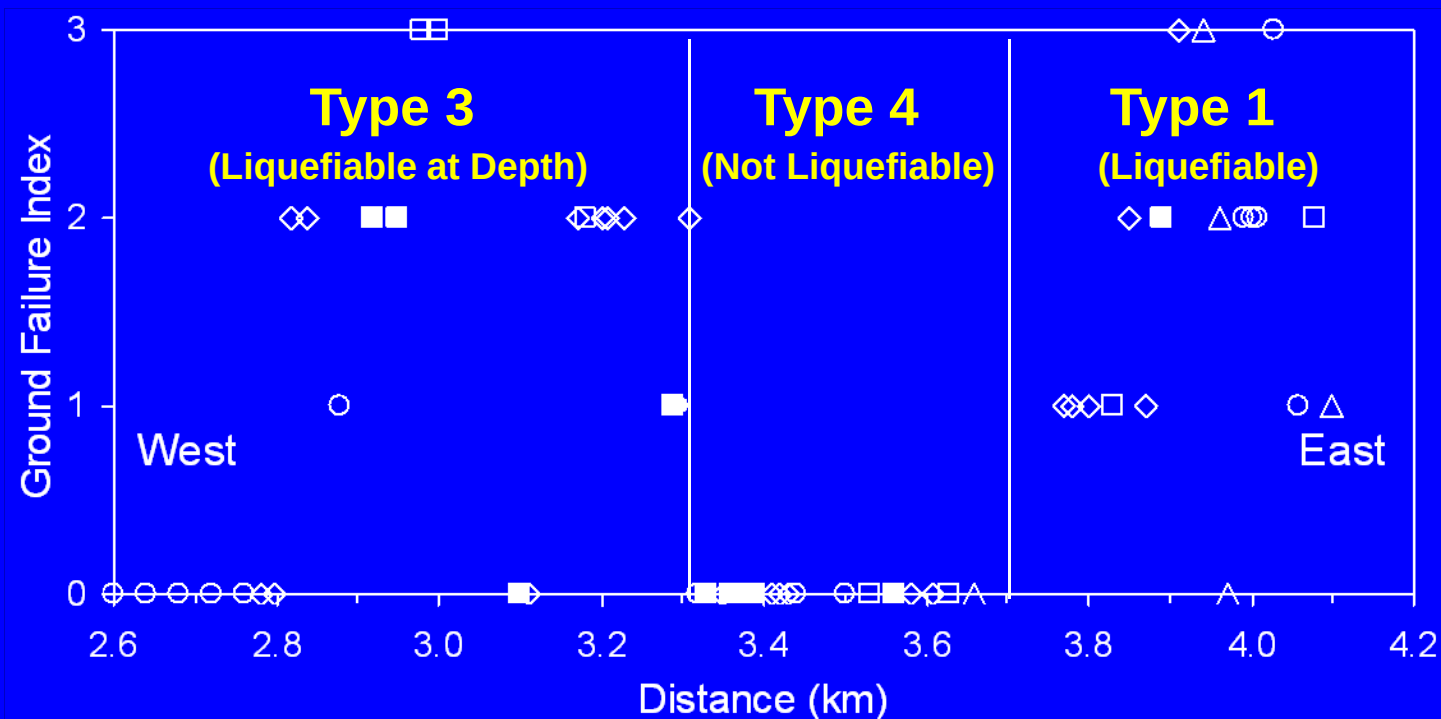
**City of
Adapazari**

**Post-EQs
Surveys**

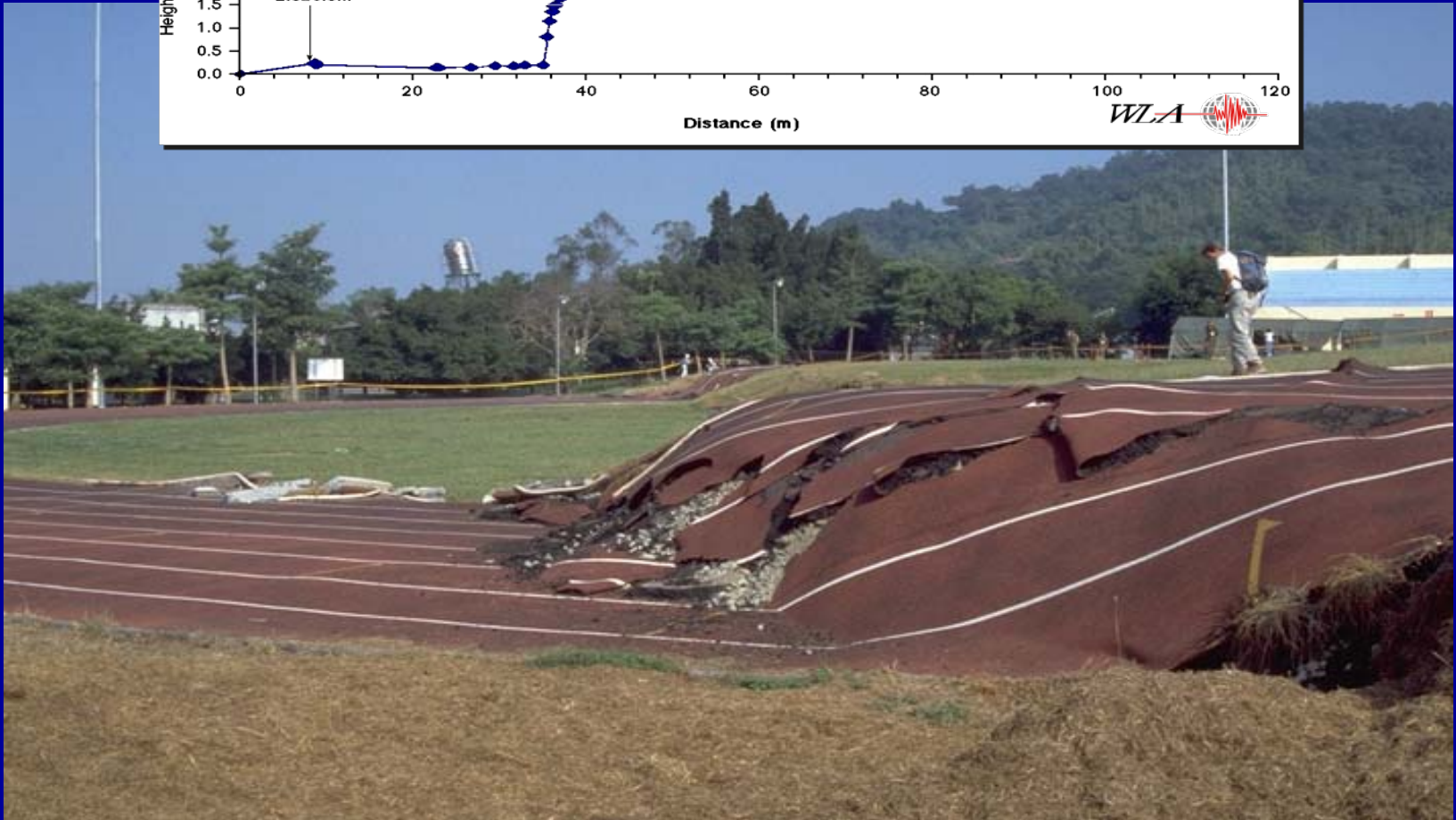
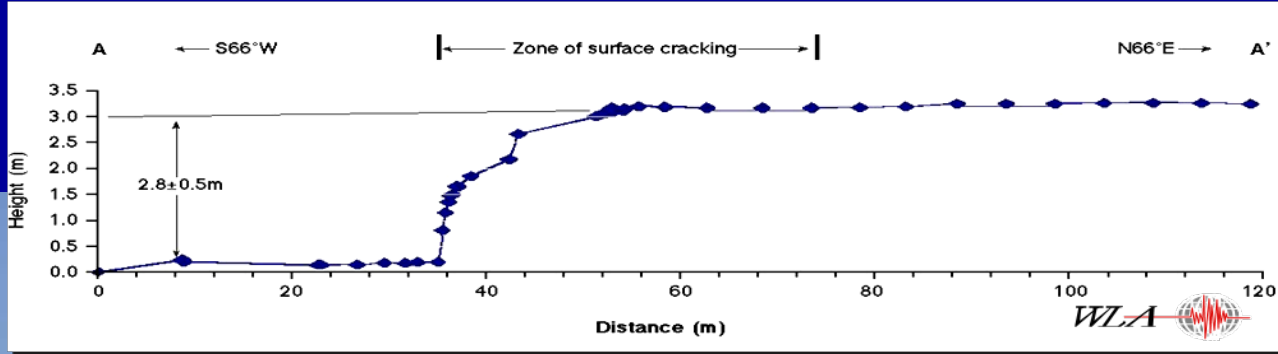




Damage Distribution along Line 1 (60 Structures)



- 1 Story
- △ 2 Stories
- 3 Stories
- 4 Stories
- ◇ 5 Stories
- 6 Stories



1999 Chi-Chi EQ: N. Abrahamson, J. P. Bardet, R. Boulanger, J.D. Bray, Y.-W. Chan, C.-Y. Chang, S. Chang, C.-H. Chen, L. Cluff, L. Harder, A-B. Huang, S. Huang, J.W. Ju, K. Kelson, S. Kieffer, S. Kramer, M.-J. Kuo, W. F. Lee, H-L. Lin, C-H. Loh, M. McRae, C-Y. Ou, W. Perkins, G. Rix, C. Roblee, R.B. Seed, J.-D. Shen, N. Sitar, J. Stewart, L. Teng, J. I. Sun, D. Wells, R. Wright and M. Yashinsky



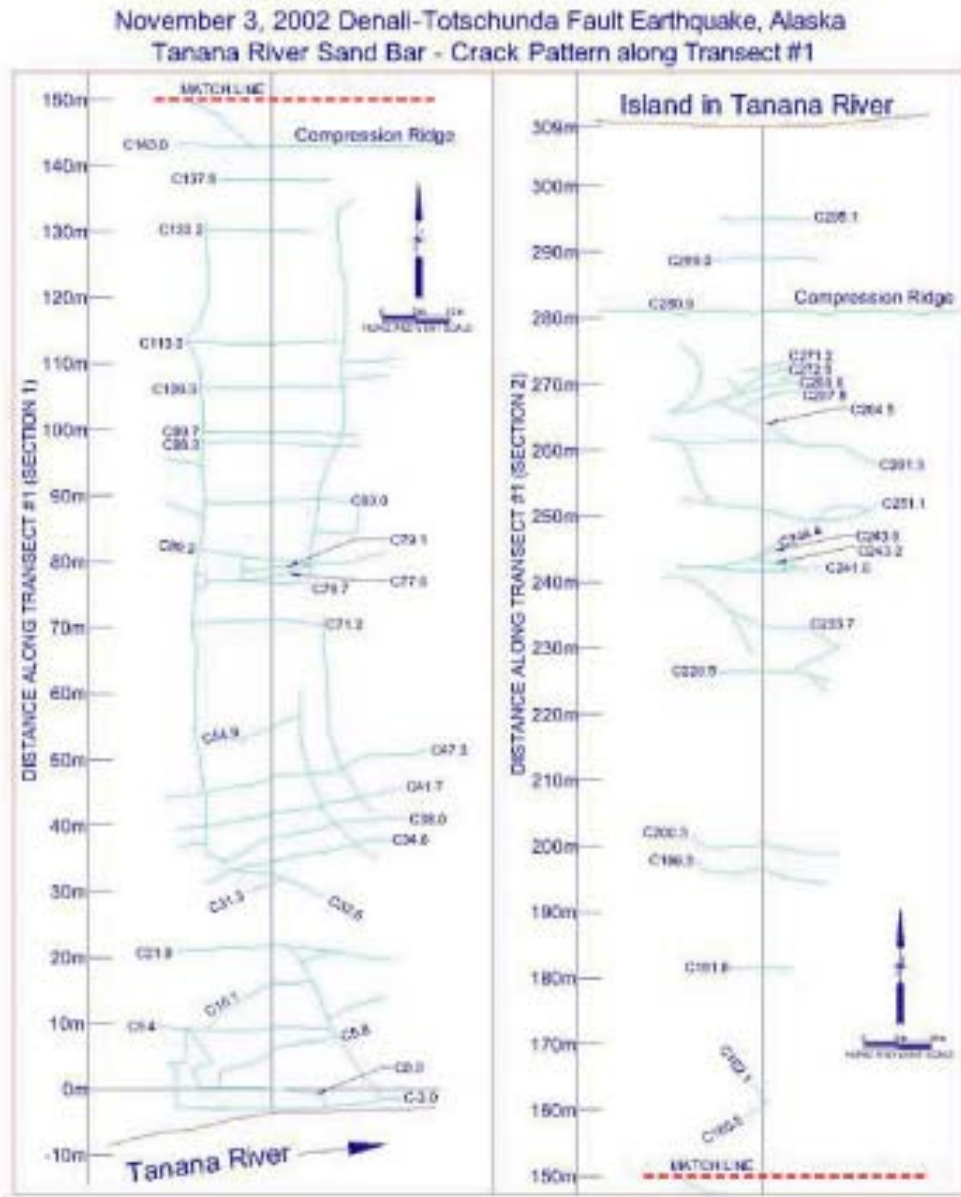
2001 Nisqually EQ: J. Bray, R. Sancio, A. Kammerer, S. Merry, A. Rodriguez-Marek, B. Khazai, S. Chang, A. Bastani, B. Collins, E. Hausler, D. Dreger, W. Perkins, & M. Nykamp; with J. Arnold, D. Booth, W. P. Grant, J. Hagedorn, M. Hamm, J. Hubbell, R. Hudson, S. Kramer, R. Mitchell, B. Muhunthan, S. Palmer, M. Vendetti, M. Wallinger, B. Topolski, K. Troost

<http://peer.berkeley.edu/nisqually/geotech/>

2002 Denali Earthquake: Detailed Surveying

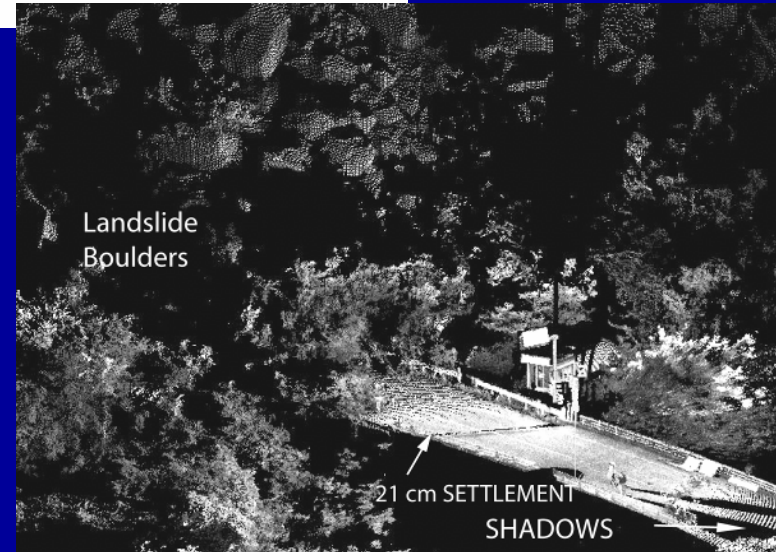
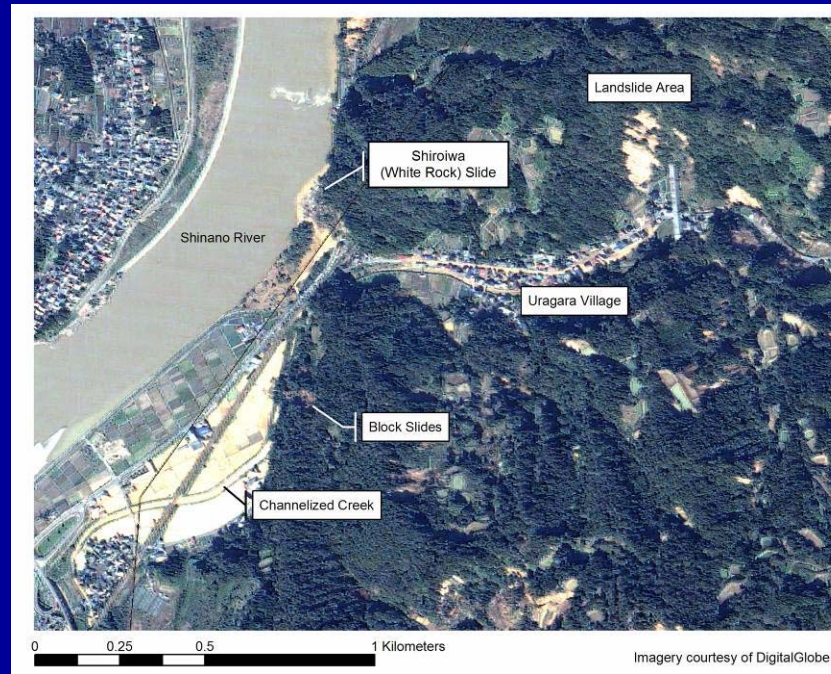


DGPS & Line-drawn mapping of polygon-shaped lateral spreads: 1.6%-3.8% shear strain toward Tanana river



Mapped by Sitar, Kayen, Collins, and others

2004 Niigata Ken Chuetsu Earthquake Remote Sensing (Rathje et al. 2006)



GEER Research Accomplishments

1. Use of new technologies for EQ reconnaissance
2. Use of existing technologies in an improved coordinated manner to document performance
3. Better training of those involved in EQ reconnaissance efforts, both in terms of effectiveness and safety; provide access to equipment required for state-of-the-art surveying
4. Timely and accurate results for the post-EQ survey efforts in terms of web-based short reports, data files, and final reports
5. A systematic mechanism for responding to EQs through the NSF SGER program

SOME KEY ISSUES

- **Better incorporation of GEER within USGS Cir. 1242:**
 - Coordination with EERI-LFE, USGS, and other organizations
- **Opportunities and challenges:**
 - Earthquake reconnaissance tools: LiDAR, GIS integration, GPS/video/picture, satellite and remote sensing, electronic collection
 - Use of geologic data and techniques
 - Role of the practitioner
 - Rapid dissemination of post-EQ reconnaissance data
 - Development of quantitative data (lessons learned from past EQs)
 - Systematic collection and archiving of post-EQ data
 - GEER response plan and funding
 - Site access
 - Multi-hazards