



PEER

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Seismic Performance Observatory:

*Development of a System for Visualization and
Management of Information on the Earthquake
Performance of Structures*

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Pacific Earthquake Engineering Research Center (PEER),

Preparing for the NEXT One

Move towards a strategic approach to earthquake investigations to support PBEE

Earthquakes as experiments

- Robust, searchable databases of damage to structures, systems and contents
- Committee formed and meeting held
- Developing Action Plan
 - More work required
 - Implementation needed!
- Funding (PEER, CalEMA, others needed)

Response on potential large west coast (or US) earthquake

- Committee established to develop action plan (email exchanges, but no meetings yet!)
 - Specific things to do before and after event
 - Initial planning group
 - U. Washington – M. Eberhart
 - UC Davis – R. Boulanger
 - UC Berkeley – S. Mahin/J. Bray
 - Stanford – E. Miranda
 - Caltech – J. Beck (provisional)
 - UCLA – John Wallace/J. Stewart
 - USC – J.P. Bardet
 - UC Irvine – Farzin Zareian
 - UCSD – Tara Hutchinson/Jose Restrepo

Seismic Performance Observatory

Background:

Although there exist a number of archives based on structural performance and behavior, these documents and recordings are often inaccessible, unorganized, or lost over time.

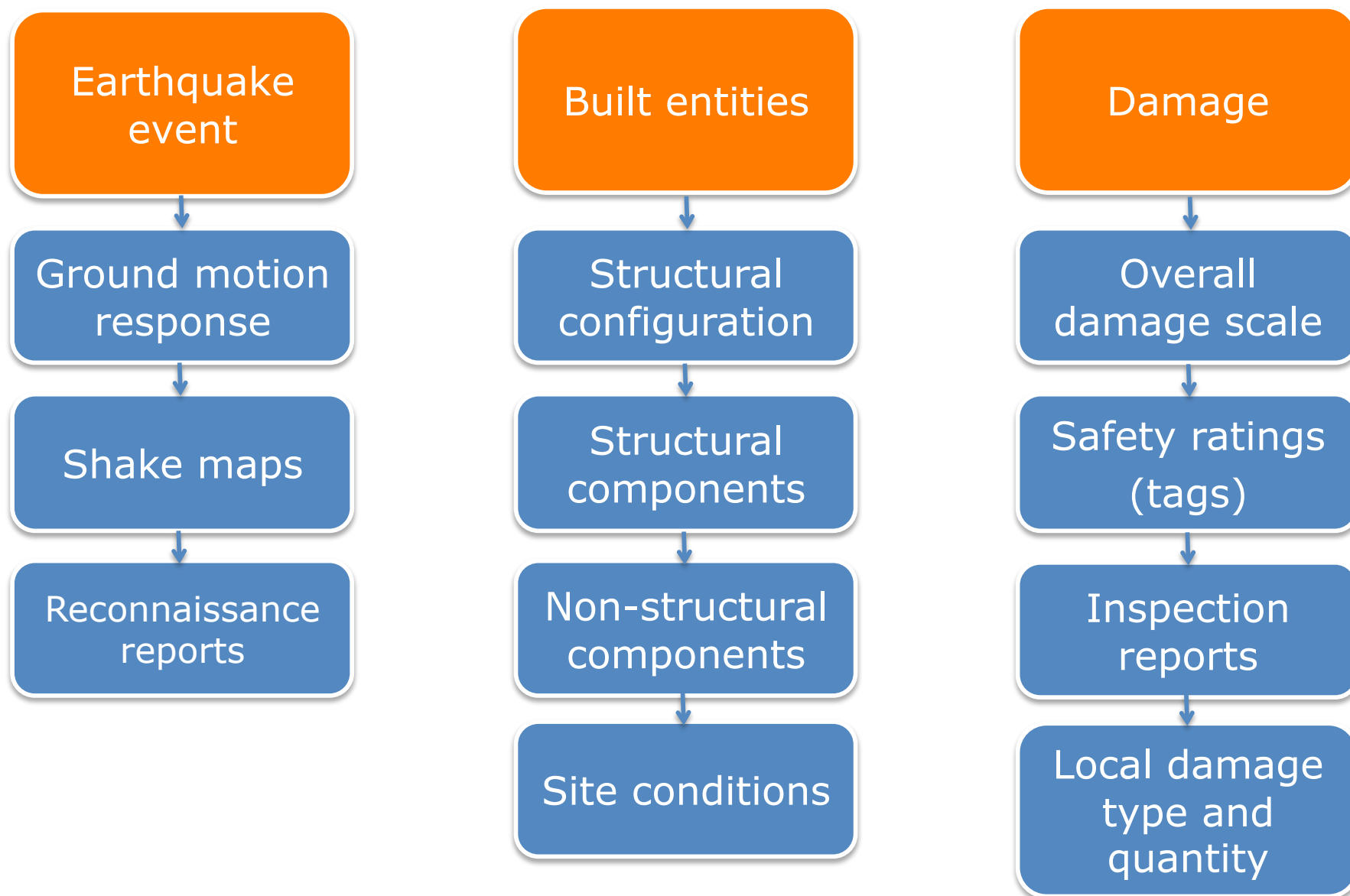
PROBLEM for earthquake engineering

- An **unsystematic** method for gathering and storing critical data after earthquakes
- Independent investigations **lacking collaboration**
- Unavailable pre-earthquake data

SOLUTION:

- Develop a **CENTRALIZED, ACCESSIBLE, EXTENSIBLE, SCALABLE DATABASE** that will:
 - ✓ Offer advanced searching capabilities
 - ✓ Allow users to identify trends
 - ✓ Quantify data
 - ✓ Link users to external resources
 - ✓ Provide pre-earthquake data for comparison purposes
- Establish a thorough procedure for both pre- and post-earthquake investigations

Object oriented programming approach



Input objects

- Short narrative descriptions
- Photographic images
- Video and audio files
- Point clouds
- Audio files
- Structural drawings
- Ground motion and in-structure instrumental records
- Inspection reports
- Reconnaissance reports
- Evaluation reports
- Computer analysis models



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New Structure

* Name

Description

* Location Latitude Longitude decimal degrees
[show on map](#)

-or-

Address

[Geocode to Lat/Lng](#)

PEER-taxonomy

[clear](#)

☒ building
☐ bridge
[new type](#)

Number of stories above ground below ground

Story height ☐ estimated?

Footprint area ☐ estimated?

Bays # Bays in X # Bays in Y

Spans span length in X span length in Y ☐ estimated?

☐ Vertical irregularities

☐ Plan irregularities

Isolators [Add Isolators](#)

Dampers [Add Dampers](#)

Foundation

Soil type

Liquefaction rating

Primary Occupancy
public assembly
commercial
residential
industrial
emergency services

Instruments [Add Instruments](#)

Inspections [Add Inspections](#)

Design date ☐ unknown

Construction date ☐ unknown

Retrofit date ☐ unknown

Building code

Notes

[Create Structure](#)



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Update Gallery

* Name

[Single Image View](#)

☒ * Please check here to indicate that you agree to the University of California, Berkeley copyright policy as described [here](#).

[Delete](#) [Unselect All](#) [Select All](#)



[Step 1 - Select Files](#)

[Step 2 - Upload Files](#)

Structures



Transamerica Pyramid
PEER Library
SF Building 2
SF Building 3
SF Building 4

☐ No Structures

Earthquakes



San Fernando, California-1971
Loma Prieta, California-1989
Northridge, California-1994
Turkey-1999
Taiwan-1999

☐ No Earthquakes

Information

Shows

Photo taken from
[show on map](#)

Structural damage
related to associated structure(s)

Geotechnical Damage

Description

Tags
separate tags with commas

[\(show damages\)](#)

[Update](#)

Photo Taken By

Name

Date


Photo Posted By

Name

Date

[New Person](#)

Assign attributes to an image









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Describe Gallery Images

Structure:
Earthquake:
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Damage

building

bridge

new type

reinforced concrete

steel

wood

masonry (brick and AAC)

steel and concrete composite

new material

arch bridge

reinforced slab bridge

beam and slab bridge

box girder bridge

integral bridge

segmental bridge

cable stayed bridge

suspension bridge

new system

column (pier)

bent cup beam

outrigger bent cup beam

cup-column joint

deck

expansion joint

girder restrainers

shear key

bearings

abutments

new component

☒ shear cracks
☐ tension cracks
☐ concrete spalling
☐ shear failure
☐ flexural-shear failure
☐ compression-shear failure
☐ hoop fracture
☐ lap-splice failure
☐ longitudinal bar anchorage failure

new damage

Description
crack at an exterior side: NE pier of Western m

Tags

separate tags with commas
(show damages)

Photo Taken By
Name
Date 2012 July 5

Photo Posted By
Name John Smith
Date 2012 July 5



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Search Structure

Name

Location Latitude Longitude decimal degrees

Type

Material

Structural System

| | View | Component | Type |
|---|---|---------------------------------------|---|
| Damage <input type="button" value="▶"/> | Global <input type="button" value="▶"/> | <input type="text"/> | <input type="text"/> |
| | Local <input type="button" value="▶"/> | Beam <input type="button" value="▶"/> | Lateral Torsional Buckling <input type="button" value="▶"/> |

Geotechnical Damage

Foundation

Distance To Fault

- ☐ instrumented
- ☐ inspected
- ☐ isolators
- ☐ dampers

Building ☐

stories: to

Occupancy:

Bridge ☐

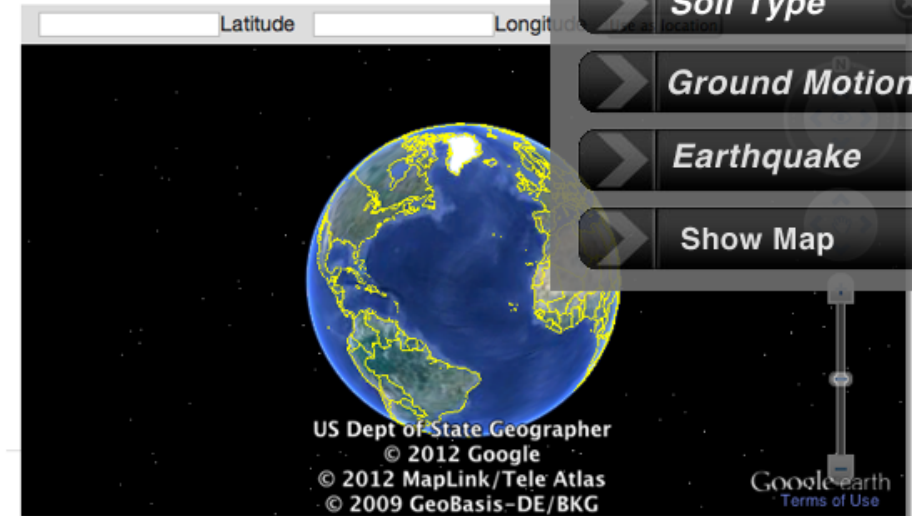
Max Spans: to

bents: to

col/bent: to

Aspect Ratio: to

X-section Shape:



Earthquake

Name

Location Latitude Longitude

USGS ID

Date

Magnitude to

Fault_Type

Soil Type

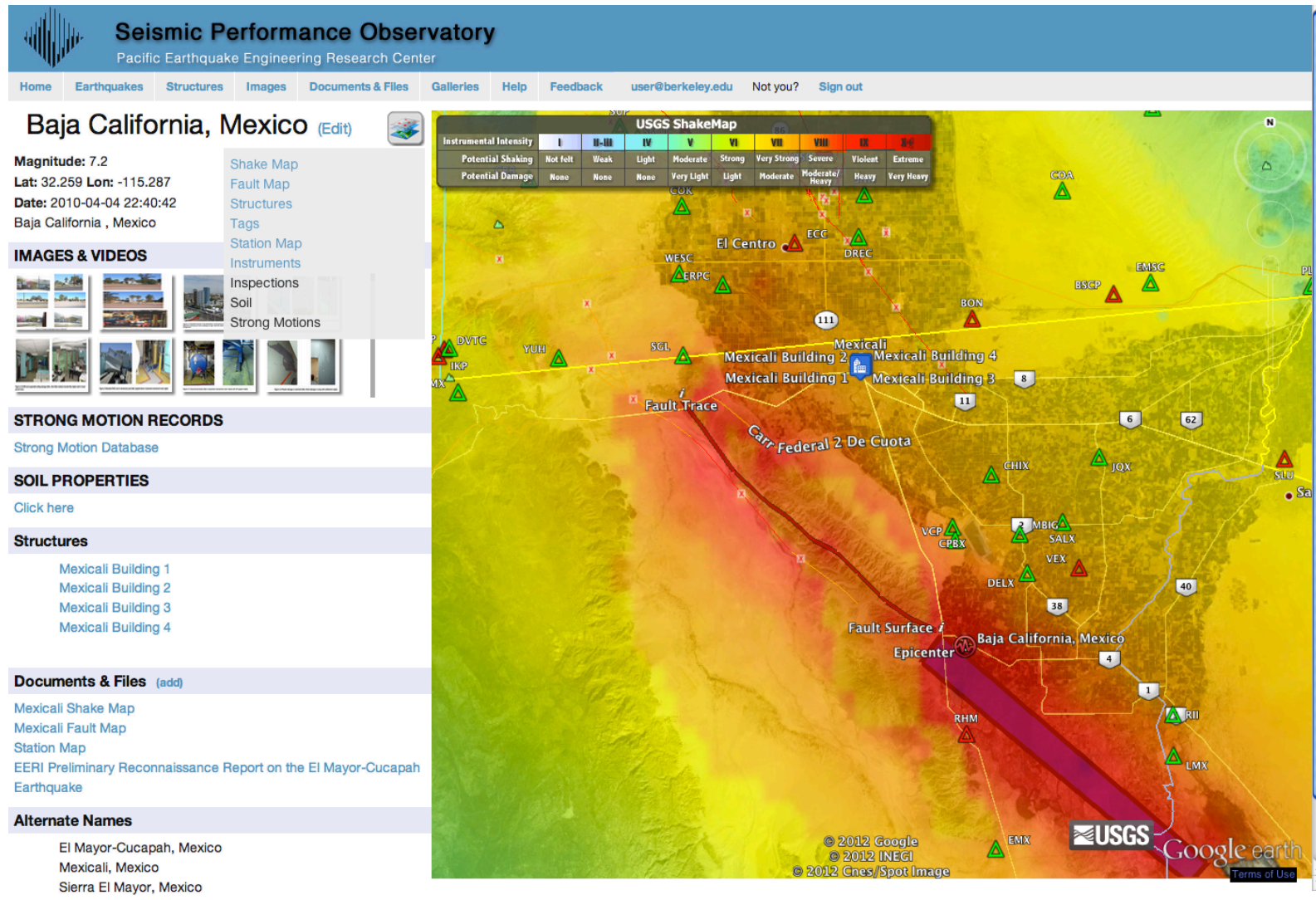
Ground Motions

Intensity to

Distance to Fault

Distance to Building

Analysis



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Offshore Maule 2010

Feb 27, 2010 06:34:14 (UTC)


Magnitude: 8.8
 Depth: 35 km (21.7 mi)
 Epicenter: 35.909°S, 72.733°W
 Countries: Chile


[Intensity](#)
[Faults](#)
[Stations](#)
[Before/After](#)
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[Tagged Structures](#)
[Instrument Structures](#)
[Soil Data](#)
[Inspected Structures](#)
[Main/After Shocks](#)


PHOTOS & VIDEOS



REPORTS & FILES

 Identifier: [Text-S21021](#)
 Title: 90-6 El terremoto de 1985 en Chile : analisis del edificio Hanga-Roa
 Creator(s): Huerta, Alvaro; Riddell, Rafael Date: 1990

 Identifier: [Text-200910163](#)
 Title: Lesson learned from March 3, 1985 Chile earthquake and related research
 Creator(s): Cassis, Juan H.; Bonelli, P. Date: 1992-07
 Digital Copy Available

 Identifier: [Text-S20060](#)
 Title: Los movimientos sismicos del mes de Mayo de 1960 en Chile
 Creator(s): Watanabe, Takeo; Karzulovic, Kokot J. Date: 1960

1 2 3 4 5 6 7 8 9 10 next >

Result 1 of 40


STRONG MOTION RECORDS

[click here](#)

SOIL PROPERTIES

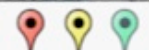
[click here](#)

TAGS: **earthquake** chile **concrete**
 subduction masonry collapsed shearing
 cracks Moehle



Imagery Date: Jan 16, 2010 34°38'47.02\"

Drag over location



Offshore Maule 2010 ▾ Any Structure ▾ Any Failure Mechanism ▾ Any Material ▾

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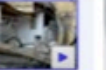
Offshore Maule 2010






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PHOTOS & VIDEOS









REPORTS & FILES



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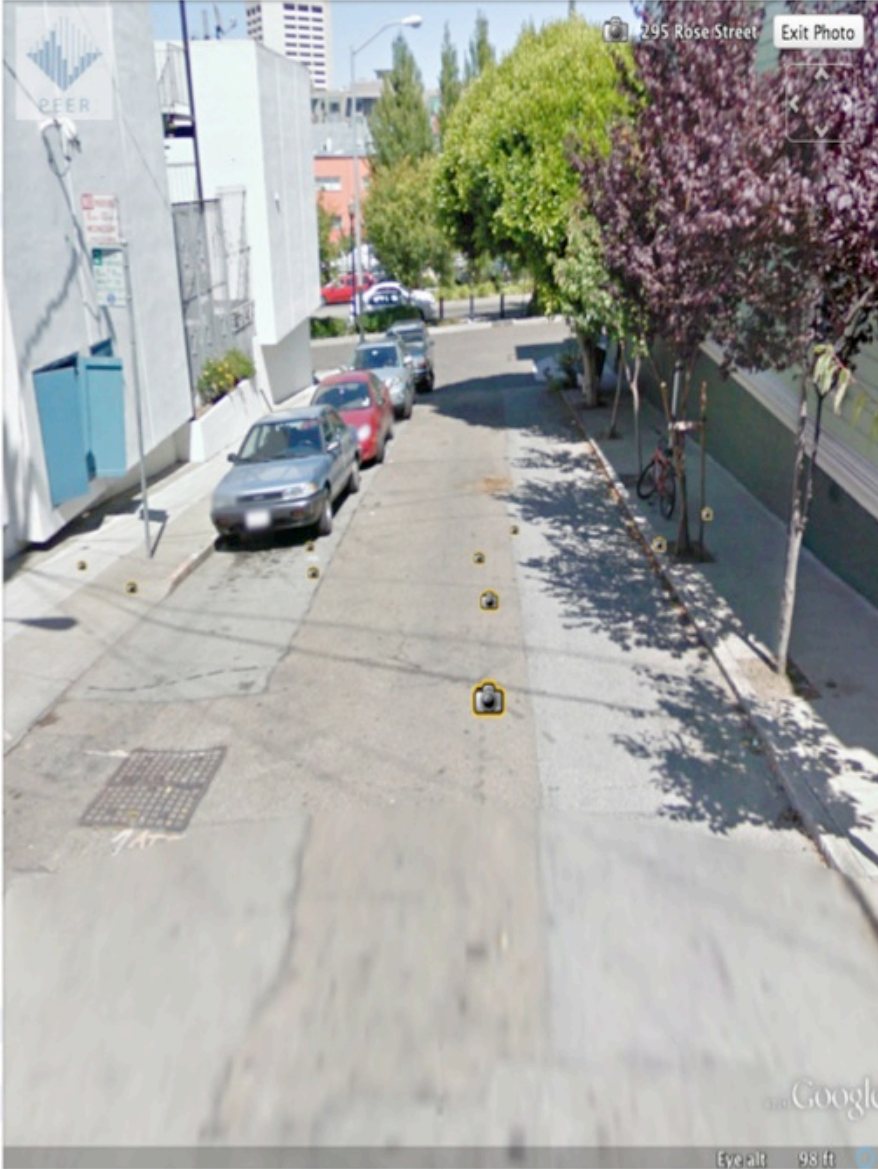
[1](#) [2](#) [3](#) [4](#) [5](#) [6](#) [7](#) [8](#) [9](#) [10](#) [next >](#)

Results page: 1 of 42

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SOIL PROPERTIES
[click here](#)

TAGS:
[earthquake](#)
[chile](#)
[concrete](#)
[subduction](#)
[masonry](#)
[collapsed](#)
[shearing](#)
[cracks](#)
[Moehle](#)



295 Rose Street Exit Photo

Eye alt 98 ft

Offshore Maule 2010 ▾ Any Structure ▾ Any Failure Mechanism ▾ Any Material ▾

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Building 001

35.909°S, 72.733°W
Chile

[Layers](#) ▼

Photos






Fierro-1 Fierro-2 Fierro-3 Fierro-3

Related Structures







YouTube

Earthquake

Offshore Maule 2010 ▼

REPORTS & FILES

Identifier: [Text-S21021](#)
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1 2 3 4 5 6 7 8 9 10 next
 Result page: 1 of 42

STRONG MOTION RECORDS

[click here](#)

SOIL PROPERTIES

[click here](#)

TAGS: **earthquake** **chile** **concrete**
 subduction masonry collapsed shearing cracks Moehle



Instrument MOS-01
[view strong motion records](#)

Interior View

Imagery Date: Sep 11, 2010 37°46'59.20" N 122°44'14.35" W elev: 28 ft Eye alt: 858 ft

Level 1 **2** 3

Offshore Maule 2010 ▼ Any Structure ▼ Any Failure Mechanism ▼ Any Material ▼






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IMG0001






21:53:10, 12 January 2010 (UTC)
18.457°N 72.533°W
Chile






PHOTOS WITHIN A DISTANCE OF: 0.1km [browse](#)

RELATED PHOTOS

REPORTS & FILES

Identifier: [Text-S21021](#)
Title: 90-6 El terremoto de 1985 en Chile : analisis del edificio Hanga-Roa
Creator(s): Huerta, Alvaro; Riddell, Rafael Date: 1990

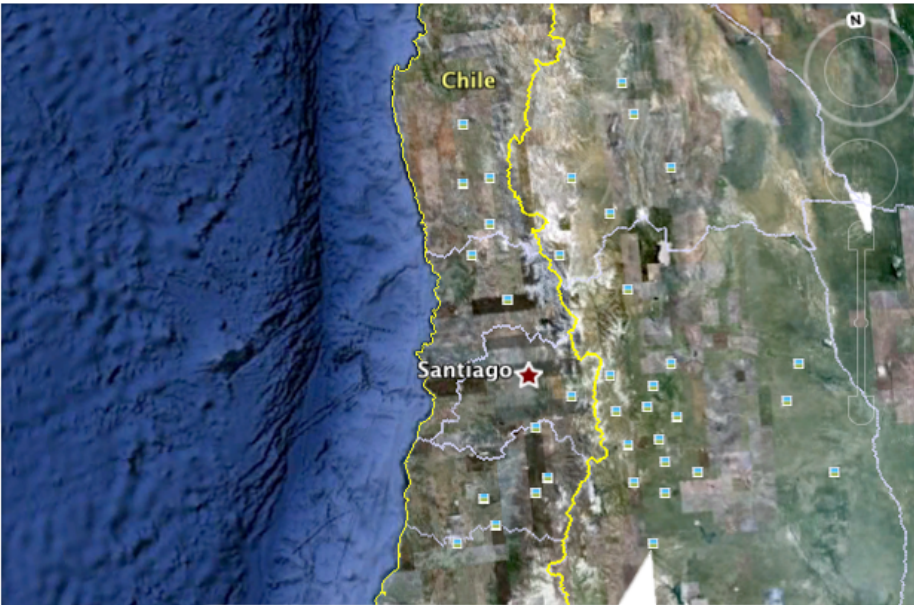
Identifier: [Text-200910163](#)
Title: Lesson learned from March 3, 1985 Chile earthquake and related research
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Digital Copy Available


1 2 3 4 5 6 7 8 9 10 next >
Result name: 1 of 42

STRONG MOTION RECORDS
[click here](#)

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TAGS: **earthquake** chile **concrete**
subduction masonry collapsed shearing cracks Moehle





Description:

[Apartment Building 202](#)

© 2010 map/Geosistemas S.R.L.

33°27'16.32" S 72°16'31.07" W elev -6485 ft Eye alt 499.70 mi

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IMG0001

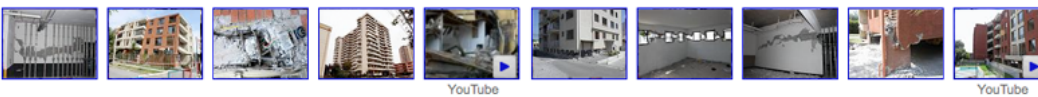
21:53:10, 12 January 2010 (UTC)
18.457°N 72.533°W
Chile

PHOTOS WITHIN A DISTANCE OF: [0.1km](#)

[standard view](#)



RELATED PHOTOS




TAGS: **earthquake** chile **concrete**
subduction **masonry** **collapsed** **shearing**
cracks **Moehle**

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Vision

- **Scenario #1:** Pre-earthquake planning reconnaissance
- **Scenario #2:** Identifying commonalities leading to seismic vulnerability, and develop fragility estimates
- **Scenario #3:** Environment for detailed post-earthquake investigations and archiving of results obtained

User Manual in Preparation



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SEISMIC PERFORMANCE OBSERVATORY
USER'S MANUAL

Draft

Last Modified: 08/20/12

For information and permission to use these training modules, please contact:
 Stephen Mahin – mahin@berkeley.edu - (510) 642-3437
 University of California Berkeley

Headquarters at: University of California, Berkeley, 325 Davis Hall, Berkeley, CA 94720-1792
 Phone: (510) 642-3437 • Fax: (510) 642-1655 • <http://peer.berkeley.edu> • peer_center@berkeley.edu



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Defining Damage

When editing a image:


IF LOCAL VIEW:

- Under "PEER Taxonomy" select either **building** or **bridge**.
- Continue by selecting the material, system, component, and type of damage in the options that follow, as shown in the image below. If the desired option is not found in the current list, add in the appropriate selection.

| | | | |
|----------|------------------------------|------------------------|---------------------------|
| building | reinforced concrete | arch bridge | sub-column joint |
| bridge | steel | reinforced slab bridge | new component |
| new type | wood | beam and slab bridge | shear cracks |
| | masonry (brick and AAC) | box girder bridge | shear failure |
| | steel and concrete composite | integral bridge | compression-shear failure |
| | new material | segmental bridge | new damage |
| | | cable stayed bridge | |
| | | suspension bridge | |
| | | new system | |

IF GLOBAL VIEW:

- Select any present damage under the dropdown menus that appear under **Structural damage** and **Geotechnical damage**, as shown in the images below.



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Structural damage

Geotechnical Damage

Description

no collapse
 partial collapse
 collapse
 soft-story collapse
 overturning
 building settlement
 pounding
 building off foundation
 building or story leaning
 racking damage to walls

Geotechnical Damage

Description

lateral spreading
 liquefaction
 differential settlement

Inputting Earthquake Data

- Click **Earthquakes > New Earthquake**
- Input the required fields marked with an asterisk:
 - Name
 - Range of Time
 - Magnitude of the earthquake
 - Location (insert the coordinate values → click "show on map" → can readjust the location by clicking a different spot and pressing "Use as location")
- Specify the region where the earthquake occurred as well as the Country
- Insert the USGS ID in the specified field
- Provide the database with any alternate names for the earthquake for a more accessible identification system

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Future Plans for SPO

- Continue improving and developing SPO
- Extend it to become “federated” database
- **Continue performing investigations and inputting data into SPO**
- Inform others of SPO’s objectives
- Training programs
- **Encourage the engineering community to contribute**
- Gain the interest of external agencies

Questions? Contact peer_center@berkeley.edu