

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

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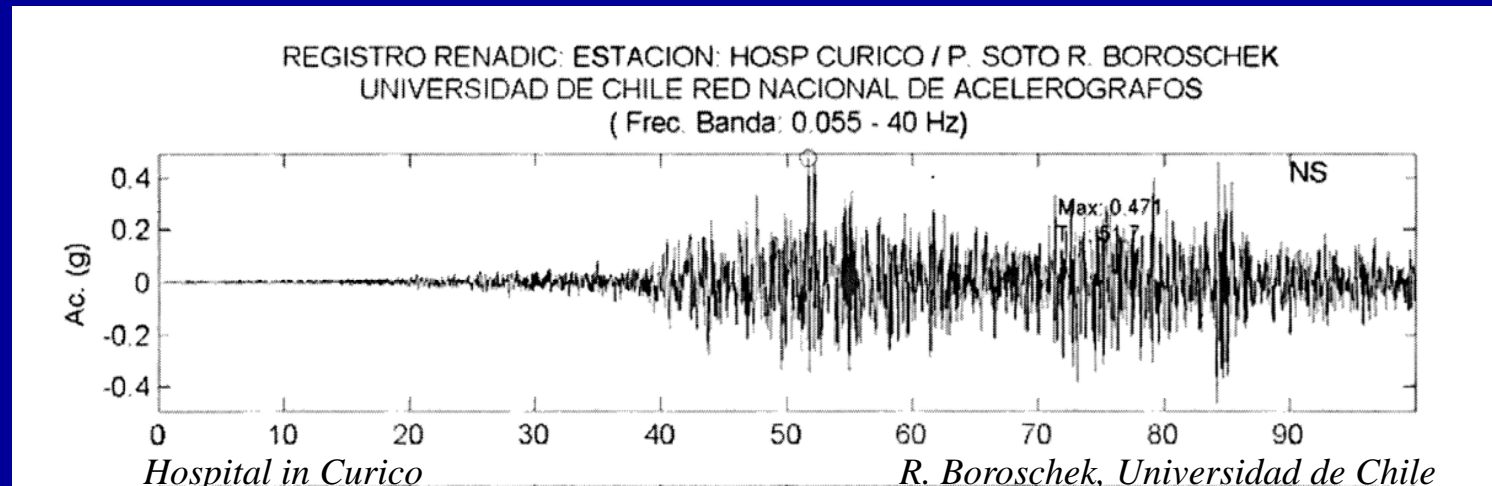


Geo-engineering Extreme Events Reconnaissance
Turning Disaster into Knowledge

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



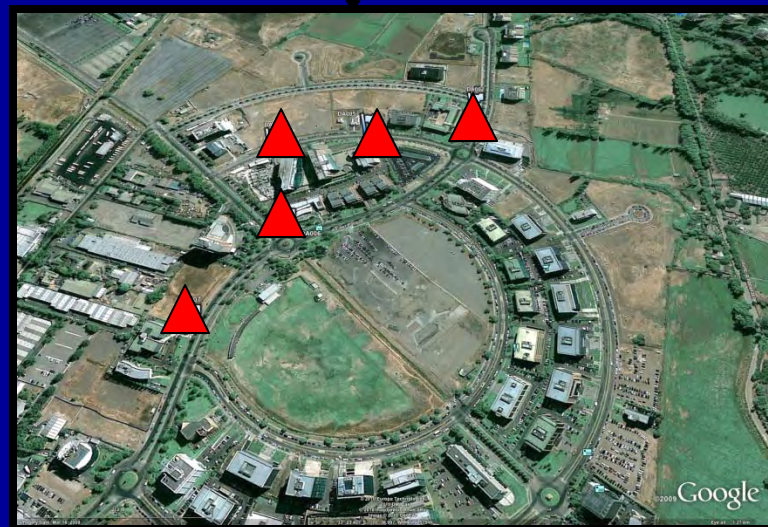
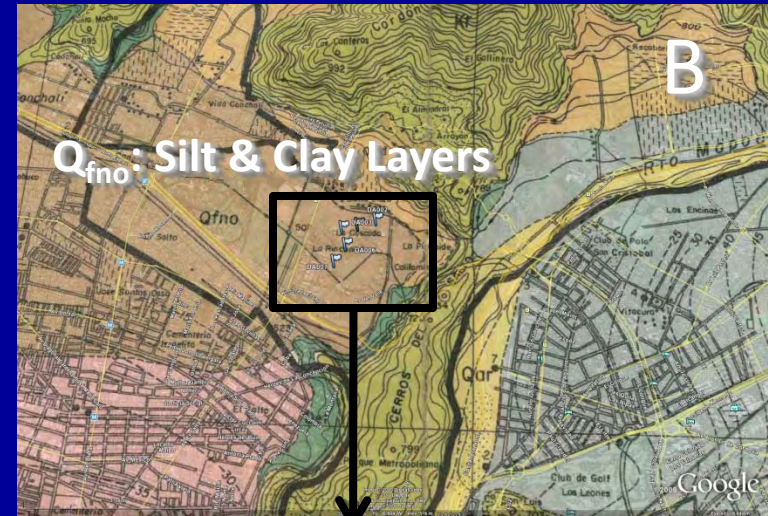
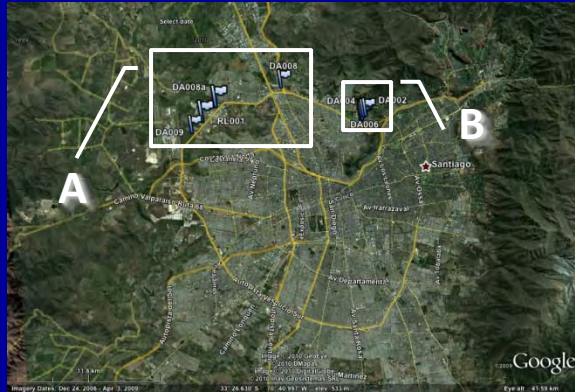
Aerial
Recon



Ground
Recon



Site Effects: Vespucio Norte & Ciudad Empresarial



Localized Damage – Site Effects?

H/V peaks: 0.5-2sec (Bonnefoy 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

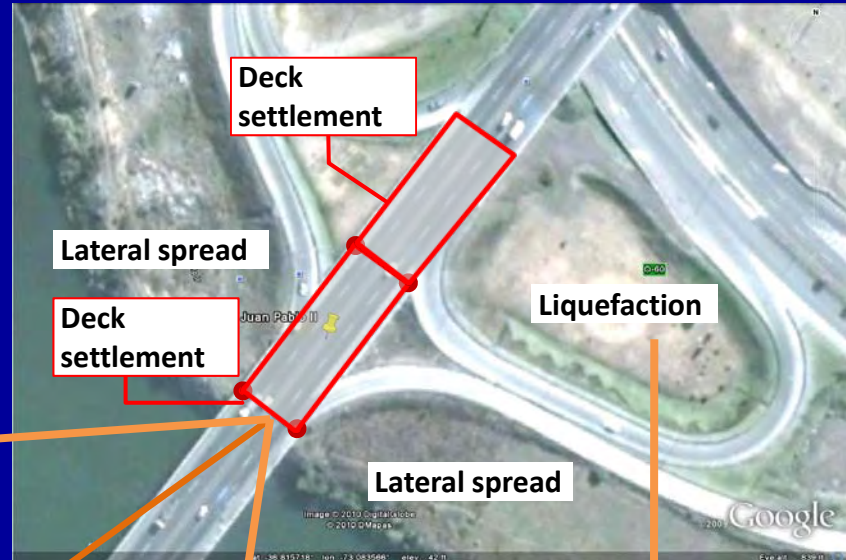


Juan Pablo II Bridge

Lateral spreading and bridge bent damage on NE approach



Deck settlement



Shear failure



Lateral spread



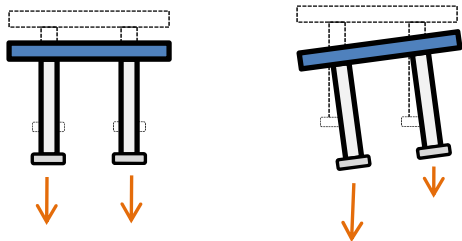
evidence of liquefaction

Juan Pablo II Bridge

Liquefaction-induced pier settlements along bridge span



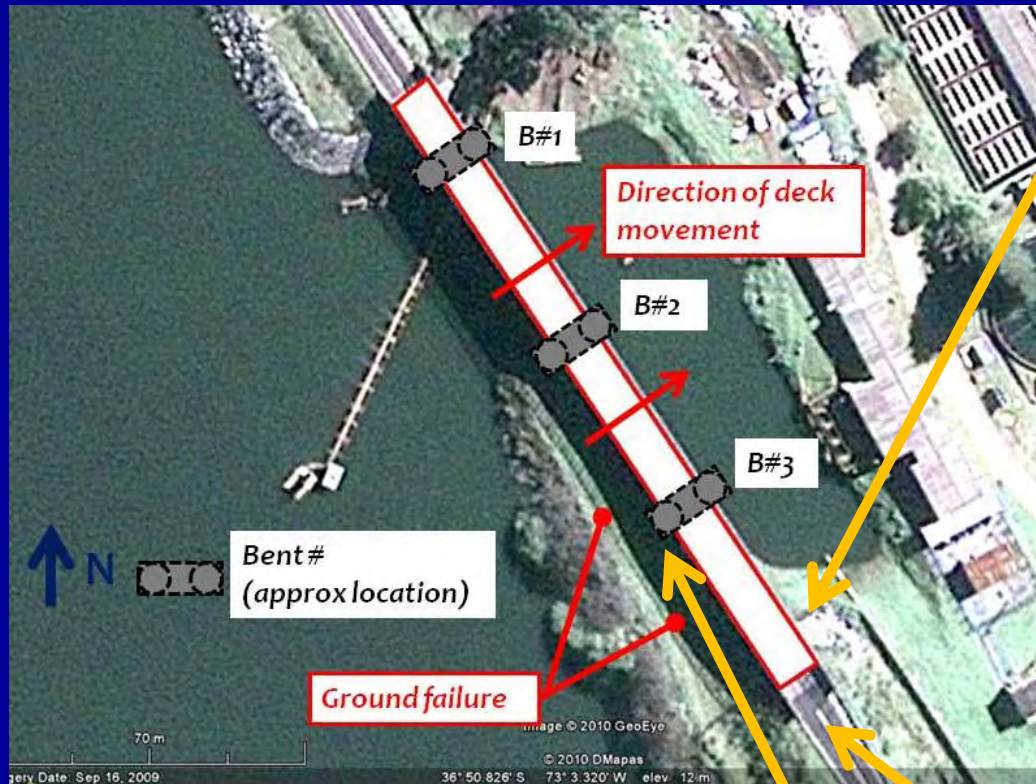
Modes of deformation



Liquefaction-induced pier settlement

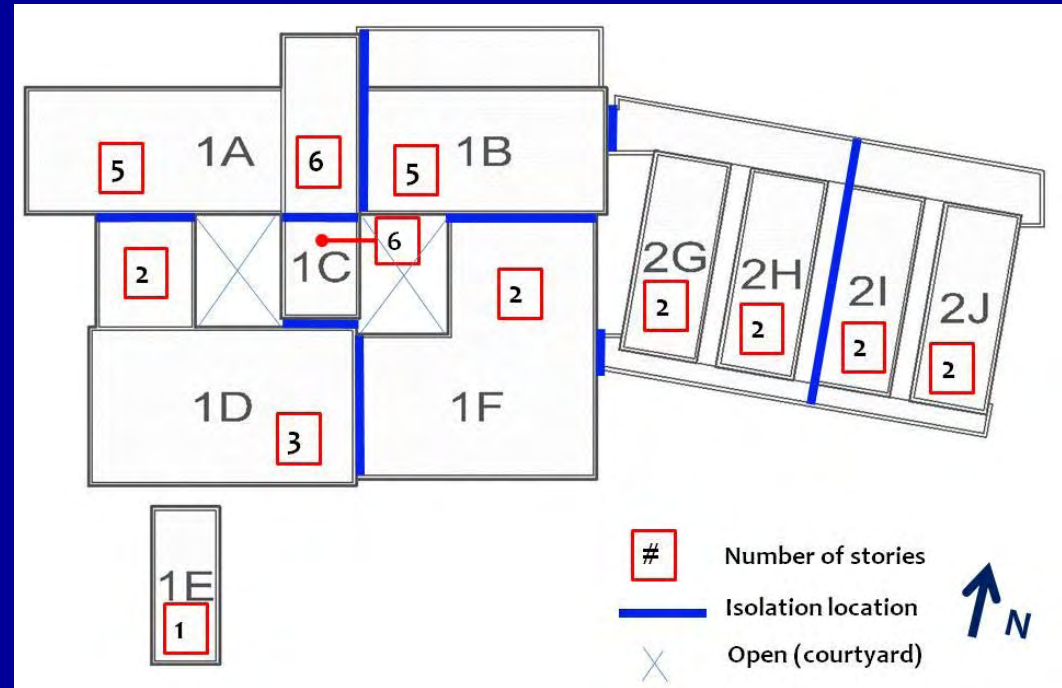


La Mochita Bridge, Concepción

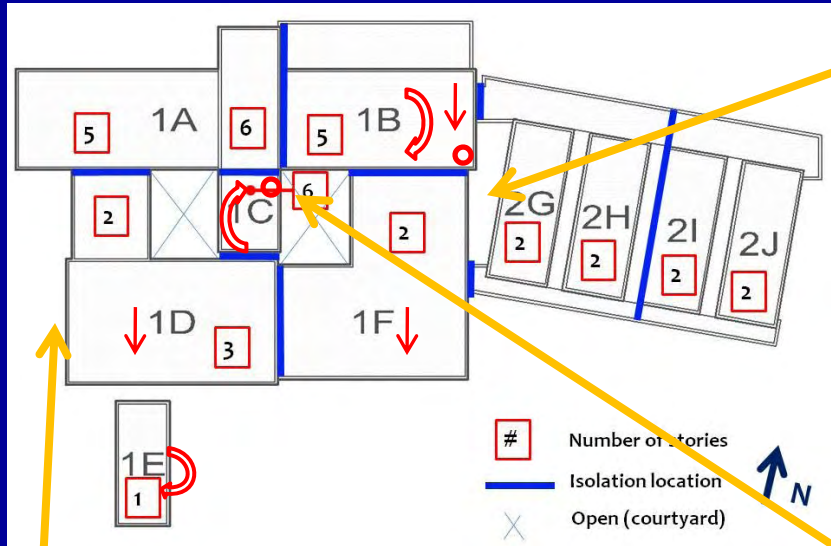


Effects of Ground Failure on Buildings

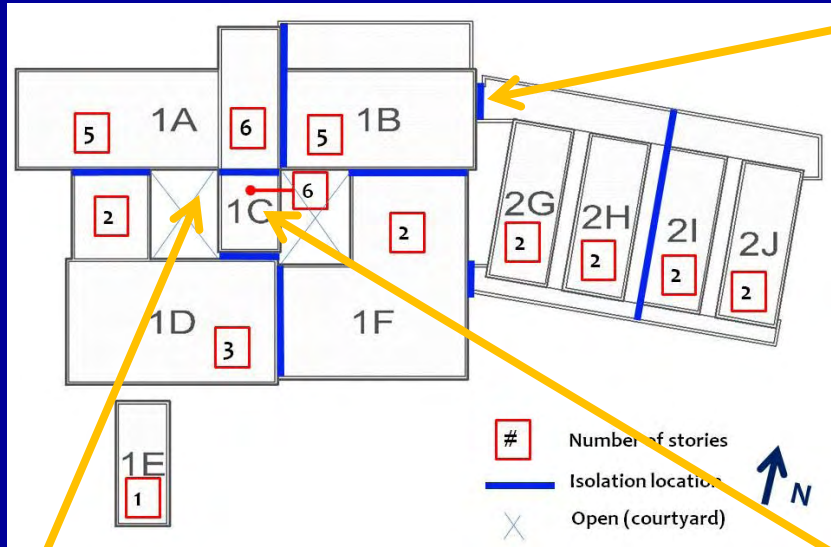
Hospital in Curanilahue



Hospital in Curanilahue



Hospital in Curanilahue



Effects of Ground Failure on Buildings

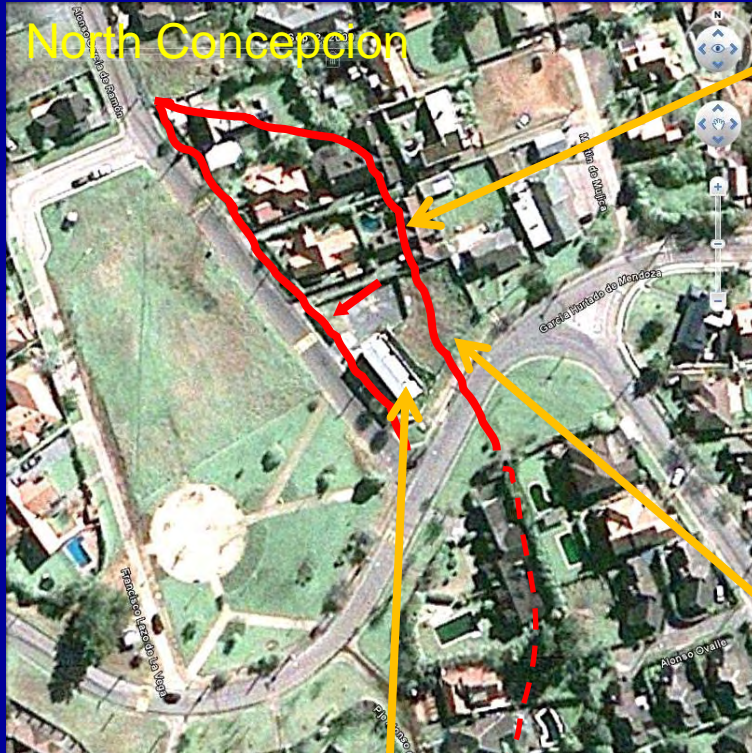
Four 8-Story Condominiums, Concepción



Four 8-Story Condominiums, Concepción

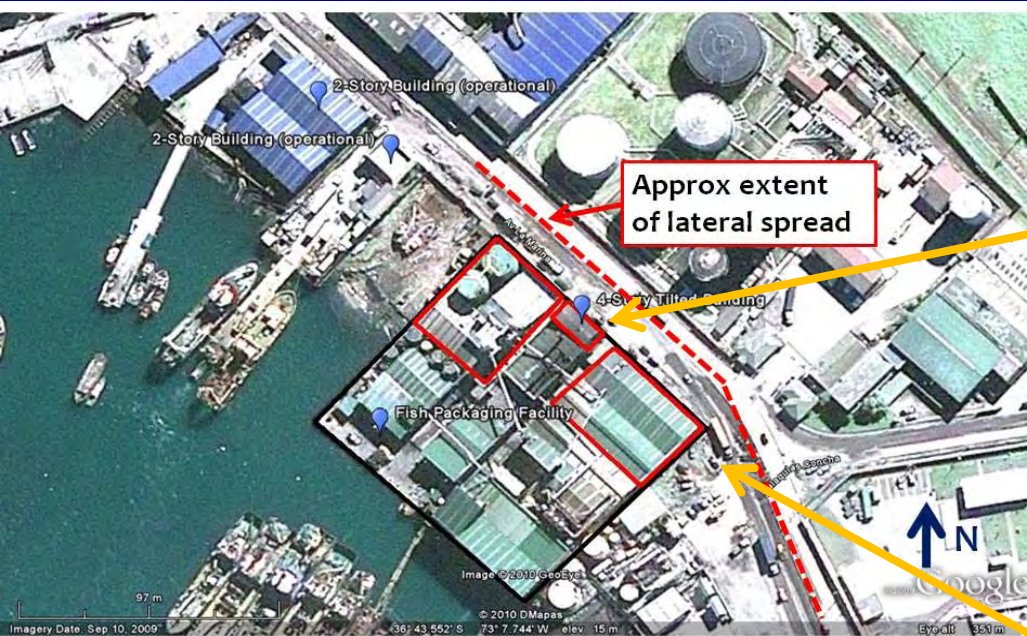


Slide Damages Homes But Not Apartments



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



Valparaíso



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

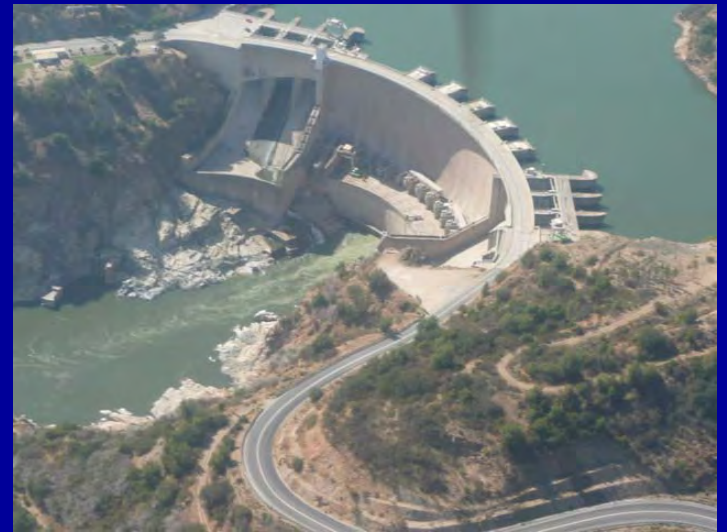
Coihueco Zoned Earth Dam Upstream Slope Failure



Levee Breach



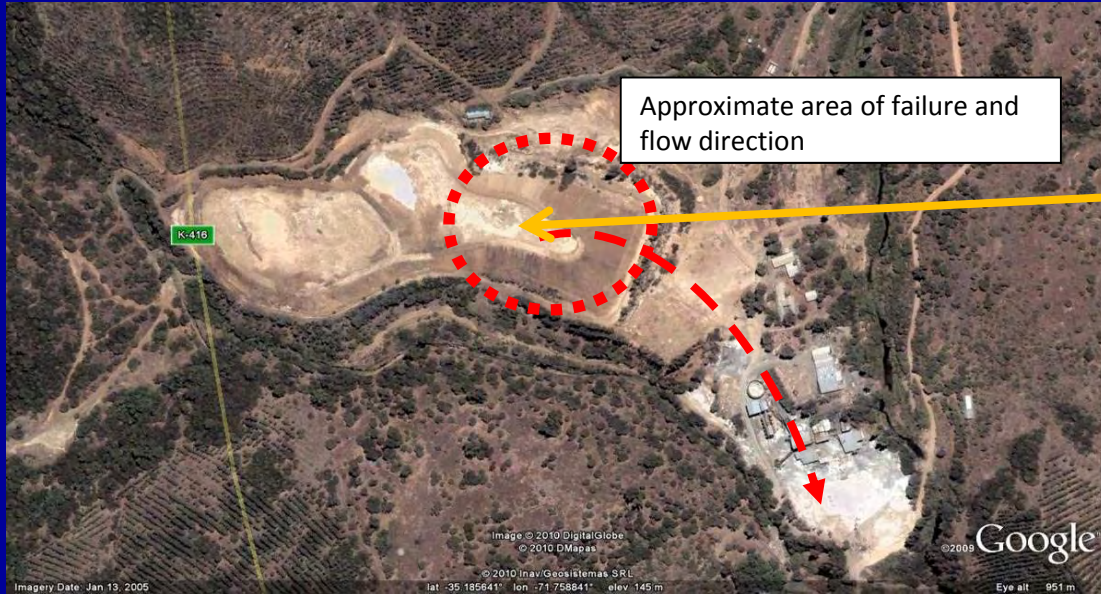
Rapel Concrete Dam



(most dams performed well)

Seismic Performance of Tailings Dams

Las Palmas Tailings Dam Failure



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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



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