

Geotechnical Aspects of the M = 8.8 February 27, 2010 Chile Earthquake

*Jonathan Bray, UC Berkeley; David Frost, Georgia Tech;
Ramon Verdugo, Universidad de Chile; Christian Ledezma, Pontificia
Universidad Catolica de Chile; & Terry Eldridge, Golder Assoc.*

Pedro Arduino, Univ. of Washington; Scott Ashford, Oregon State Univ.; Dominic Assimaki, Georgia Tech; R. Boroschek, Universidad de Chile; Gabriel Candia, UC Berkeley; Leonardo Dorador, Univ. de Chile; Aldo Faúndez, Servicio de Salud Arauco; Gabriel Ferrer, Pontificia Univ. Catolica de Chile; Lenart Gonzalez, Golder Assoc.; Tara Hutchinson, UC San Diego; Laurie Johnson, Laurie Johnson Consulting; Katherine Jones, UC Berkeley; Keith Kelson, Fugro William Lettis & Assoc.; Rob Kayen, US Geological Survey; Gonzalo Montalva, Universidad de Concepcion; Robb Moss, Calif. Polytechnic Univ. SLO; Sebastian Maureira, Universidad de Chile; George Mylonakis, Univ. of Patras; Scott Olson, Univ. of Illinois; Kyle Rollins, Brigham Young Univ.; Nicholas Sitar, UC Berkeley; Jonathan Stewart, UC Los Angeles; Mesut Turel, Georgia Tech; Alfredo Urzúa, Prototype Engineering; Claudia Welker, Golder Assoc.; Rob Witter, DOGAMI; & Chilean Air Force

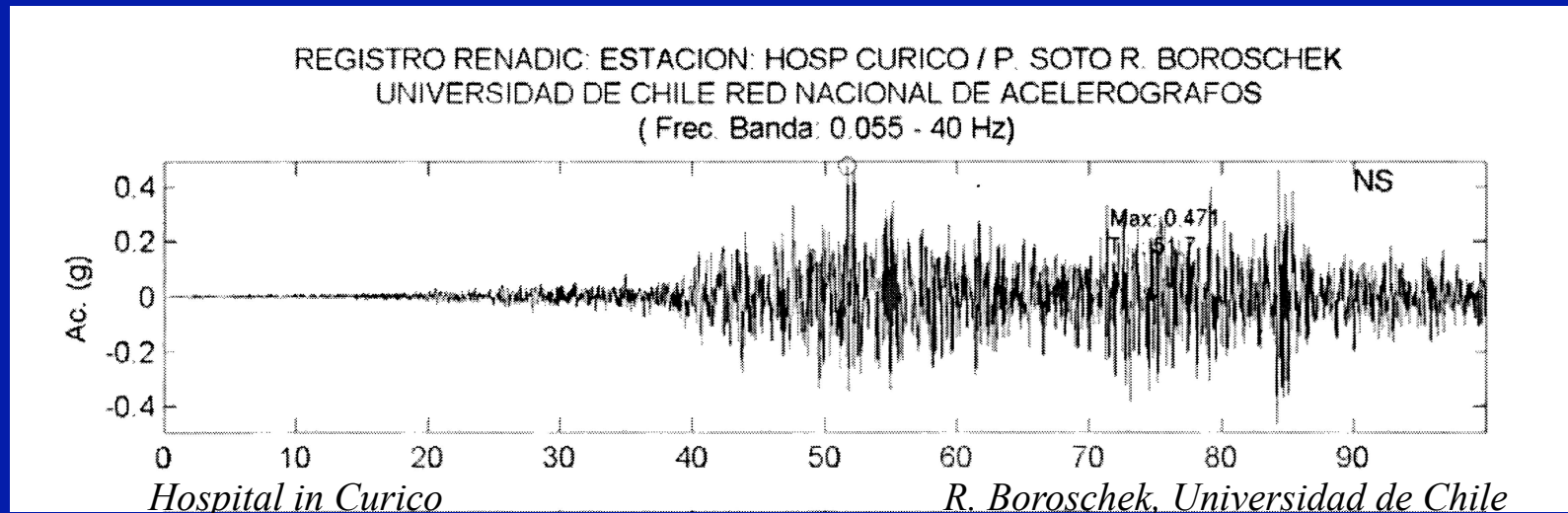


Geo-engineering Extreme Events Reconnaissance
Turning Disaster into Knowledge

www.geerassociation.org

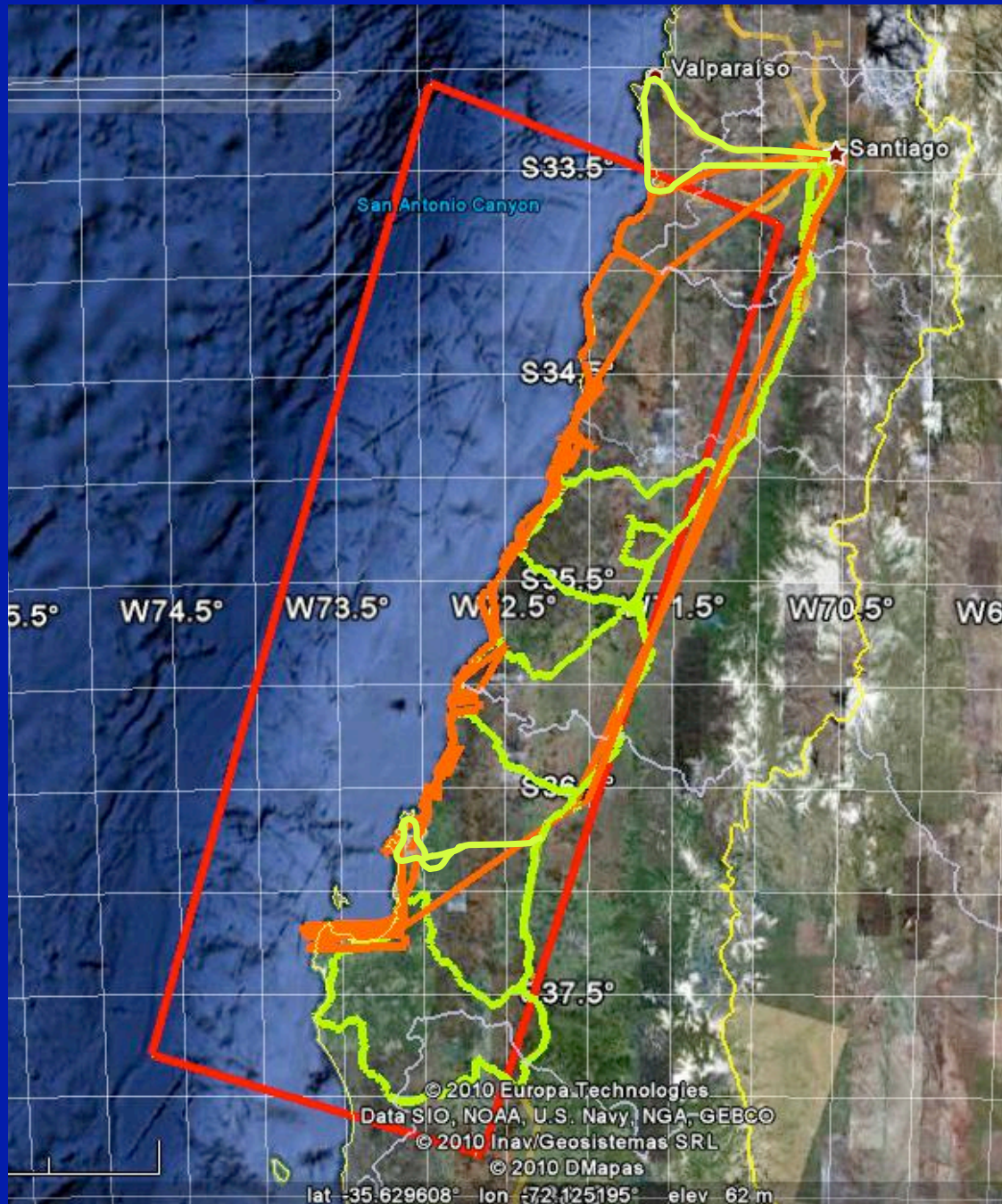


M = 8.8 Chile Earthquake



- Large Magnitude Subduction Zone Event
- Long Duration of Shaking (often > 60 s)
- Several Significant Aftershocks
- Well-Designed Earth Systems Shaken
- Many Opportunities to Gain Knowledge

NSF-Sponsored GEER Reconnaissance



Chile-US
Partners



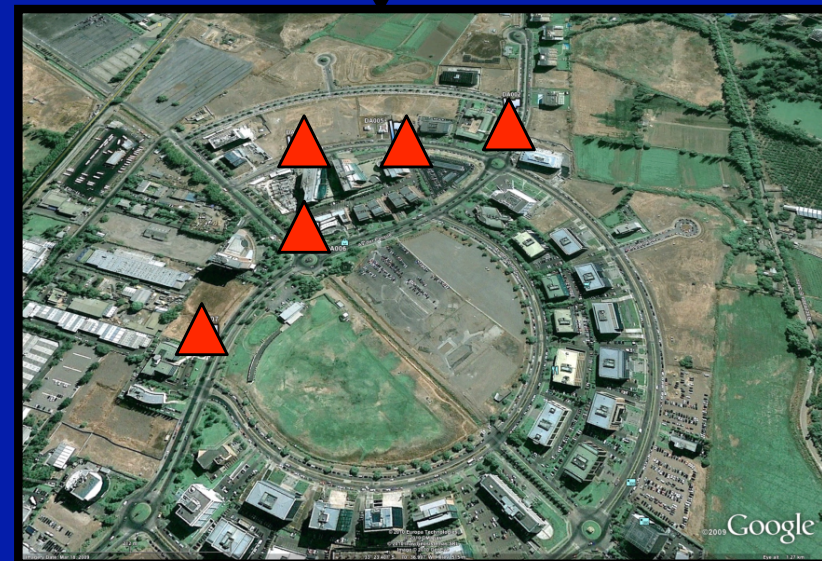
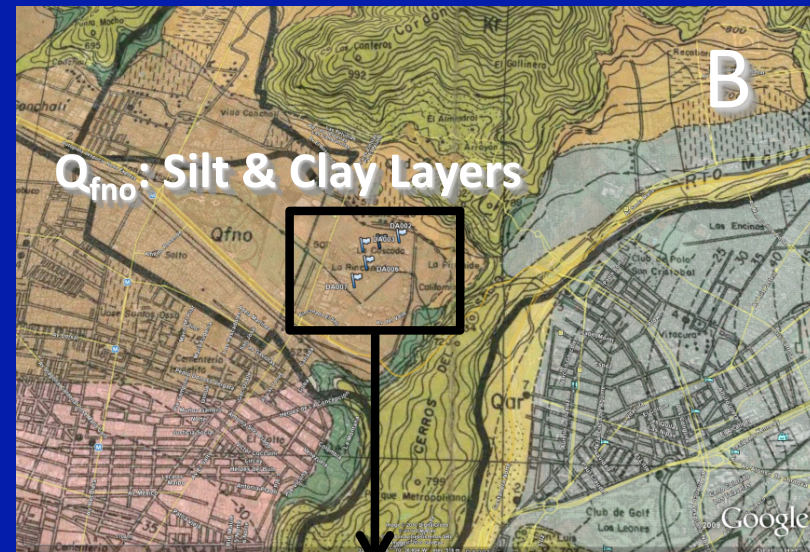
Aerial
Recon



Ground
Recon



Site Effects: Vespucio Norte & Ciudad Empresarial



Localized Damage – Site Effects?

H/V peaks: 0.5-2sec (Bonney et al, 2008)
Damage to 5 to 20-story buildings

Juan Pablo II Bridge, Concepción

Bent damage due to lateral spreading on NE approach
Liquefaction-induced pier settlements along bridge span

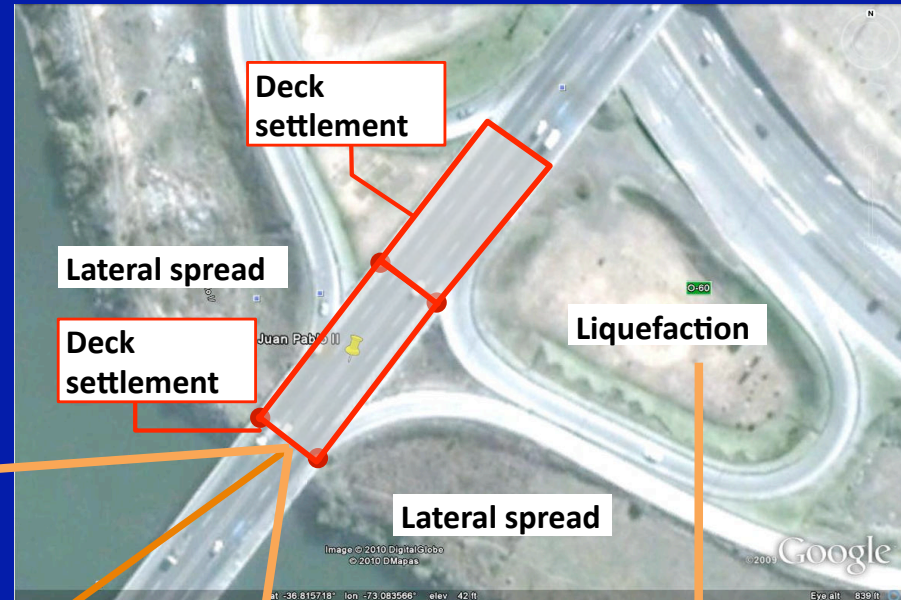


Juan Pablo II Bridge

Lateral spreading and bridge bent damage on NE approach



Deck settlement



Shear failure



Lateral spread



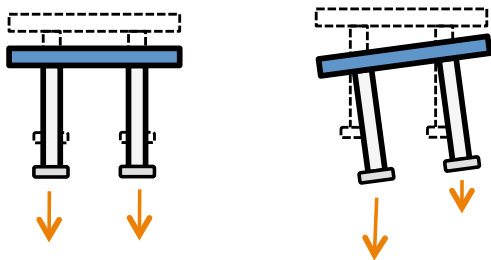
evidence of liquefaction

Juan Pablo II Bridge

Liquefaction-induced pier settlements along bridge span



Modes of deformation



Liquefaction-induced pier settlement

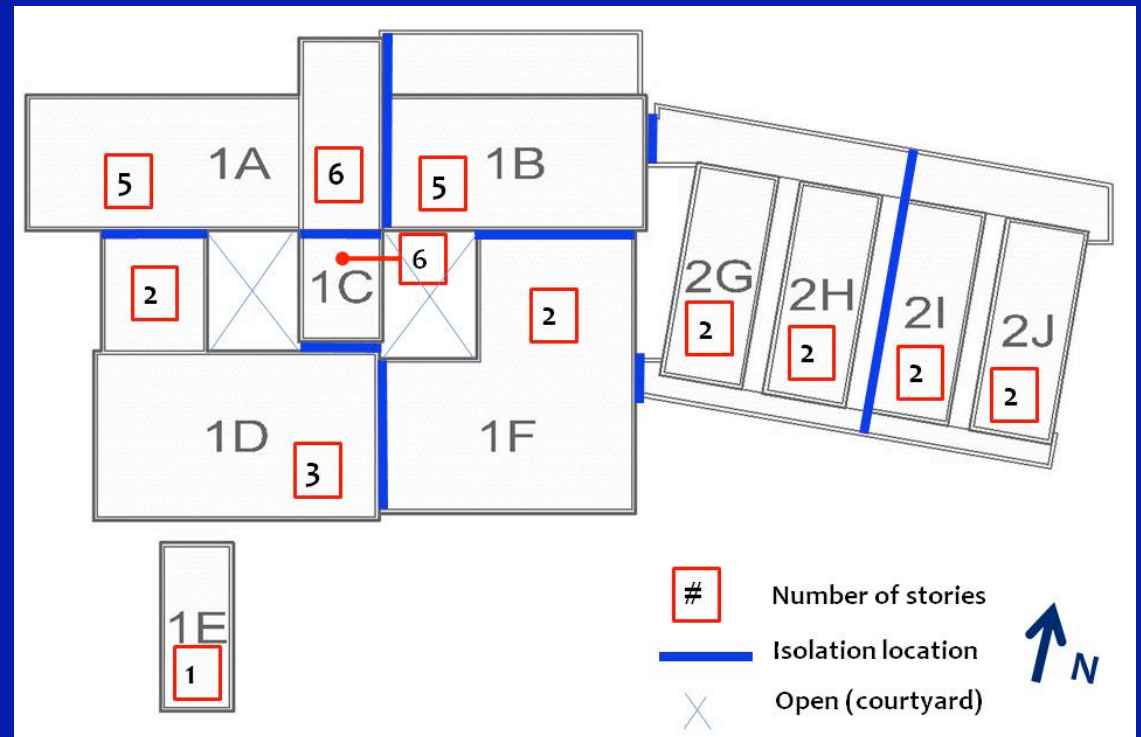


La Mochita Bridge, Concepción

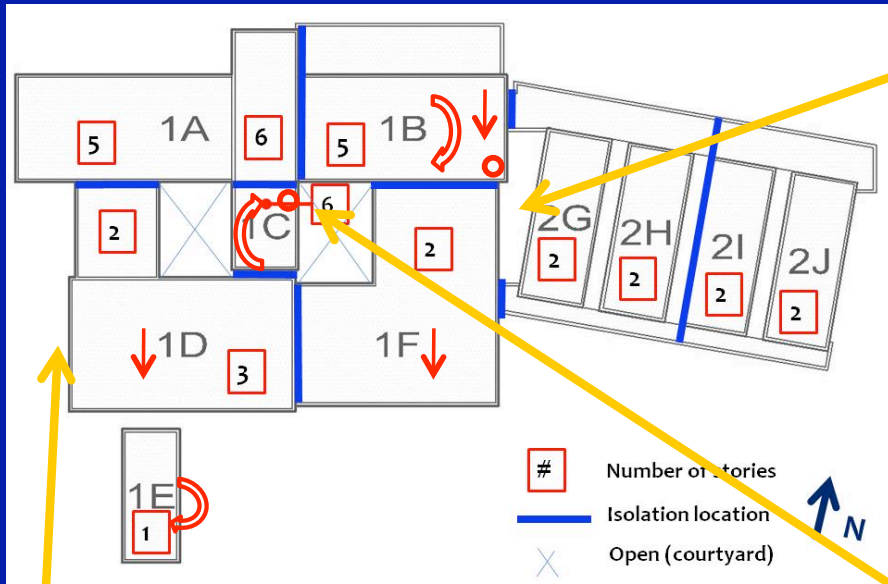


Effects of Ground Failure on Buildings

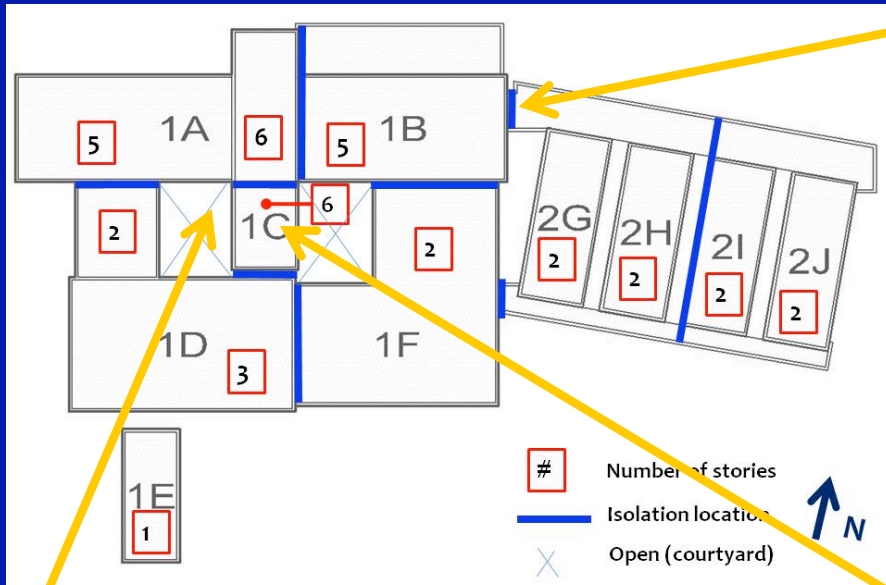
Hospital in Curanilahue



Hospital in Curanilahue

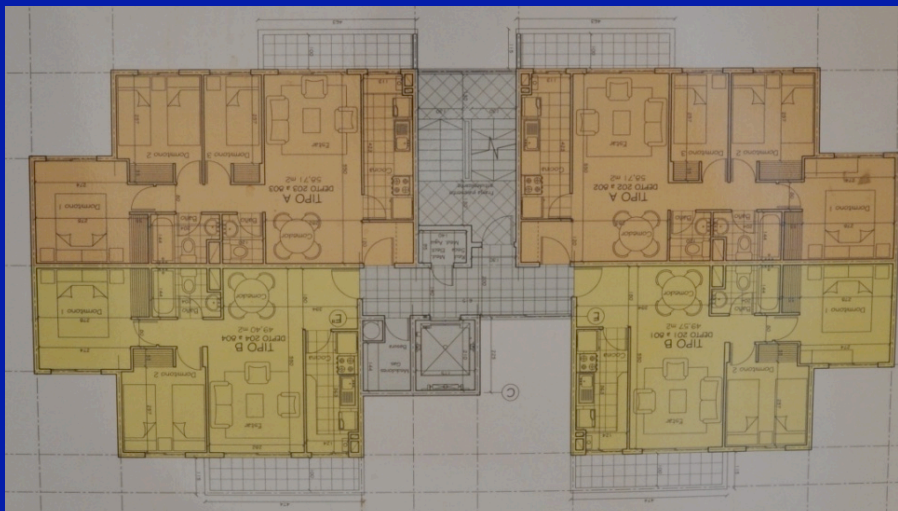


Hospital in Curanilahue



Effects of Ground Failure on Buildings

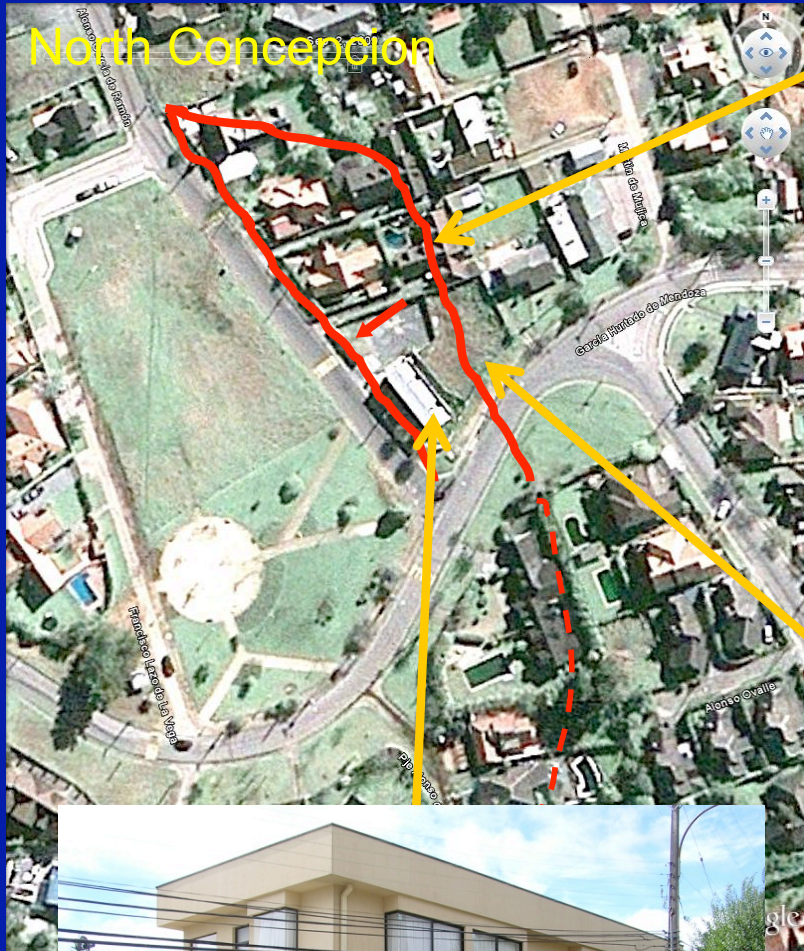
Four 8-Story Condominiums, Concepción



Four 8-Story Condominiums, Concépcion

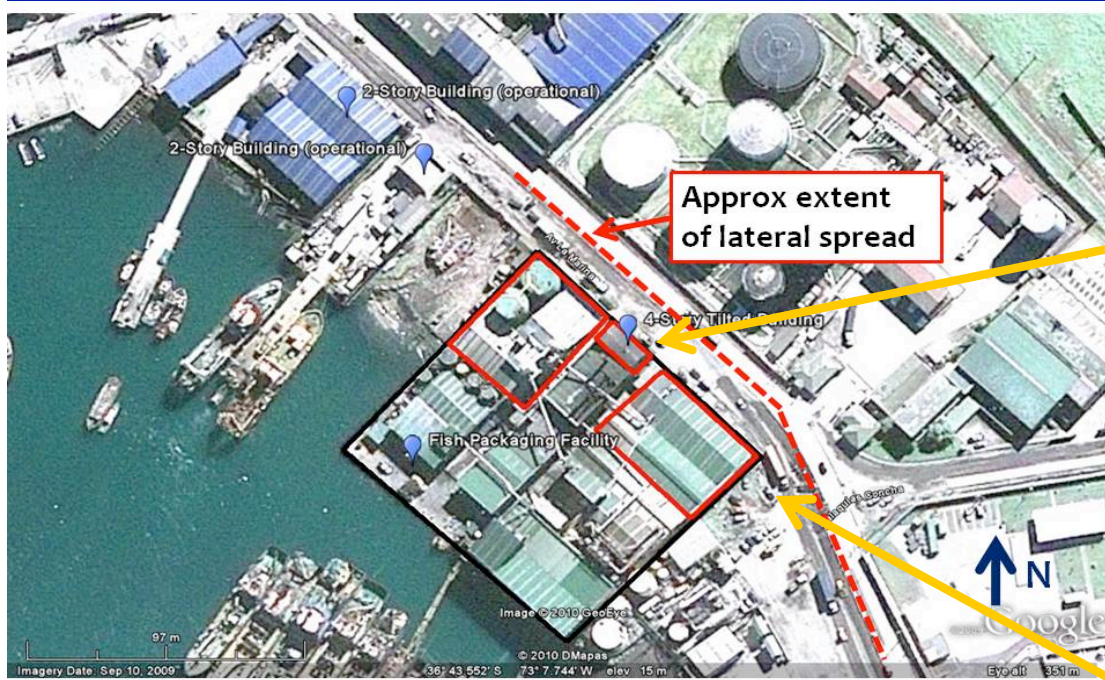


Slide Damages Homes But Not Apartments



Lateral Spreading Effects on Industrial Facilities

Fish Packing Facility, San Vicente



Lebu (Fishing Port & Village)



Uplift (~2m), quay wall failure, liquefaction – fishing industry devastated

Effects of Ground Failure on Port Facilities



San Antonio



Valparaiso



Coronel : a) Lateral Spreading/Settlement, b) Sediment Ejecta/Sinkholes, & c) Pile Damage

Embankment Failures along Highway 5



Possible liquefaction of thin seams in foundation soils led to translational failures of highway embankments



Seismic Performance of Dams & Levees

Coihueco Zoned Earth Dam Upstream Slope Failure



Levee Breach



Rapel Concrete Dam

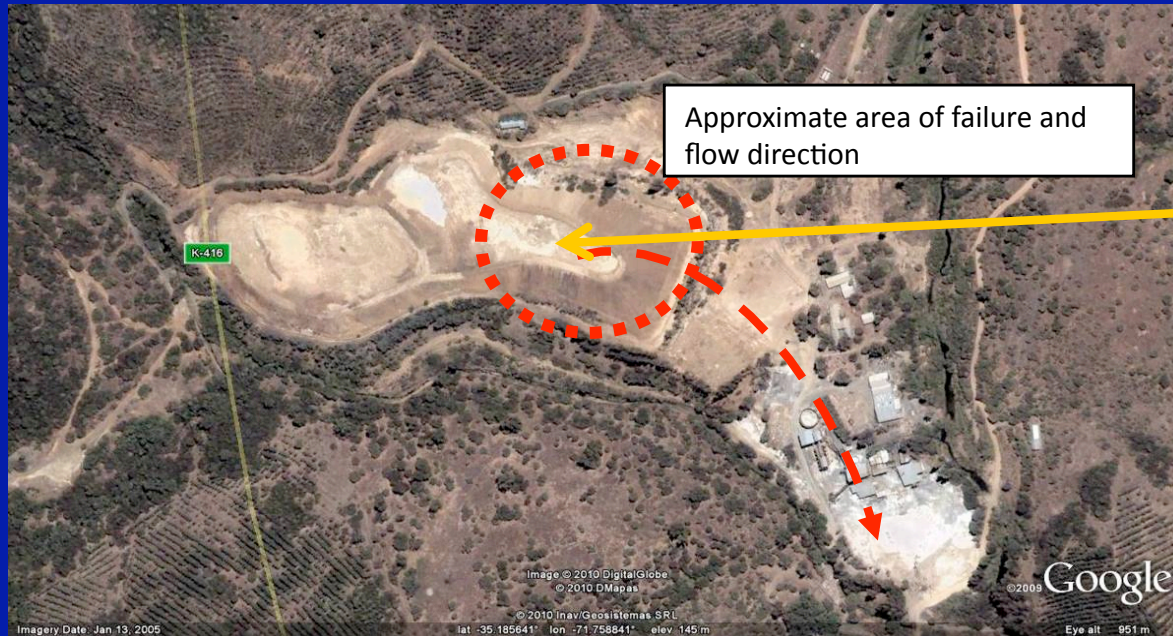


(most dams performed well)



Seismic Performance of Tailings Dams

Las Palmas Tailings Dam Failure



Geotechnical Aspects of the M = 8.8 Chile Earthquake

Opportunities to Gain Knowledge regarding:

- Liquefaction-induced pier settlement
- Lateral spreading effects on bridges
- Liquefaction-induced building displacements
- Lateral spreading effects on ports and industrial facilities
- Seismic performance of dams, levees, & tailings dams
- Seismic performance of earth embankments & retaining walls
- Landslides
- Site effects
- Effects of long duration of shaking and multiple aftershocks



Geo-engineering Extreme Events Reconnaissance
Turning Disaster into Knowledge

www.geerassociation.org

