



Welcome & PEER Overview

Khalid M. Mosalam

PEER Director, Taisei Prof. of Civil Eng., UC-Berkeley

2019 PEER Annual Meeting (PAM)

PAM Steering Committee



**Gregory
Deierlein**



**Grace
Kang**



**Amarnath
Kasalanati**



**Steven
Kramer**



**Sashi
Kunnath**



**Khalid
Mosalam**



**Thomas
Shantz**



**Matthew
Barnard**



**Craig
Davis**



**Jonathan
Stewart**



**Ertugrul
Taciroglu**



**John
Wallace**



**Farzin
Zareian**

PEER Staff Supporting PAM



**Christina
Bodnar-Anderson**



**Erika
Donald**



**Selim
Günay**



**Claire
Johnson**



**Zulema
Lara**



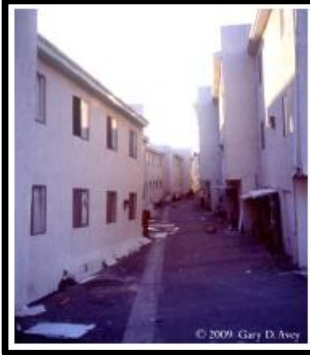
**Gabriel
Vargas**



**Helen Weary,
UCLA**

Jan. 17, 1994 Northridge Earthquake

**More Today
& Tomorrow!**



Fractures in welded steel moment frame beam-to-column connections



Soft & weak story wood-frame collapses

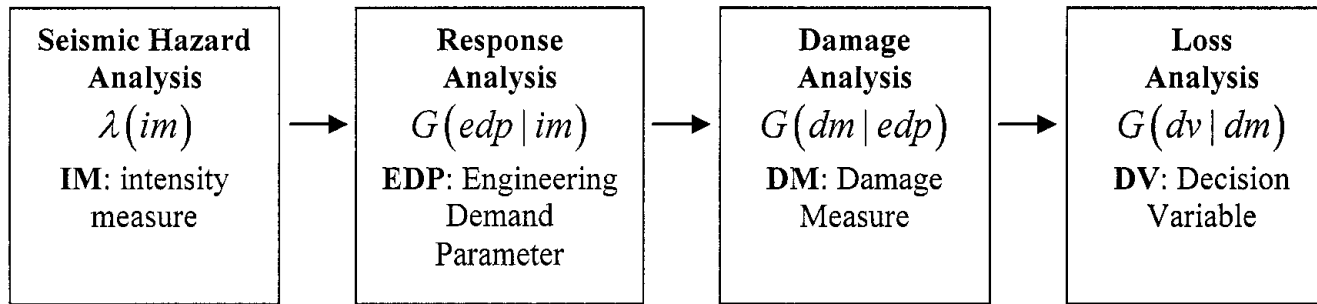


Non-ductile concrete & weak stories

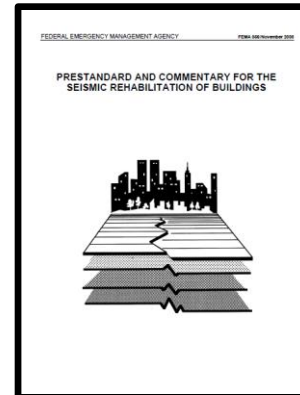
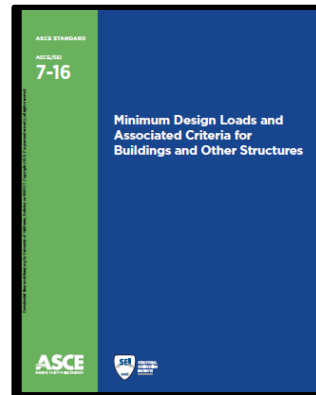
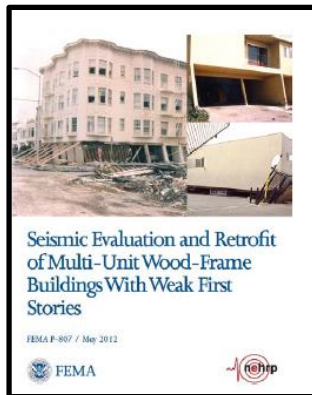
57 lives lost & about \$40B in property damage

1994 Northridge Earthquake Consequences

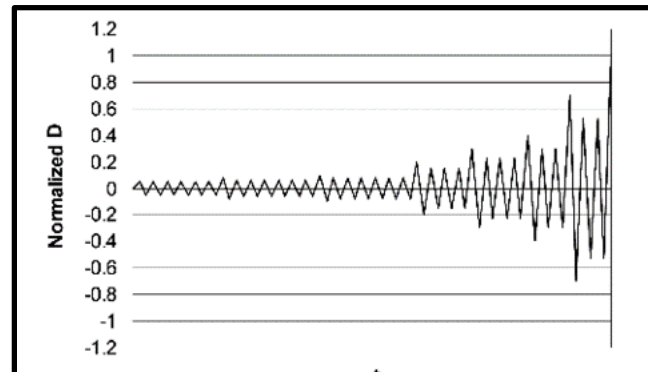
More Today
& Tomorrow!



Initiation of PBEE



Changes to codes & guidelines



New load protocols
& expanded testing
opportunities

Older Concrete Buildings

10/la-seismic-safety-law-of-october-9-2015-peer-research/

Search

☆

News

LA Seismic Safety Law of October 9, 2015 & PEER Research

PEER News Alerts

RSS Industry News Feed

News Archive

Media Requests

Site Map

Search

LA Seismic Safety Law of October 9, 2015 & PEER Research

On October 9, 2015, after receiving unanimous support by the Los Angeles City Council, [Los Angeles Mayor Eric Garcetti](#) signed a law mandating seismic retrofits of vulnerable buildings. The mandatory retrofit law would affect up to 13,500 soft-story wood-frame structures as well as 1,500 older concrete buildings.


Under the new ordinance, building owners will be required to accomplish the following seismic safety measures:

For soft-first story buildings built before 1980, under the new law, building owners will have one year to submit to the City documentation establishing that an acceptable retrofit has already been conducted or that a retrofit is required, and an additional year to acquire necessary permits. Property owners will have seven years total to retrofit their buildings upon receipt of notice. The seven years is inclusive of the two years granted to the property owner to conduct an assessment and obtain permits.

For non-ductile reinforced concrete, building owners will have three years to submit documentation to the City to begin the inspection process, and 10 years to establish whether an acceptable retrofit has already been conducted or that a retrofit is required. Property owners would have 25 years total to complete the retrofit work, inclusive of the first 13.

This mandate follows a [plan released by the Mayor on December 8, 2014](#) to address the city's greatest earthquake vulnerabilities, including timelines for mandatory retrofitting of both soft-story and non-ductile reinforced concrete buildings.

PEER research about the performance of older concrete buildings, started in the late 1990s, and funded by Network for Earthquake Engineering Simulation – National Science Foundation (NEES-NSF) from 2007-2012 provided the basis of information about the seismic performance of these older concrete buildings, which can be severely damaged or collapse due to insufficient design consideration of earthquake effects. This project identified how widespread the collapse hazard is in the existing building stock, and it developed engineering and policy tools to identify and reduce the risk of hazardous buildings.



PEER research
made a difference!

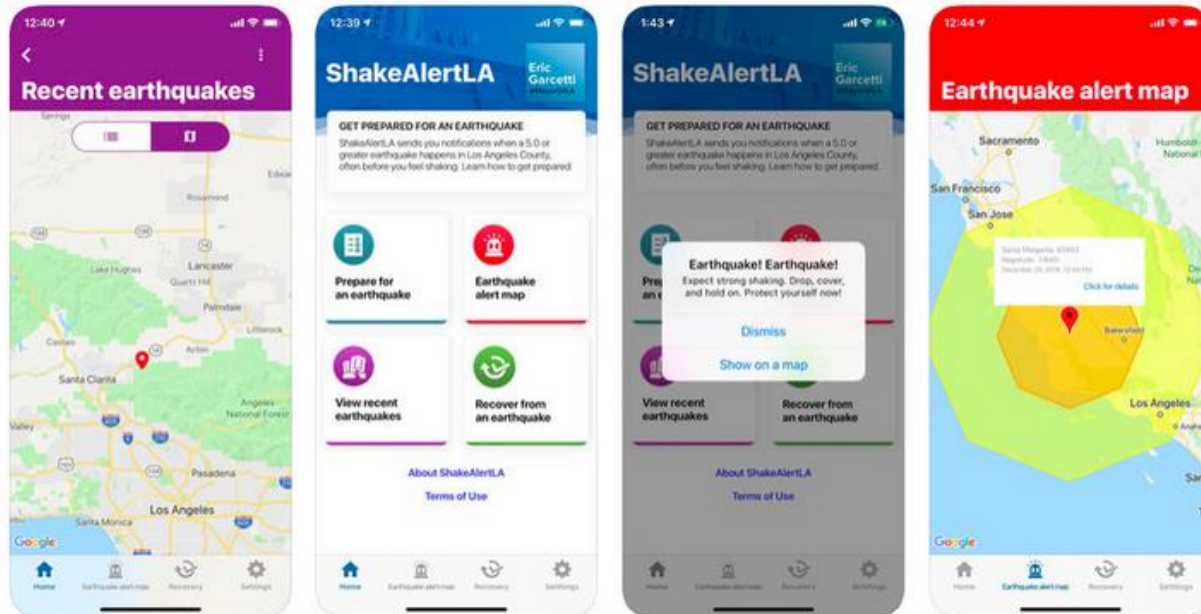
ShakeAlertLA Announced Early January

NEWS EARTHQUAKES

Earthquake early warning app now available for LA

ShakeAlertLA sends a warning to smartphones when shaking is expected anywhere in Los Angeles County

By **Allissa Walker** | [@awalkerinLA](#) | Updated Jan 3, 2019, 12:26pm PST



**More in Plenary 6
Tomorrow!**

Outline

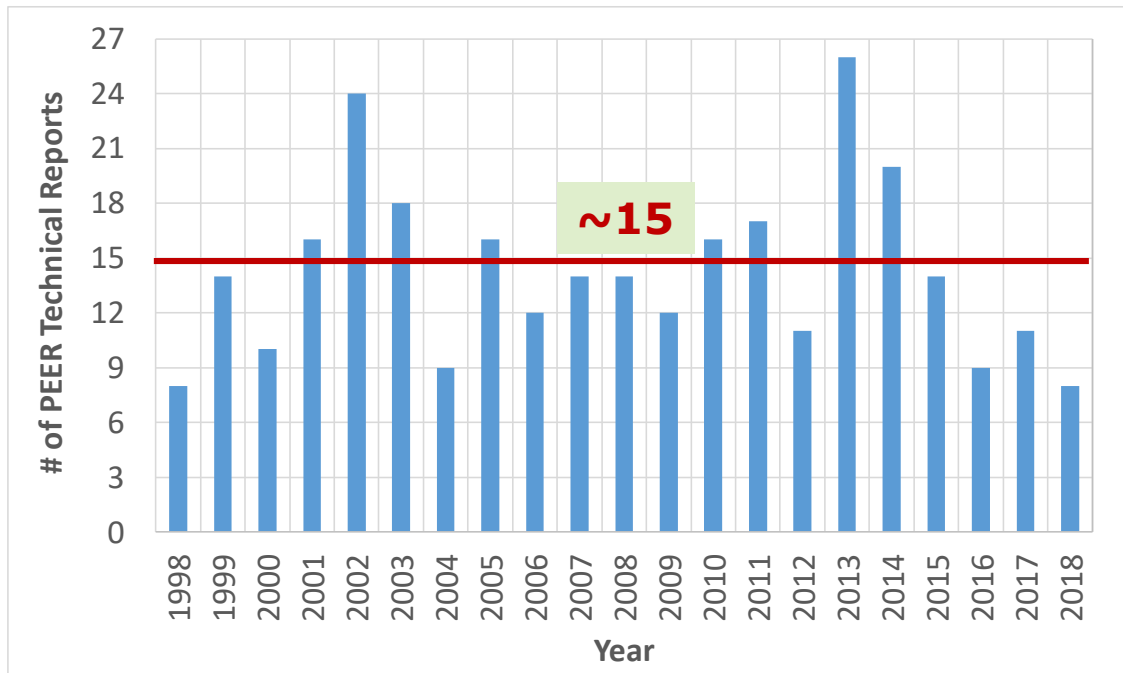
- **PEER status**
- PEER vision, mission & strategic plan
- Highlights of ongoing & future PEER activities

Status (1/3)

- PEER has been the primary earthquake eng. research arm of CA since 1997 & home for earthquake eng. research in Western United States.
- PEER had major impacts on research & professional practice nationally & internationally and continues to provide major contributions by supporting:
 - a) research in Transportation & Lifelines, Tall Buildings and Ground Motions,
 - b) technology development including OpenSEES in analytical simulation, OpenFresco in hybrid simulation & BridgePBEE for PBEE in bridges, and
 - c) disseminating research outcomes, supporting undergraduate interns, training graduate researchers, publishing PEER reports, and operating NISEE* library.

*NISEE: National Information Service for Earthquake Engineering

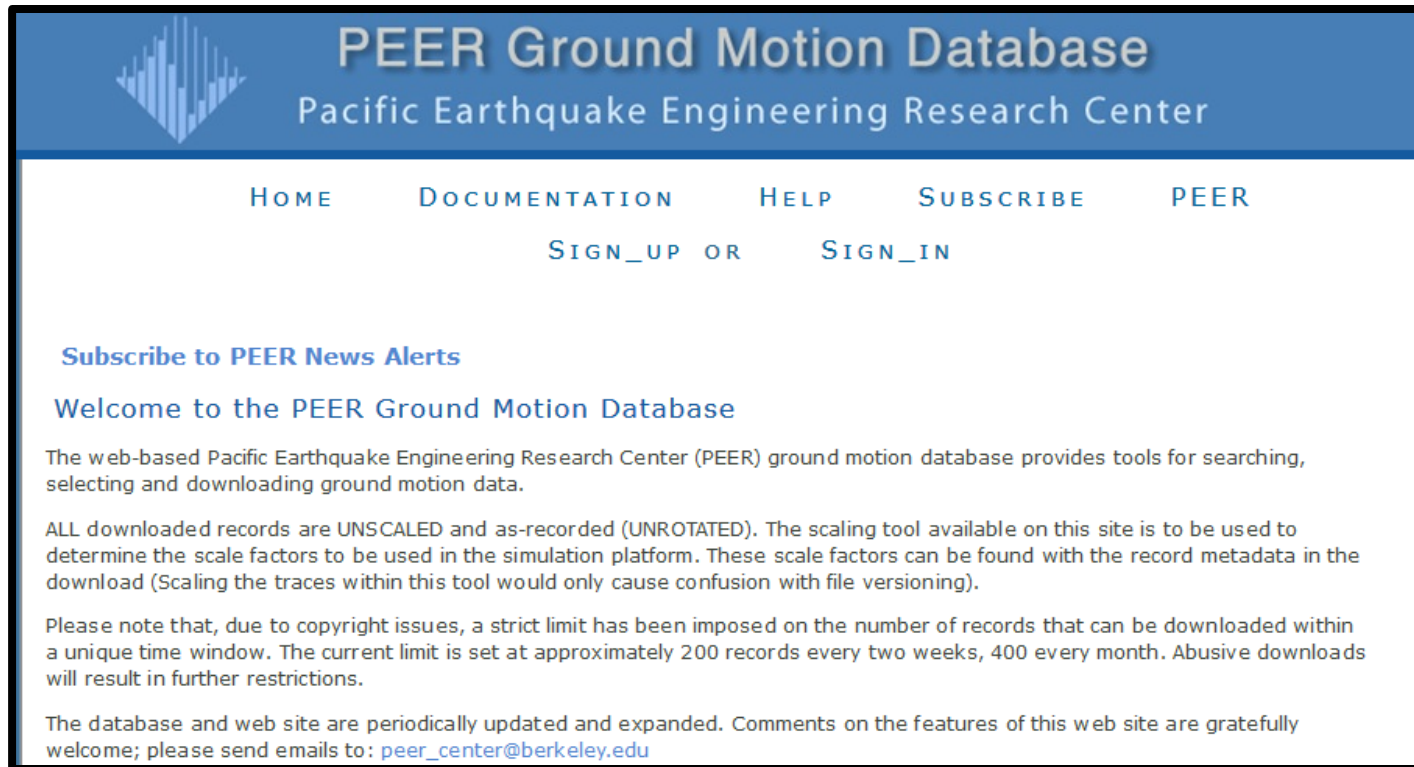
Technical Reports



To date, **299** PEER technical reports published,
http://peer.berkeley.edu/publications/peer_reports.html



Future Reports: Ground Motion Prediction & NGA Databases



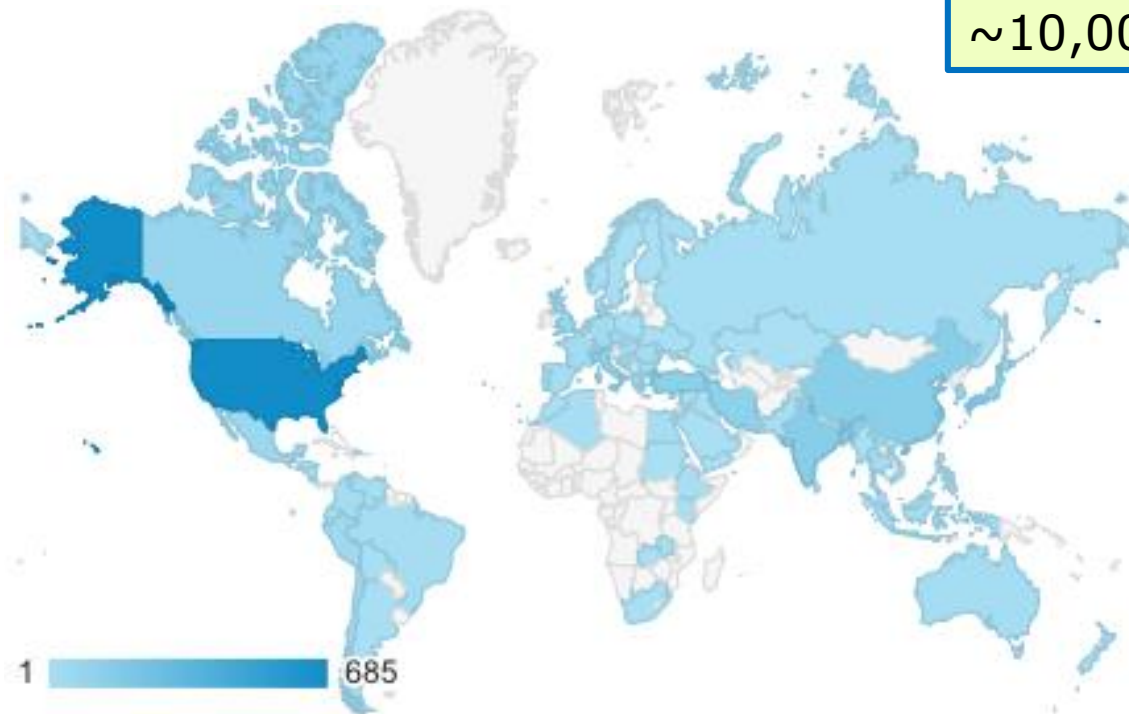
The screenshot shows the homepage of the PEER Ground Motion Database. At the top, there is a blue header with the PEER logo (a stylized diamond shape made of vertical bars) on the left and the text "PEER Ground Motion Database" and "Pacific Earthquake Engineering Research Center" on the right. Below the header is a navigation bar with links: HOME, DOCUMENTATION, HELP, SUBSCRIBE, and PEER. Underneath these links are the options SIGN_UP OR SIGN_IN. The main content area has a section titled "Subscribe to PEER News Alerts" followed by a "Welcome to the PEER Ground Motion Database" message. The welcome message states: "The web-based Pacific Earthquake Engineering Research Center (PEER) ground motion database provides tools for searching, selecting and downloading ground motion data." It then explains that all downloaded records are UNSCALED and as-recorded (UNROTATED), and that a scaling tool is available to determine scale factors. A note mentions a download limit of 200 records every two weeks or 400 every month. At the bottom, it says the database is updated periodically and provides the email peer_center@berkeley.edu for comments.

NGA-East: Final report approved and to appear as a PEER report (end of Jan. 2019).

NGA-Subduction: A PEER report with one ground motion model published **mid-2018**. Four new models are being finalized and a PEER report to be published **March 2019**.

NISEE-PEER Library Users [Oct. 1 – Dec. 31, 2018]

~10,000 members



(From Google Analytics)

NISEE-PEER Library – Extensive collection of hard copy & digital texts, images & software specializing in earthquake structural eng., geotechnical eng., engineering dynamics, engineering seismology, earthquake public policy & natural hazard risks.

<https://nisee.berkeley.edu/elibrary/>

Highlights of 2018 Events (1/3)

HayWired workshop – Jan. 2018

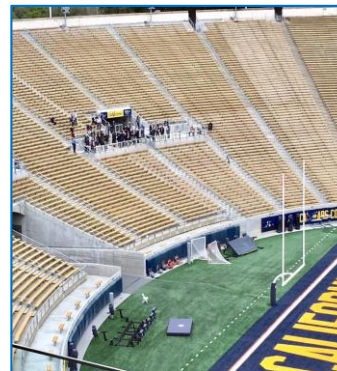
<https://peer.berkeley.edu/news/peer-usgs-workshop-haywired-and-building-codes>



HayWired scenario press conference – April 2018

<https://peer.berkeley.edu/news/haywired-scenario-rollout-april-18-2018>

PEER is a partner in the HayWired Coalition (HayWired scenario creates a platform where research can dig deeper into developing solutions to **shorten the region's recovery time.**)



Highlights of 2018 Events (2/3)

Cal Day, UC Berkeley lab, April 2018



PEER participation at 11NCEE, June 2018

<https://peer.berkeley.edu/news/peer-participation-11ncee>



PEER researchers workshop, Aug. 2018

<https://peer.berkeley.edu/news/peer-researchers'-workshop-summary>

Highlights of 2018 Events (3/3)



MTS LAB EXPERT SEMINAR SERIES:

Hybrid Simulation Technologies & Methods for Civil Engineering



MTS Systems and the Pacific Earthquake Engineering Research (PEER) Center cordially invite you to attend a comprehensive, two-day exploration of hybrid simulation technologies and methods for civil engineering applications.

Guided by thought leaders from PEER and MTS Systems, seminar attendees will gain an understanding of the tools, techniques and best practices required for pursuing safe, meaningful and productive Quasi-static and Real-time hybrid simulation investigations; the seminar agenda comprises a compelling mix of:

- » In-depth Tutorials
- » Real-world Case Studies
- » Virtual Explorations
- » Live Quasi-static and Real-time Demonstrations



REGISTER ONLINE TODAY

Register by March 9 to secure your place at this informative seminar and gain the insight needed to develop and refine your organization's Quasi-static and Real-time hybrid simulation capabilities. Learn more and register online at <http://www.mts.com/events/berkeley/>

REGISTER

LOCATION:

Pacific Earthquake Engineering Research Center - Richmond Field Station
University of California, Berkeley
1301 South 46th Street
Richmond, California 94804-4698

DATE:

March 20-21, 2018

TIME:

8:00 - 17:00 (lunch provided)

MTS PRESENTERS:

Dr. Shawn Gao
Dr. Shawn Yu

BERKELEY PRESENTERS:

Dr. Selim Gunay
Dr. Amarnath Kasalanati
Dr. Alex Mead
Prof. Khalid Mosalam
Dr. Martin Neuenchwander
Dr. Andreas Schellenberg
Yingjie Wu

MTS CIVIL ENGINEERING TESTING SOLUTIONS
be certain.

March 2018 – MTS/PEER
Hybrid Simulation Workshop

Hybrid Simulation Workshop Hosted by PEER and MTS

PEER, in collaboration with MTS's Lab Expert Seminar Series, held a two day workshop on March 20-21, 2018, focusing on a comprehensive exploration of hybrid simulation technologies and methods. The event was held at the UC Berkeley Richmond Field Station and had a great turnout with active participation of 45 attendees.



Hybrid Simulation Testing Demonstration at PEER-UC Berkeley Lab Shaking Table

The first day of the workshop focused on quasi-static (slow) hybrid simulation. The morning session was devoted to lectures that described an overview of the methodology and fundamentals. Professor Khalid Mosalam, PEER Director and Professor at UC



<http://apps.peer.berkeley.edu/events/mts2018/>

Status (2/3)

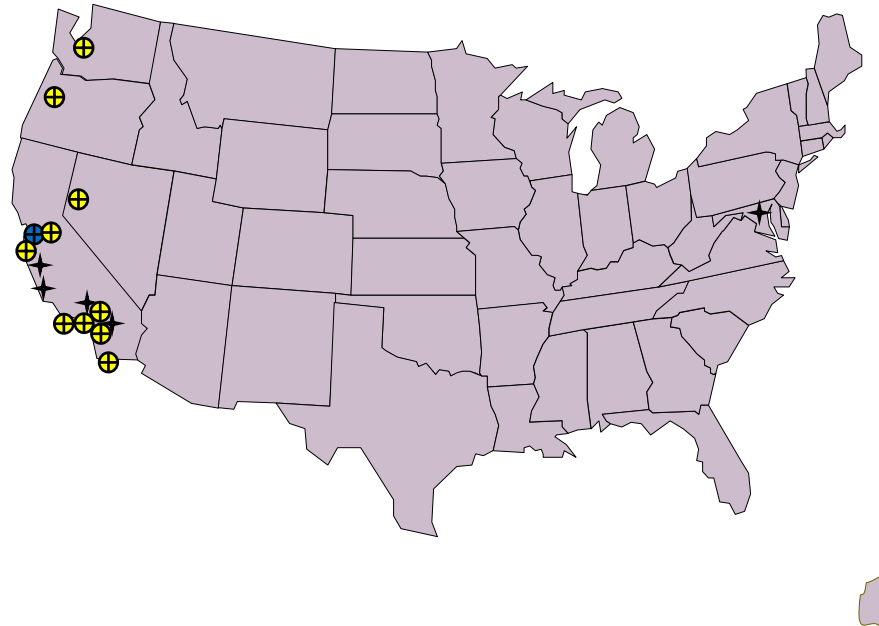
- Today, PEER comprises **11** core institutions & **6** educational affiliates with over **200** researchers to participate in or contribute to PEER research activities.
- These researchers have expertise in geo-hazards, building & bridge systems, network systems, experimental & analytical techniques, and new technologies.
- With access to this expertise, excellent research facilities at core institutions, and culture of developing powerful & robust methodologies, simulation tools & databases, PEER is poised to achieve **Resilient Design for Extreme Events**.

PEER: University, Government, Professional & Industry Alliance

6 Educational Affiliates



PEER: **The Pacific Earthquake Engineering** Research Center is a multi-institutional research & education center with headquarters at the **University of California, Berkeley**.



11 Core Institutions



PEER combines resources of major research universities in Western US where earthquake hazards are largest. PEER is able to represent consensus of many experts. PEER Mission focuses on **Integrated Performance-based Engineering (PBE) Methodology** towards **Resilient Design for Extreme Events**.

Why “Resilience”?






National Benefit-Cost Ratio Per Peril <small>*BCR numbers in this study have been rounded</small>		Federally Funded	Beyond Code Requirements
Overall Hazard Benefit-Cost Ratio		6:1	4:1
 Riverine Flood		7:1	5:1
 Hurricane Surge		Too few grants	7:1
 Wind		5:1	5:1
 Earthquake		3:1	4:1
 Wildland-Urban Interface Fire		3:1	4:1

Table 1. Benefit-Cost Ratio by Hazard and Mitigation Measure.

Two mitigation strategies:

Federal grants: The impacts of 23 years of federal mitigation grants provided by FEMA, the Economic Development Administration (EDA), and Department of Housing and Urban Development (HUD), resulting in a national benefit of \$6 for every \$1 invested.

Beyond code requirements: The costs and benefits of designing all new construction to exceed select provisions in the 2015 *International Building Code* (IBC) and the 2015 *International Residential Code* (IRC) and the implementation of the 2015 *International Wildland-Urban Interface Code* (IWUIC). This resulted in a national benefit of \$4 for every \$1 invested.

Modern mitigated homes withstood Hurricane Irma, Good **mitigation** learns from mistakes to build **more-resilient communities**.

Mitigation pays back at a benefit-cost ratio of over **5:1**; for every \$1 spent, more than \$5 are saved, not including measures of human suffering (**World Bank, 2008**).



National Institute of
BUILDING SCIENCES

Natural Hazard Mitigation Saves: 2017 Interim Report



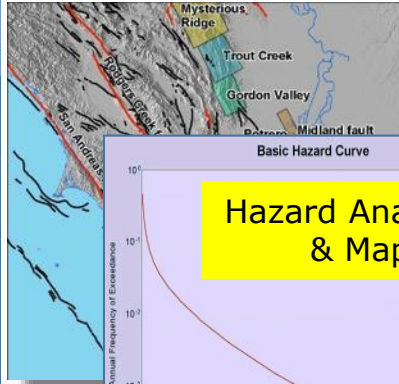
An Authoritative Source of Innovative Solutions for the Built Environment

Status (3/3)

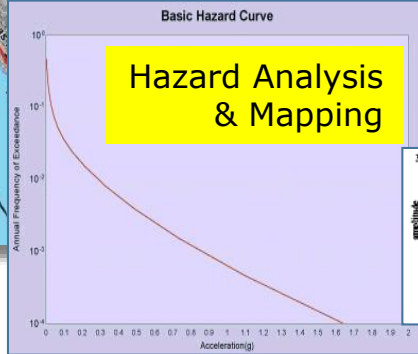
- In past decade, there has been rapid growth in available data, affordable sensors, High-Performance Computing (HPC) & **Artificial Intelligence (AI)** tools.
- These tools are now popular in domains such as **Structural Health Monitoring (SHM)**, city-scale simulations & physics-based ground motion modeling.
- PEER recognizes the far-reaching potential of these tools if incorporated into **research & practice of earthquake engineering and other extreme events building on past & on-going research in PBEE.**

PEER DNA: Integrated PBEE Methodology

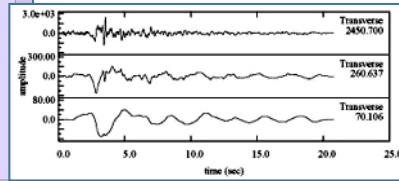
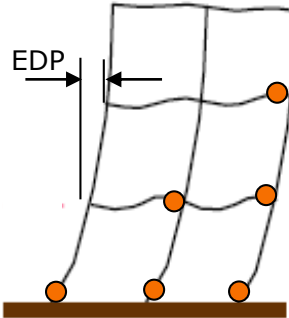
Engineering Seismology



Hazard Analysis & Mapping



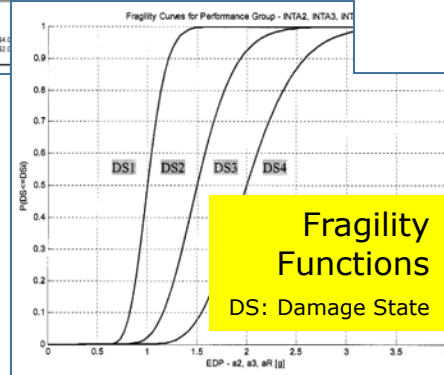
HPC simulation



Ground motion selection & scaling

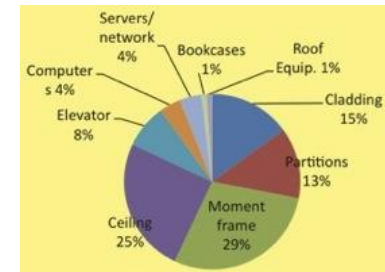
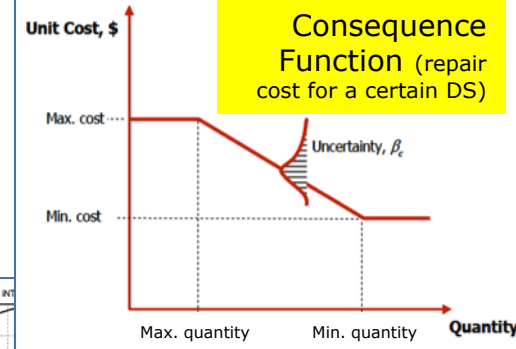
Performance Databases

BASIC COMPOSITION	DAMAGES STATES		
No. of square feet of flexurally controlled R/C concrete shear walls in each direction	DS1	DS2	DS3
DESCRIPTION	Flexural cracks < 1/16" Shear (diagonal) cracks < 1/16" No significant spalling No fracture or buckling of steel structurally significant	Flexural cracks < 1/8" Shear (diagonal) cracks < 1/8" Moderate spalling/ loose cover No fracture or buckling of steel Significant residual drift/shortening	Max. crack widths > 1/8" Significant spalling/ loose cover Fracture or buckling of steel Significant residual drift/shortening Heavier in place impact
ILLUSTRATION (example photo or drawing)			
MEDIAN EDP (INTERPOLATED)	1.0%	3.0%	5.0%
BETA	0.2	0.3	0.4
CORRELATION (rho)		10%	
REPAIR MEASURES	Patch cracks each side with caulk Paint each side	Remove loose concrete Patch spalls with 100 g/pcf Patch cracks each side with caulk Paint each side	Shore (Demo existing wall Replace Patch and paint
CONSEQUENCE FUNCTION Cost and health of wall for repair			
Max. cost up to lower quantity Min. cost over upper quantity Beta (cost)			



Fragility Functions

DS: Damage State



Loss Assessment

Seismic Hazard Analysis

$\lambda(im)$

IM: intensity measure

Response Analysis

$G(edp | im)$

EDP: Engineering Demand Parameter

Damage Analysis

$G(dm | edp)$

DM: Damage Measure

Loss Analysis

$G(dv | dm)$

DV: Decision Variable

Probabilistic Assessment of:

- ✓ Cost of repair & Downtime
- ✓ Lifecycle costs
- ✓ Casualties
- ✓ Embodied energy

$$\lambda(DV > dv) = \int \int \int G(dv | dm) dG(dm | edp) dG(edp | im) d\lambda(im)$$

Enabling Technology Development

Analytical Simulation



Open System for Earthquake Engineering Simulation, <http://opensees.berkeley.edu/>

Hybrid Simulation (HS)



Open-source Framework for Experimental Setup and Control, <http://openfresco.berkeley.edu/>

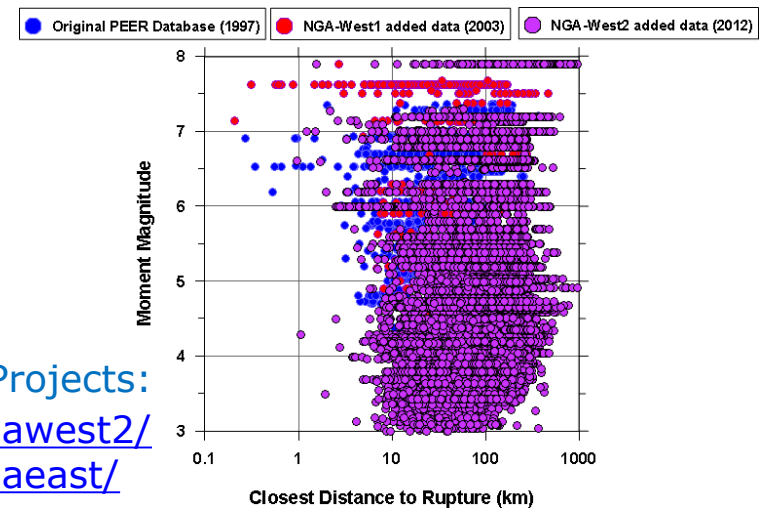
Databases



Next Generation Attenuation (NGA) Projects:

<http://peer.berkeley.edu/ngawest2/>

<http://peer.berkeley.edu/ngaeast/>



OpenSEES & NGA Analytics for 2018

OpenSEES



Visitors

130,496

% of Total: 100.00% (130,496)



Visits

403,316

% of Total: 100.00% (403,316)



Pageviews

2,188,456

% of Total: 100.00% (2,188,456)



Visitors

39,519

% of Total: 100.00% (39,519)



Visits

92,355

% of Total: 100.00% (92,355)



Pageviews

178,057

% of Total: 100.00% (178,057)



NGA

Mega-Projects

TBI

Tall Buildings Initiative

Guidelines for Performance-Based Seismic Design of Tall Buildings

Version 2.03
May 2017

Developed by
Pacific Earthquake Engineering Center
Report No. 2017/05

Sponsored by
Charles Pankow Foundation
ACI Foundation (Concrete Research Council)
American Institute of Steel Construction
Federal Emergency Management Agency
Structural Engineering Institute of ASCE (SEI)
Structural Engineers Association of California

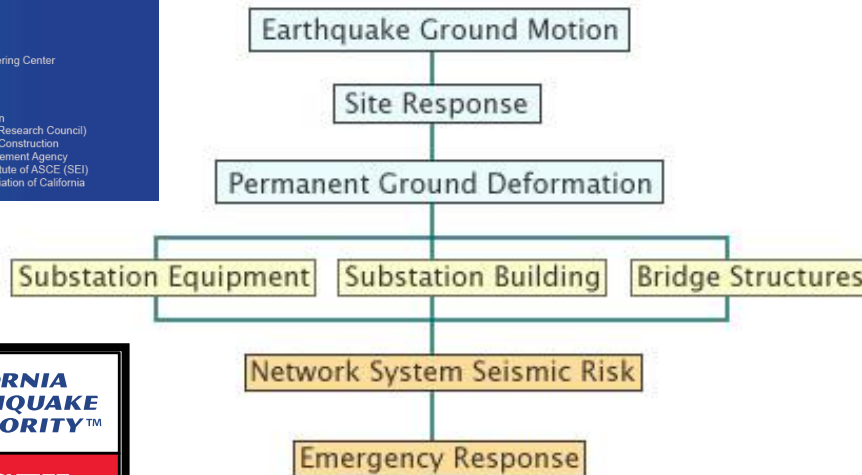


Transportation Systems Research Program

Pacific Earthquake Engineering Research Center



Lifelines Program



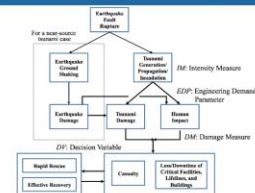
Tsunami Research Program

Pacific Earthquake Engineering Research Center



PROGRAM GOALS

- Develop an effective methodology for damage analyses for critical structures, lifelines, and important public facilities
- Reduce loss of life, delays in emergency response, and long-term economic impacts
- Augment existing tsunami research efforts
- Employ Performance-Based Tsunami Engineering (PBTE) to expand and extend the existing Performance-Based Earthquake Engineering (PBEE) Methodology DEVELOP practical guidelines for researchers and practitioners



Probabilistic Tsunami Hazard Analysis
Example: 475 Year Return Period

PROGRAM TASKS

- **SCENARIO-BASED ANALYSIS** - develop a tool for scenario-based hazard analysis
- **TSUNAMI HAZARDS** - carry out analysis for physical and simulation-driven tsunami uncertainties
- **TSUNAMI IMPACTS** - develop tools to evaluate Damage Measure for critical coastal structures and lifelines
- **RECOVERY EFFORTS** - develop an effective tool used for immediate damage assessment and optimal recovery tactics for critical coastal facilities and infrastructures
- **DESIGN GUIDELINES** - develop guidelines for new bridges subjected to tsunami loads

SPONSORS

Funding for the Tsunami Research Program is provided by:

- Peer through the Lifelines Program & Transportation System Research Program (TSRP)
- Federal Highway Administration & 5 western states: California, Oregon, Washington, Alaska, and Hawaii

For more information and details visit: <http://peer.berkeley.edu/tsunami>
PEER Center • 325 Davis Hall, University of California Berkeley, CA 94720-1792 • (510) 642-3437 • peer_center@berkeley.edu

CEA CALIFORNIA EARTHQUAKE AUTHORITY™

THE STRENGTH TO REBUILD®

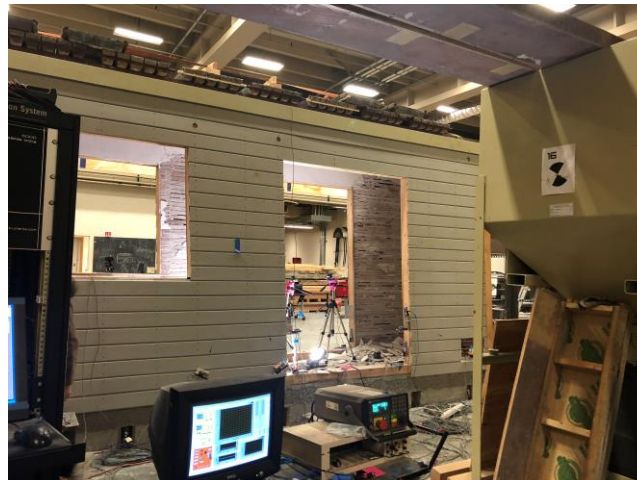
CEA Project

Quantifying Performance of Retrofitted & Unretrofitted Cripple Walls & Sill Anchorage in Single Family Wood-frame Buildings

Objective: Develop “fragility” (damage) function modification factors for use by loss modelers in evaluating raised-foundation homes that have a cripple-wall & sill-anchorage retrofit

Technical progress as planned in the contract with end date of **March 2020**.

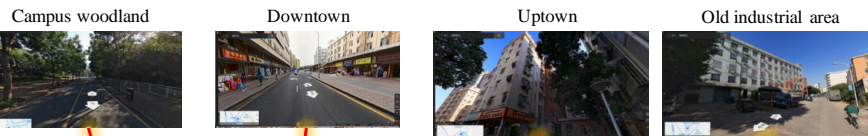
Testing on 1/11/2019!



**More in
concurrent
Discussion C6
Tomorrow!**

New Project: PEER-TBSI Research Towards Resilient Shenzhen, China

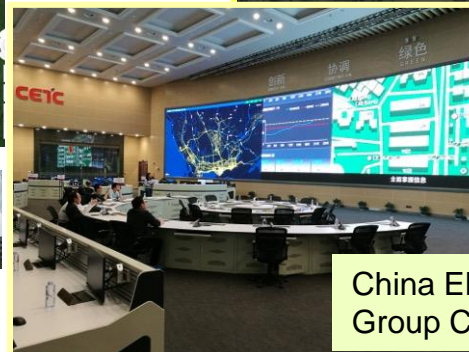
- About **20,000,000 RMB (~\$3M)** funds from Shenzhen Innovation Commission approved **Jan. 2019**
- A multidisciplinary team from UC-Berkeley, MIT, CMU, Tsinghua hosted by TBSI* in Shenzhen
- Team expertise includes Structure Eng., Machine Learning, Sensor Networks & Computer Simulation
- Team will develop the **digital twin of urban system** for physics-based simulation & machine learning techniques to create **city's resiliency against hazardous conditions**.
- A 4 km² testbed in Shenzhen will be outfitted with sensors to validate developed algorithms and tools.
- As a concerted effort with PEER, **TBSI welcome visitors to Shenzhen to collaborate.**



4 km² testbed in Shenzhen



***TBSI: Tsinghua-Berkeley Shenzhen Institute new fully instrumented campus**



China Electronics Technology Group Corporation (CETC)

PEER Website Gets a Makeover (Open Berkeley Drupal Platform)

- Critical solutions to security, accessibility & maintenance
- Continuous improvement & new features automatically rolled out to all sites

The screenshot shows the PEER website homepage with a dark blue header containing university affiliations (UC Berkeley, CALTECH, OSU, Stanford, UC Davis, UCI, UCLA, UCSD, UNR, USC, UW) and a search bar. The main navigation bar includes links for Home, News and Events, Research, Publications & Products, Laboratories, Library, and About. A large banner for the 'PEER 2019 Annual Meeting: January 17-18, 2019, UCLA - Registration Open!' is featured. Below this, a large image of the Golden Gate Bridge is shown with a 'Transportation Systems' caption. To the right, a 'Recent News' section lists updates from December 2018, including project awards and research highlights. An 'Upcoming Events' section lists the 2019 annual meeting and application deadlines. A 'PEER Research' section describes the center's focus on earthquake engineering methodology. At the bottom, there is a 'Subscribe to PEER News Alerts' button.

PEER products & most visited sites:

This collage displays various PEER products and resources. It includes the OpenSees logo, a map of the United States showing seismic hazard zones, and social media icons for Twitter, Facebook, and YouTube. Key products and resources shown are: 'Equipment for Essential Facilities' (a photograph of industrial equipment), 'Ground Motion Databases' (a word cloud), 'Seismic Performance Observatory' (a blue banner with the center's logo), 'Service to Industry' (a photograph of a building), 'Database and Application Resources' (a photograph of a library), 'PEER Reports' (a cover of the 'PEER 2016 Annual Report'), and 'NISEE-PEER Library' (a photograph of a library building). A section titled 'Core Institutions' lists various academic partners including Berkeley, UC Davis, USC, Caltech, UC Irvine, University of Nevada, Oregon State University, UCLA, UC San Diego, Stanford University, and the University of Washington. The PEER logo is also present in the bottom right corner.

New PEER Website went live on July 23, 2018

PEER Analytics for 2018

Visitors

79,725

% of Total: 100.00% (79,725)



Visits

149,225

% of Total: 100.00% (149,225)



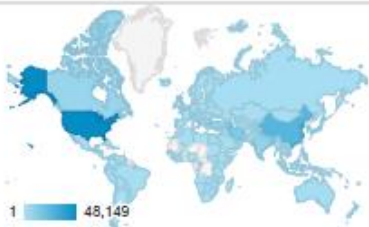
Pageviews

429,635

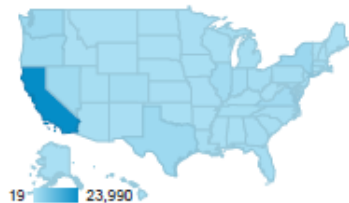
% of Total: 100.00% (429,635)



Visits



Visits



Visits

● Sessions

1,500

1,000

500

March 2018

May 2018

July 2018

September 2018

November 2018

March: MTS/PEER Hybrid Simulation Workshop

April: HayWired Scenario Press Conference

Aug.: PEER researchers workshop & Φ -Net Challenge

Sept.: TSRP RFP release

Outline

- PEER status
- **PEER vision, mission & strategic plan**
- Highlights of ongoing & future PEER activities

Vision

PEER's vision is to be the leader in **Resilient Design for Extreme Events** affecting the built environment. PEER will lead the research and development of new modeling, analysis, assessment, and design frameworks, technologies and tools to enhance the **resilience of communities** exposed to natural hazards.

Mission

PEER's mission is to:

1. develop, validate, and disseminate **performance-based engineering technologies** for buildings, critical civil structures, and infrastructure networks subjected to earthquakes and other natural hazards, with the goal of achieving community resilience; and
2. equip the earthquake engineering and other extreme event communities with **tools, technologies and the future workforce**, through collaboration between PEER institutions and industry partners.

Strategic Goals

1. Bring PEER institutions closer, with **focus on multi-institution research work and interaction**;
2. Continue **innovative research in earthquake engineering** and expand to other extreme events;
3. Develop **new AI tools for extreme events**, in combination with physics-based analysis tools;
4. Expand **outreach activities** and increase the advocacy role in shaping public policy; and
5. Identify and **pursue new, large and sustained funding sources** to achieve these goals.

Committee Structure in 2019

1. Institutional Board (IB): provides policy level guidance and oversight to the PEER Director and Associate Director.
2. Research Committee (RC): sets the research agenda based on PEER's vision and work with stakeholders and industry partners to identify the needs of the community and integrate them into the research plan.
3. Industry Advisory Board (IAB): identifies present and future needs of the profession and the engineering community.
4. Resource Identification Committee (RIC): pursues existing opportunities and actively seeks out new sources of funding to help realize PEER's vision.

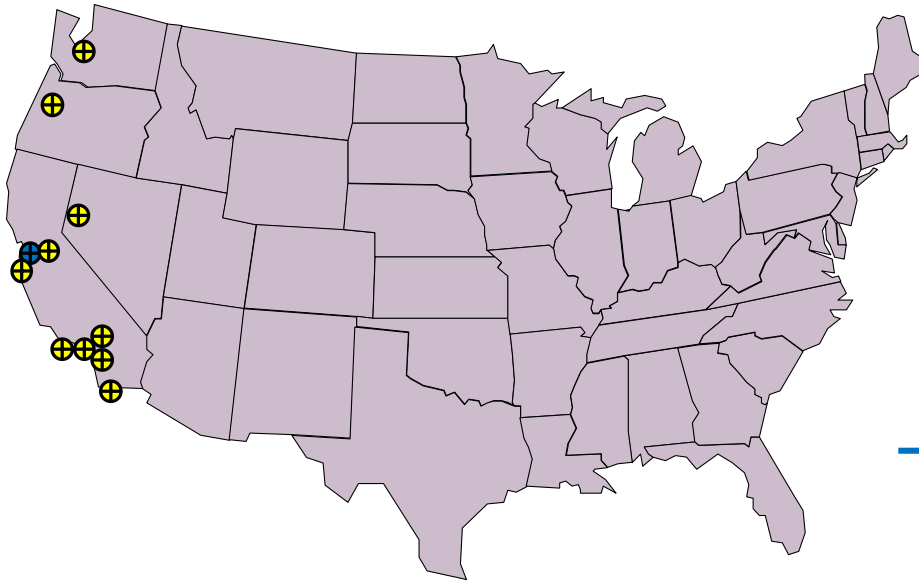
PEER: University, Government, Professional & Industry Alliance

Government/Industry Advisory Board Members



WALTER P MOORE

Business & Industry Partnership (BIP) Members



PEER Labs: Service to Industry

- ❑ Tesla
- ❑ ABB
- ❑ Caterpillar
- ❑ US Gypsum
- ❑ Autostore
- ❑ Multi-Stack
- ❑ HuntAir
- ❑ Engineered Air
- ❑ MindCore
- ❑ Southern States
- ❑ VMC Group
- ❑ Structural Integrity
- ❑ Soft Story Brace Co.
- ❑ EQX Global
- ❑ MuraFlex



PEER Labs: Research & Outreach

Research

- ❑ Resilient Bridge Column Tests – Shaking Table & Hybrid Simulation
- ❑ Non-structural Systems Anchorage Tests
- ❑ Hybrid Shaking Table Tests
- ❑ Steel Column Tension Tests

Outreach

- ❑ Kennedy High School – Richmond, CA
- ❑ Pre-College Trio – Berkeley, CA
- ❑ Gyeonggibuk Science High School, Korea



Outline

- PEER status
- PEER vision, mission & strategic plan
- **Highlights of ongoing & future PEER activities**

New Projects (1/2)

- PEER supports research to **lessen impacts of earthquakes on the transportation systems**, including highways & bridges, port facilities, high-speed rail & airports.
- Every **Sept. 12**, PEER issues request for proposals aligned with current **TSRP** research priorities & vision.
- 2018 RFP: **47** proposals received, covering **18 of 19** topics in Geotechnical Eng. (G), PBEE of Bridge & Other Transportation Systems (S), PBEE Methodology (M), PBEE Tools (T), and Different Areas of Application (A).
- Each proposal received **three** independent reviews. Based on priorities of the TSRP vision & evaluation criteria, **11** new projects are approved (~\$800,000).
- This is in addition to currently active **23** projects & **8** completed ones in 2018.

**More in Concurrent
Discussions Tomorrow!**

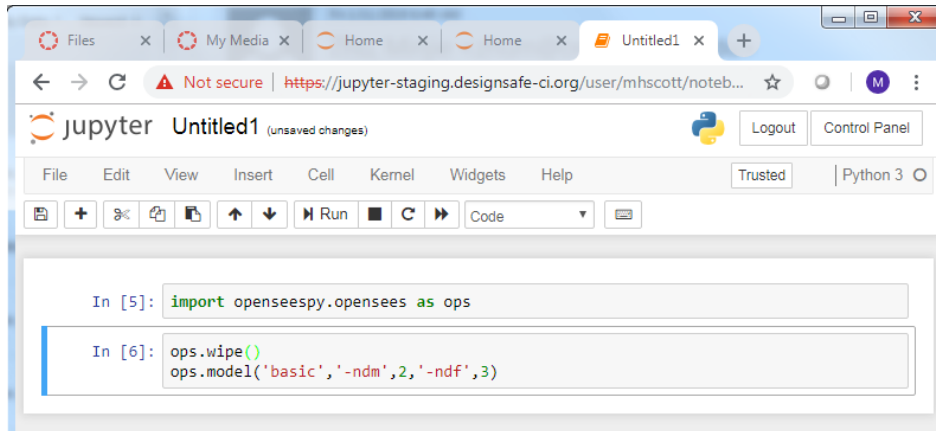
New Projects (2/2)

1. G1: **Analysis of fine-grained soil failure in Chiba during 2011 Tohoku Earthquake, and development of community lab test database**; PI: Scott Brandenburg, [UCLA](#); Co-PI: Jonathan Stewart, [UCLA](#)
2. G3: **DEM modeling of the influence of depositional fabric on the mechanical properties of granular sediments using XRT data**; PI: Nicholas Sitar, [UC Berkeley](#)
3. S1: **Establishing bridge column capacity limit states through modeling and simulation**; PI: Sashi Kunnath, [UC Davis](#)
4. S1&T2: **Bridge functionality instead of component damage as PBEE metric**; PI: Michael Scott, [OSU](#); Co-PI: Kevin Mackie, University of Central Florida
5. S3: **New seismically resilient system for HSR, ports and vehicular transportation systems: Reducing downtime, construction cost and post-earthquake repair**; PI: Dawn Lehman, [UW](#); Co-PI: Charles Roeder, [UW](#)
6. M1: **Non-ergodic ground-motion model for California**; PI: Norm Abrahamson, [UC Berkeley](#)
7. M2: **Validation and utilization of physics-based simulated ground motions for bridge performance assessment**; PI: Farzin Zareian, [UCI](#); Co-PI: Mayssa Dabaghi, American University of Beirut; Consultant: Sanaz Razeian, USGS
8. M3: **Inclusion of modeling uncertainty, parameter uncertainty and parameter estimation uncertainty in PBSD of ordinary standard RC bridges**; PI: Joel Conte, [UCSD](#)
9. T4: **City-scale multi-infrastructure network resilience simulation tool**; PI: Kenichi Soga, [UC Berkeley](#); Co-PIs: Joan Walker, [UC Berkeley](#), Alexandre Bayen, [UC Berkeley](#) & Jack Baker, [Stanford](#)
10. A1: **Tsunami-borne debris loading on bridges**; PI: Ian Buckle, [UNR](#); Co-PIs: Denis Istrati, [UNR](#) & Michael Scott, [OSU](#)
11. A2: **Seismic evaluation of the California high speed rail system**; PI: John Stanton, [UW](#); Co-PI: Marc Eberhard, [UW](#)

New in OpenSEES

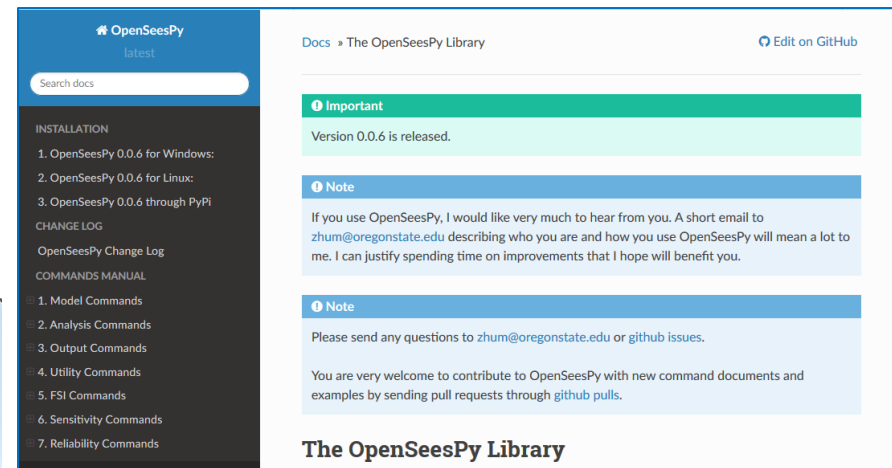
OpenSeesPy =  OpenSees +  pythonTM

- Python3 module available for OpenSEES
- All commands from Tcl have Python equivalents
- Leverage other Python tools to build applications around OpenSEES
- Available soon in Jupyter Notebooks on JupyterHub at DesignSafe

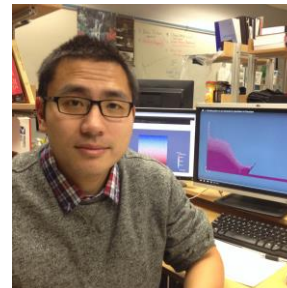


<https://openseespydoc.readthedocs.io>

Developed by Dr. Minjie Zhu, Oregon State University

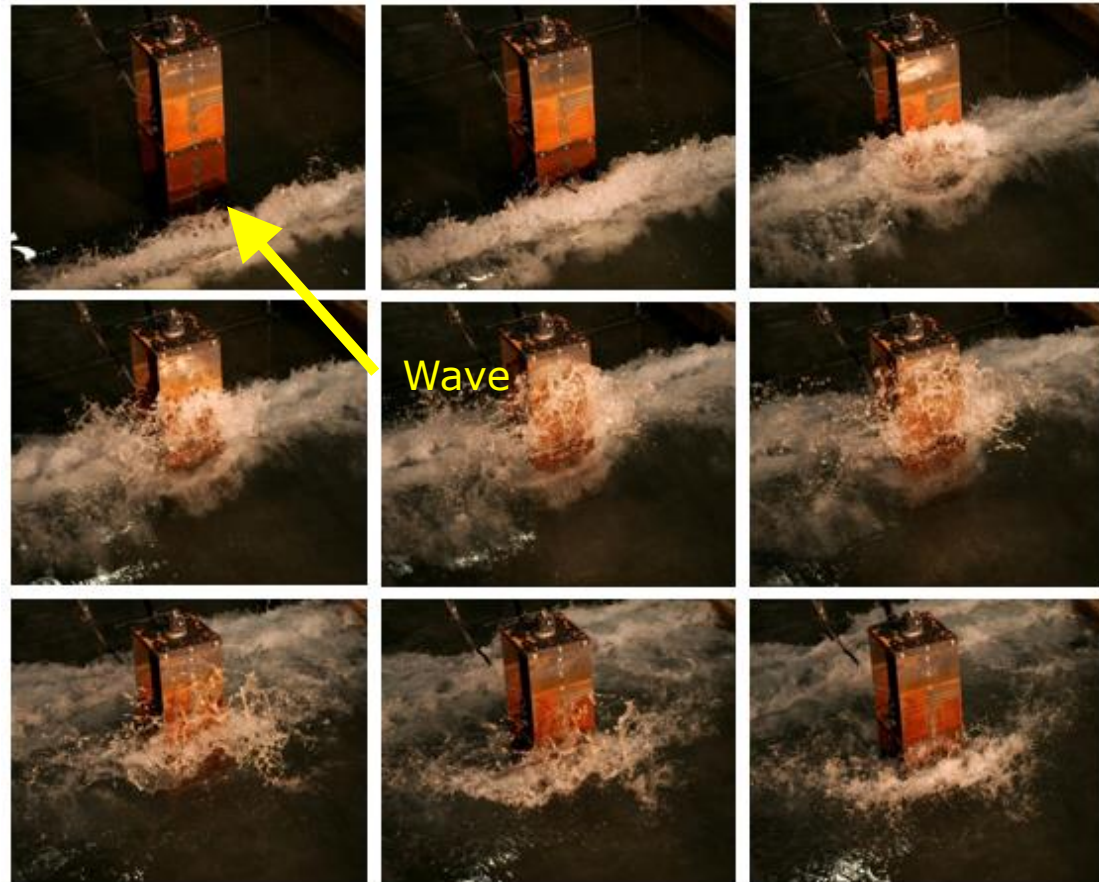


- Uses python instead of tcl
- Installation + Commands + Examples



New in OpenSEES – Fluid-Structure Interaction

- Particle Finite Element Method (PFEM) implementation validated for 2D problems
- 3D implementation & validation underway
- Testbed – Steel frame building model tested in long wave flume at OSU
 - ✓ Free vibration data for various inundation depths
 - ✓ Dynamic response and pressure distributions for wave loading

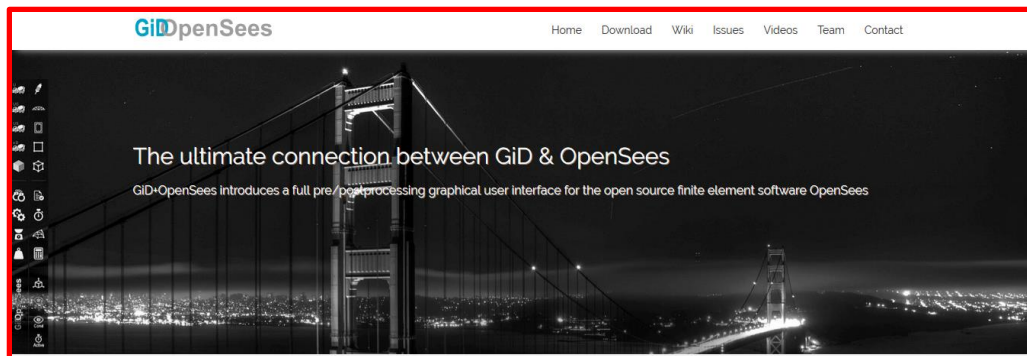


New in OpenSEES

OpenSees: Regular sequential version

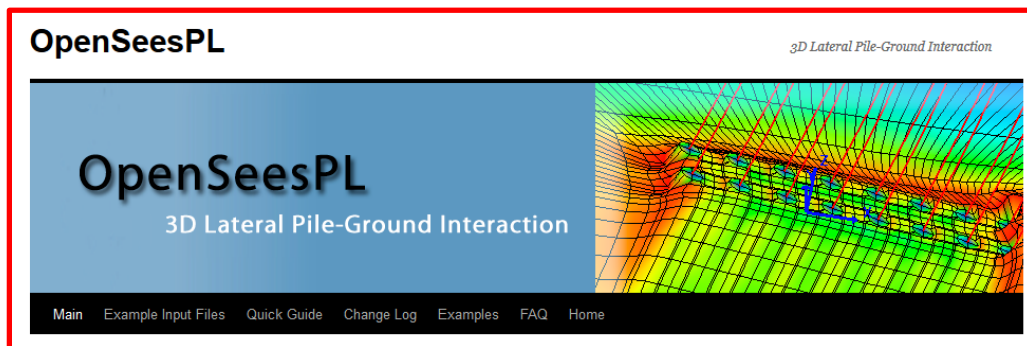
OpenSeesSP: For performing analysis of very large models

OpenSeesMP: For performing parametric studies, running many ground motions, etc.



GiD & OpenSEES

<http://gidopensees.rclab.civil.auth.gr/>



OpenSeesPL

<http://soilquake.net/openseespl/>

OpenSEES is growing not only in capabilities, but also in versions & user interfaces.

New Products

BridgePBEE: Software for PBEE of highway bridges with a GUI that runs OpenSEES for structural analyses



The screenshot shows the BridgePBEE website. The header features the 'bridgePBEE' logo with 'powered by PEER' underneath. A navigation bar includes links for HOME, COPYRIGHT, EXAMPLES, MODIFY PBEE, and REFERENCES. The main content area is titled 'BridgePBEE*' and describes the software as a PC-based graphical pre- and post-processor for conducting Performance-Based Earthquake Engineering (PBEE) studies. It mentions that the analysis is conducted using OpenSees and lists three analysis options: 1) Pushover Analysis, 2) Base Input Acceleration Analysis, and 3) Full Performance-Based Earthquake Engineering (PBEE) Analysis. A search bar and a menu with 'Log in' and 'Register' options are also visible. The footer includes a download and installation section with a note about system requirements and a link to the user manual. A green arrow points to the user manual link.

peer.berkeley.edu/bridgepbear/

bridgePBEE

powered by PEER

HOME COPYRIGHT EXAMPLES MODIFY PBEE REFERENCES

BridgePBEE*

BridgePBEE is a PC-based graphical pre- and post-processor (user-interface) for conducting Performance-Based Earthquake Engineering (PBEE) studies for bridge-ground systems (2-span single column). The three-dimensional (3D) finite element computations are conducted using **OpenSees** developed by the Pacific Earthquake Engineering Research Center (PEER). The analysis options available in BridgePBEE include: 1) Pushover Analysis, 2) Base Input Acceleration Analysis, and 3) Full Performance-Based Earthquake Engineering (PBEE) Analysis.

*Lu, J., Mackie, K.R., and ElGamel, A. (2011). BridgePBEE: OpenSees 3D Pushover and Earthquake Analysis of Single-Column 2-span Bridges, User Manual, Beta 1.0. [pdf]

Download & Install BridgePBEE

Note: BridgePBEE only works on Windows based PC computers. It is best to use a relatively new Laptop or Desktop with a fast processor, and at least 2GB of memory.

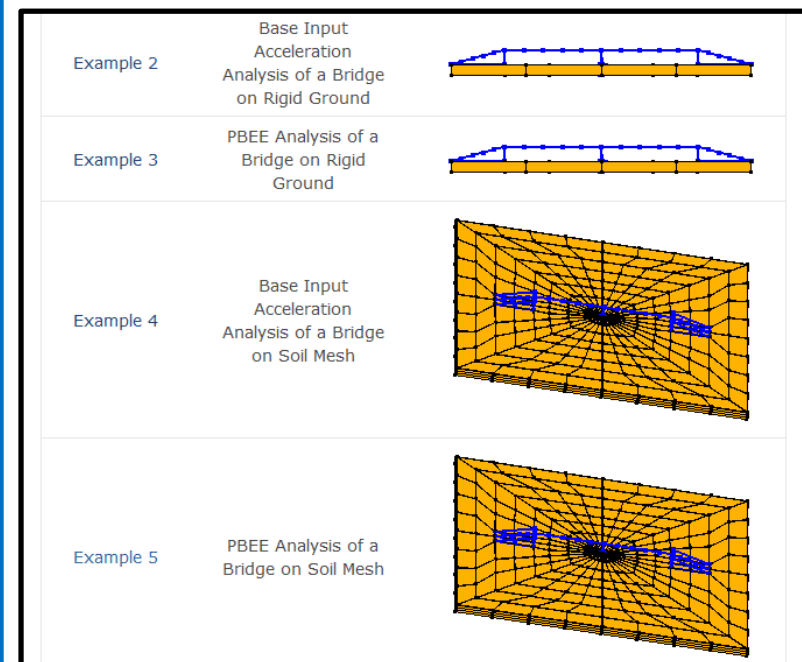
The following steps describe how to download, install and run **BridgePBEE**. For detailed documentation, please see the user manual (6.4 MB pdf file, updated Aug 2017). In

Menu

- Log in
- Register

bridgePBEE

PEER



This block displays five examples of BridgePBEE analysis results. Each example is shown in a separate row with a title, a description, and a corresponding 3D visualization of the bridge structure and its analysis results. The visualizations show the bridge deck, piers, and the surrounding soil mesh, with various colored regions indicating different analysis results.

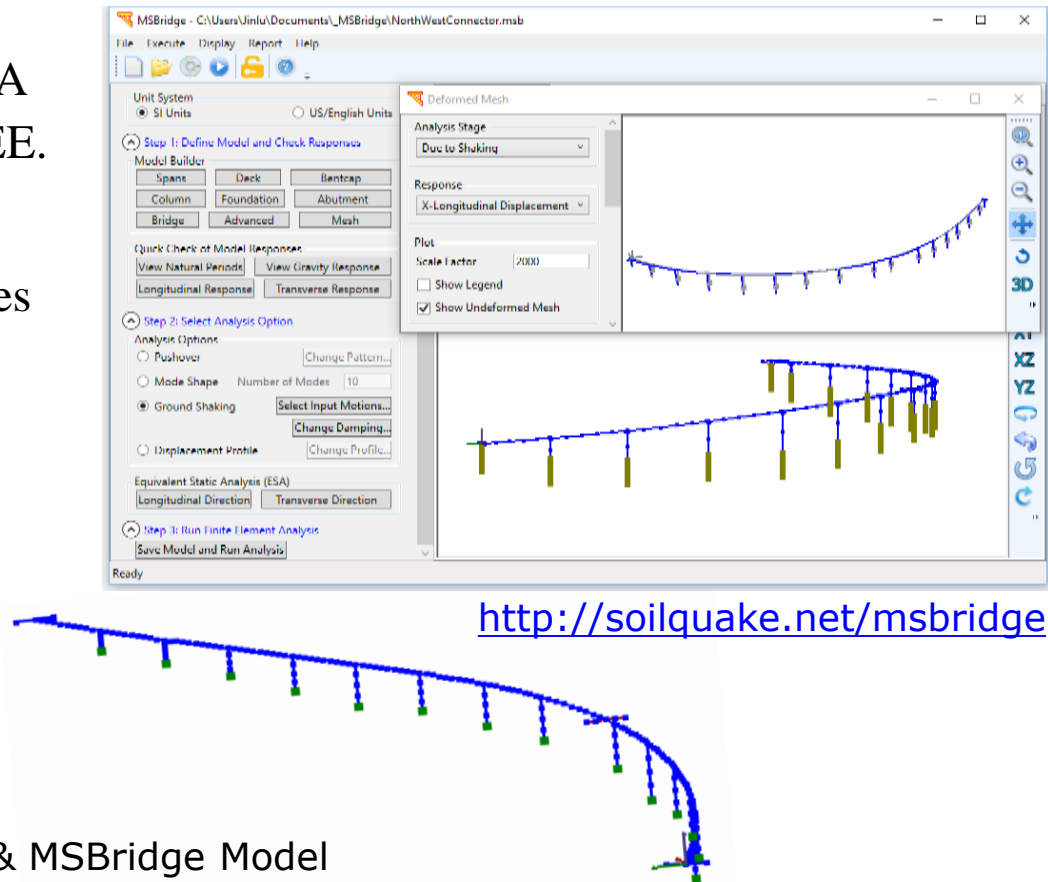
Example	Description	Visualization
Example 2	Base Input Acceleration Analysis of a Bridge on Rigid Ground	3D model of a bridge on rigid ground with blue and yellow regions.
Example 3	PBEE Analysis of a Bridge on Rigid Ground	3D model of a bridge on rigid ground with blue and yellow regions.
Example 4	Base Input Acceleration Analysis of a Bridge on Soil Mesh	3D model of a bridge on soil mesh with blue and yellow regions.
Example 5	PBEE Analysis of a Bridge on Soil Mesh	3D model of a bridge on soil mesh with blue and yellow regions.

MSBridge: GUI for Seismic Analysis of Multi-Span Bridge-Ground Systems Integrated with PEER PBEE Framework

- A computational user interface (MSBridge) combine nonlinear THA (using OpenSEES) with PEER PBEE.
- Displays seismic response ensembles & PBEE outcomes

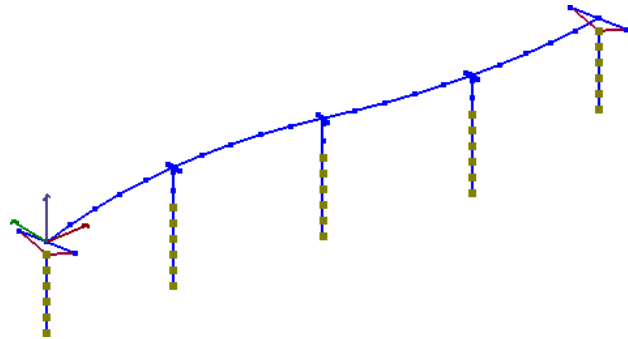


Eureka Channel Bridge & MSBridge Model

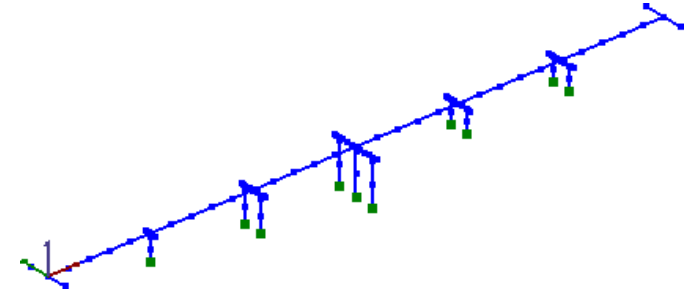


Details in: **Elgamal, A., Lu, J., Almutairi, A., and Mackie, K (2017). MSBridge: OpenSees Pushover and Earthquake Analysis of Multi-span Bridges - User Manual, Beta 1.0.**

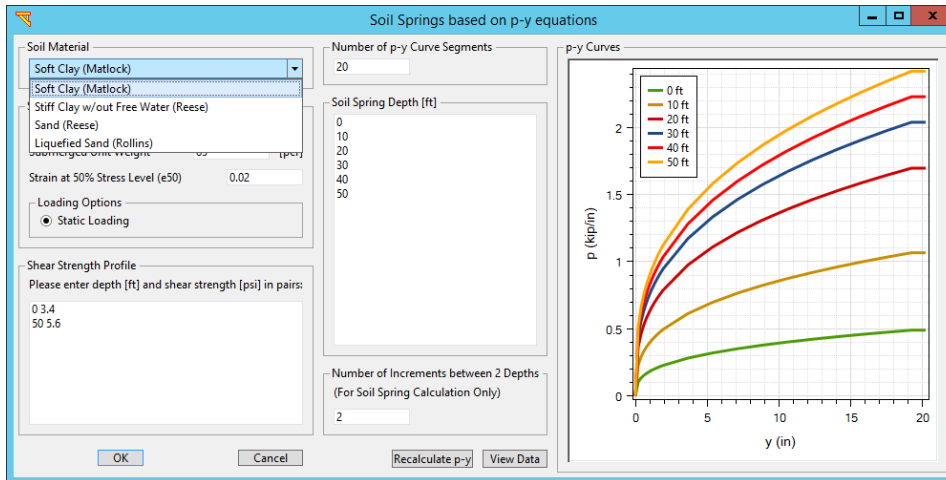
MSBridge: Capabilities



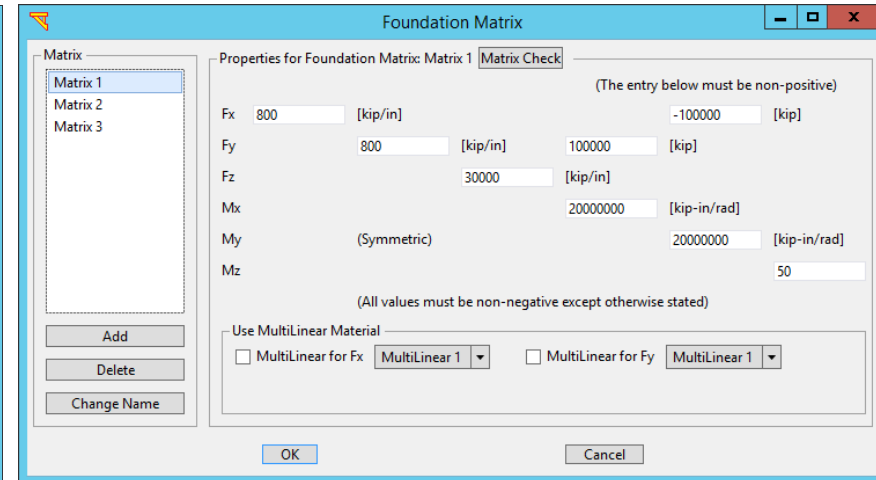
Curved bridge with foundation & soil springs



Bridge with different number of nonlinear fiber element columns for each bent



p-y springs: a) Soft clay (Matlock); b) Stiff clay without free water (Reese); c) Sand (Reese); & d) Liquefied sand (Rollins)




Foundation matrix (Lam and Martin 1986)

PEER Interacting with Natural Hazards Engineering Research Infrastructure (NHERI)


An NSF national facility to provide the engineering community with research infrastructure to protect homes, businesses & infrastructure lifelines from earthquakes & windstorms preventing natural hazards from becoming societal disasters.

NHERI FACILITIES

Shared-use sites including Experimental Facilities, the Computational Modeling and Simulation Center, and the Network Coordination Office.




UCSD



UF



OSU



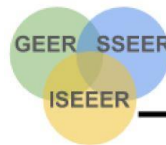
FIU



SimCenter NHERI
Center for Computational Modeling and Simulation

PEER – The EQ Node of StEER

Structural Extreme Events Reconnaissance (StEER) Network



PARTNERS

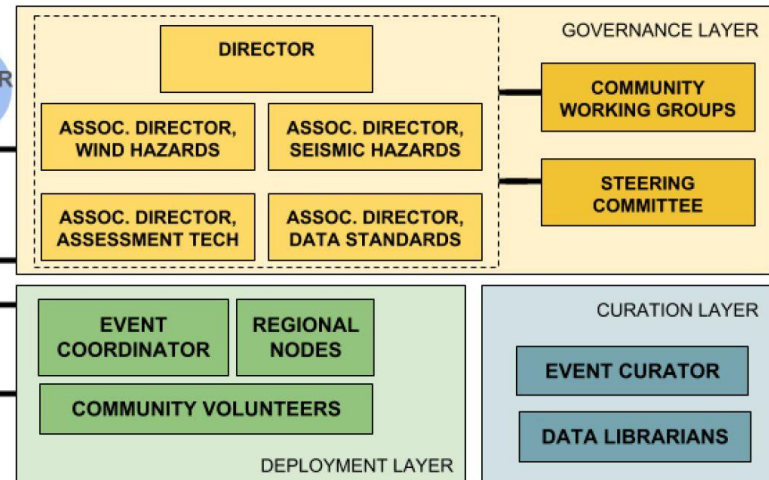


Figure 1. Proposed Initial Organizational Structure for StEER

NSF project: "**EAGER: Operationalization of the Structural Extreme Events Reconnaissance (StEER) Network**," co-PIs: T. Kijewski-Correa, K. Mosalam, D. Prevatt, I. Robertson & D. Roueche, 10/1/18 to 9/30/20.

StEER: Structural Engineering Extreme Event Reconnaissance Network 2018 HAITI EARTHQUAKE PRELIMINARY VIRTUAL ASSESSMENT TEAM (P-VAT) REPORT



Collapsed School Building in Gros-Morne, Haiti

P-VAT Authors

Fan Hu, University of California, Berkeley
Han Peng, University of California, Berkeley
Jade Cohen, University of California, Berkeley
Selim Gunay, University of California, Berkeley
Khalid M. Mosalam, University of California, Berkeley

P-VAT Editors (in alphabetical order)

Christiano Burlitos, University of Notre Dame
Tracy Kijewski-Correa, University of Notre Dame
David O. Prevatt, University of Florida
Ian Robertson, University of Hawaii

Released: October 10, 2018
NHERI DesignSafe Project ID: PRJ-2112

Haiti EQ, Oct 2018

StEER: Structural Extreme Event Reconnaissance Network

HURRICANE MICHAEL PRELIMINARY VIRTUAL ASSESSMENT TEAM (P-VAT) REPORT



Rescue personnel perform a search in the aftermath of Hurricane Michael in Mexico on October 11, 2018. (Source: Gerald Herbert/AP via Business Insider)

P-VAT Authors (in alphabetical order)

Alice Allipour, Iowa State University
Aly Mousaad Aly, Louisiana State University
Brett M. Davis, Auburn University
Marianiela Gutierrez Soto, University of California, Berkeley
Tracy Kijewski-Correa, University of California, Berkeley
Ali Lerjani, Purdue University
Benjamin Lighty, Iowa State University
Nathan Miner, University of Kansas
Abdullahi Salim, University of Kansas
Daniel J. Smith, University of Kansas

Released: October 15, 2018
NHERI DesignSafe Project ID: PRJ-2112

Hurricane Michael, Oct 2018

StEER: Structural Extreme Event Reconnaissance Network & Earthquake Engineering Research Institute (EERI)

ALASKA EARTHQUAKE PRELIMINARY VIRTUAL ASSESSMENT TEAM (P-VAT) JOINT REPORT



Earthquake damage on Vine Road, near Wasilla, Alaska, on Nov. 30, 2018. (Source: Time Magazine, Image Credit: Marc Lester - Anchorage Daily News/AP)

P-VAT Authors (in alphabetical order)

Jorge Archbold, University of California, Berkeley
Wael M. Hassan, University of Alaska, Anchorage
Tracy Kijewski-Correa, University of Notre Dame
Justin Marshall, Auburn University
George P. Mavroudis, University of Notre Dame
Khalid M. Mosalam, University of California, Berkeley
Sifat Muin, University of California, Berkeley
Harish Mulchandani, Birla Institute of Technology & Science
Han Peng, University of California, Berkeley & Harbin Institute of Technology
Renmin Preteli, University of California, Berkeley

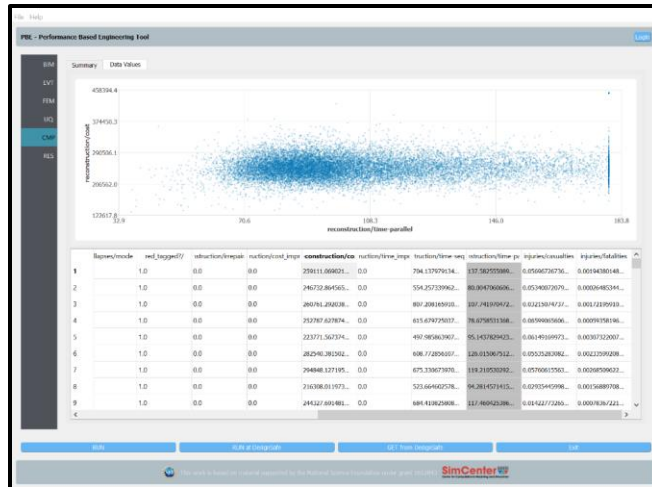
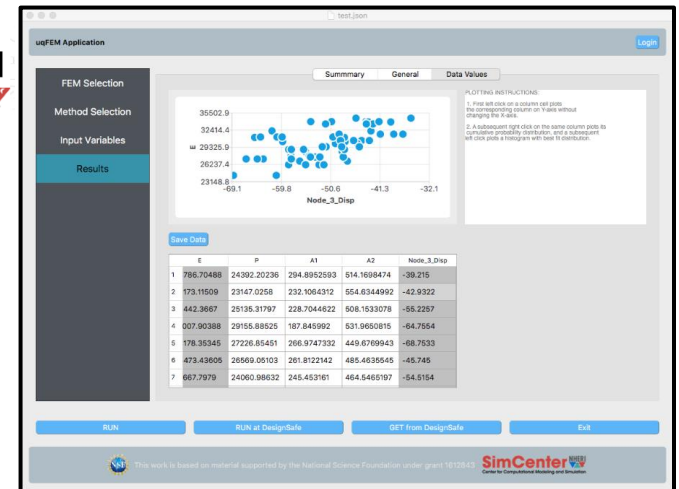
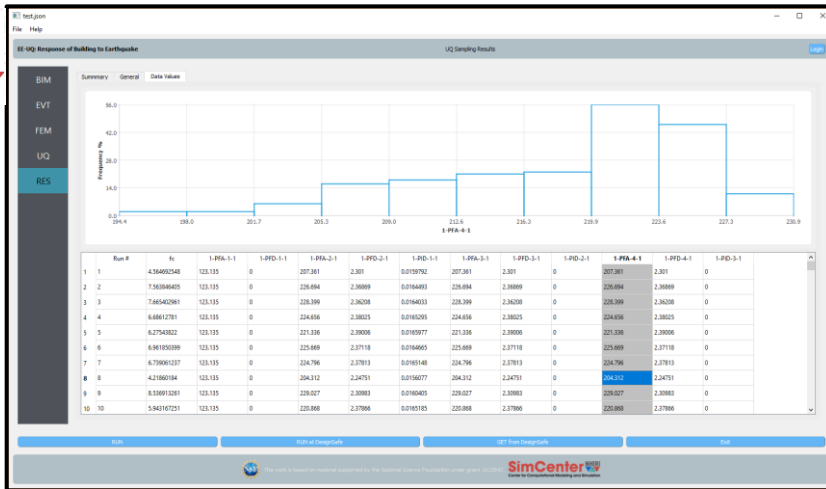
P-VAT Editors (in alphabetical order)

David Prevatt, University of Florida
David Roueche, University of Hawaii

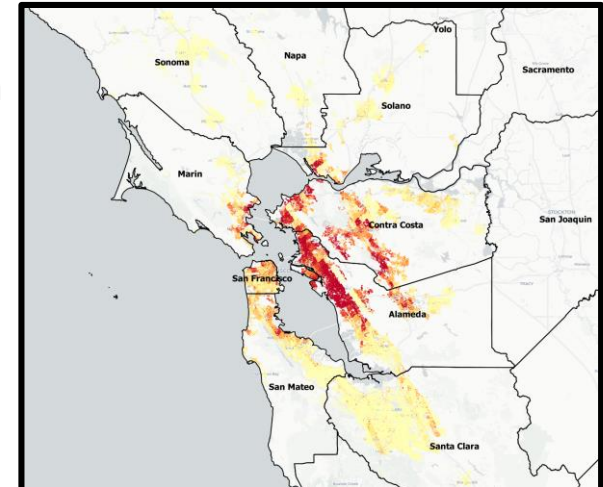
Released: December 10, 2018
NHERI DesignSafe Project ID: PRJ-2153

Alaska EQ, Dec 2018

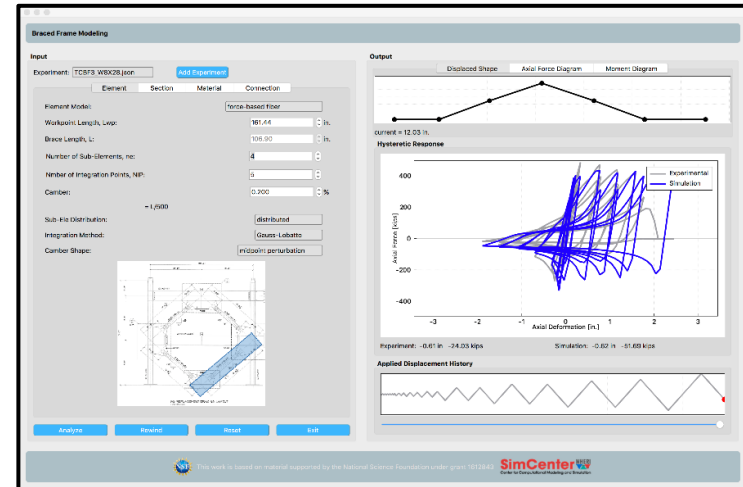
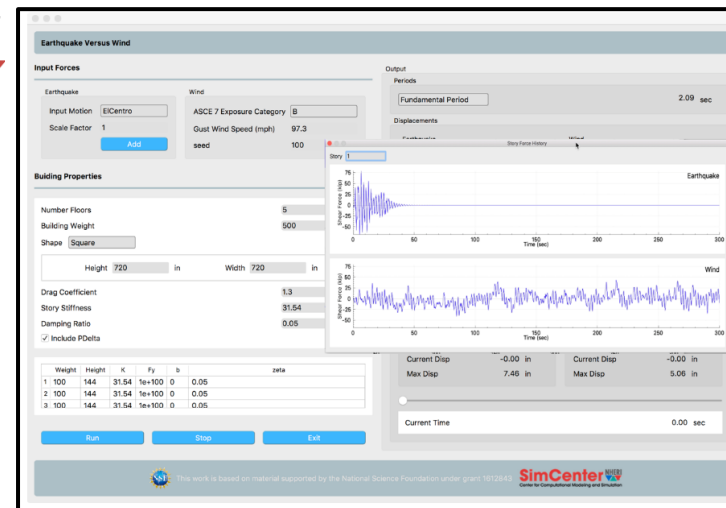
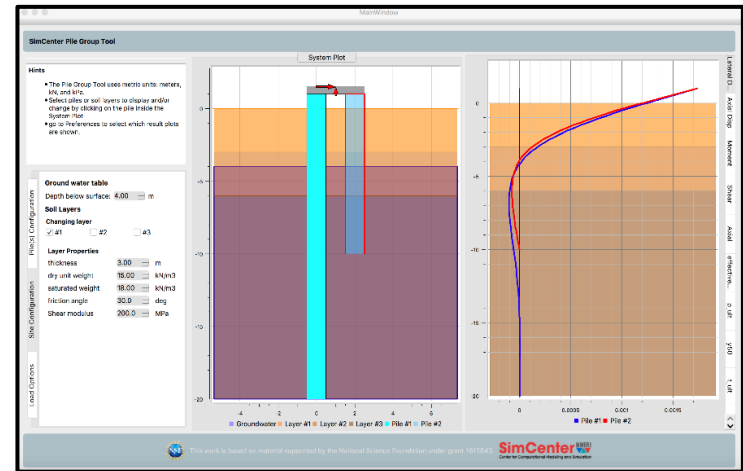
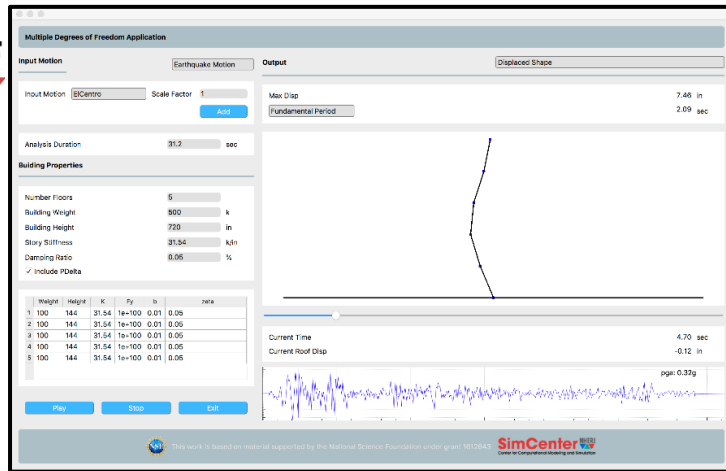
NHERI SimCenter Tools Promoted through PEER TSRP RFP (1/2)



Regional simulation workflows



NHERI SimCenter Tools Promoted through PEER TSRP RFP (2/2)



Why Blind Predictions/Challenges?

- Highlight the gap between analysis & experiments
- What are the sources of these differences?
- A step towards IV&V [**I**ndependent **V**erification & **V**alidation]
- What does this mean to:
 - Safety of our structures
 - Expected performance levels (Immediate Occupancy vs. Operational)
 - Hybrid simulation, that relies on accurate modeling of part of the system
- How to systematically improve the analytical predictions?
- Many possibilities for blind predictions (challenges) of existing & new components, systems & systems of systems.

PHI Challenge 2018



- From August 23rd to November 25th, 2018
- Teams completed **8** multi-classification tasks
- **~25,000** labeled images for training
- Total of **68** team applications worldwide



PHI Challenge 2018



**More in Plenary
4a Today!**



2018 PEER Blind Prediction Contest



- ✓ Class B blind prediction of a large scale shaking table test on a shallow foundation in liquefied soils
- ✓ Collaboration between UNR & UCSD
- ✓ Tested on one of the UCSD shaking tables in June 19-21, 2018

**More in Plenary
4a Today!**

Future 2019-2028 PEER Blind Prediction Contests

PEER core institutions include major laboratories with unique features:

- ✓ The largest 1 DOF shaking table (UCSD)
- ✓ The largest 6 DOF shaking table (UC Berkeley)
- ✓ The largest geotechnical centrifuge (UC Davis)
- ✓ The largest field testing facility (UCLA)
- ✓ The largest tsunami wave tank (OSU)
- ✓ The largest shaking table array (UNR)



Education in PEER: Interns



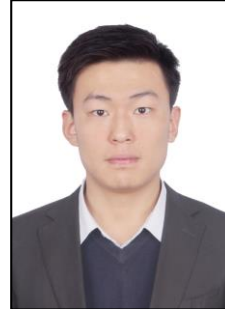
Fan Hu



Jaewon Saw



Sunbin Kim



Albert Qu



Wyeth Binder

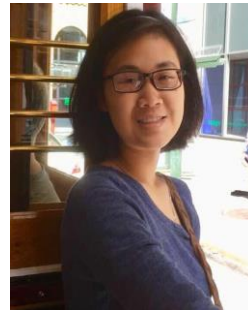
**Current
Interns**



Matthew Yeung



Hagen Tam



Lillian Lau



Alida van der Eems

**Summer
Interns**



Efe Ozcanli



Alejandro Duarte



Giancarlo Garcia

Education in PEER: Interns

StEER: Structural Engineering Extreme Event
Reconnaissance Network
2018 HAITI EARTHQUAKE
PRELIMINARY VIRTUAL ASSESSMENT TEAM (P-VAT)
REPORT



Collapsed School Building in Grot-Morne, Haiti

P-VAT Authors

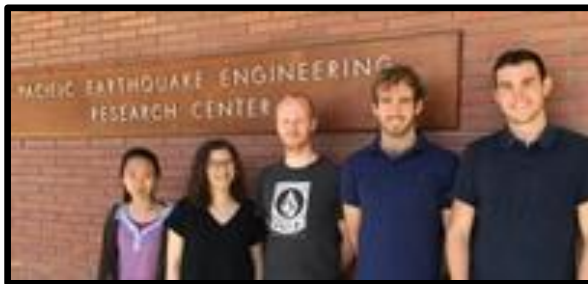
Fan Hu, University of California, Berkeley
Han Peng, University of California, Berkeley
Jade Cohen, University of California, Berkeley
Selim Günay, University of California, Berkeley
Khalid M. Mosalam, University of California, P

P-VAT Editors
(in alphabetical order)

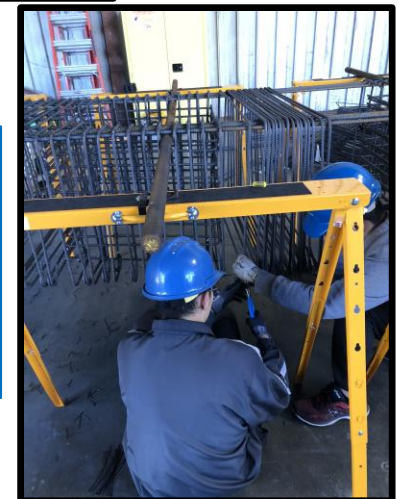
Christinos Burdett, University of California, Berkeley
Tracy Kijewski-Correa, University of California, Berkeley
David O. Rabinovich, University of California, Berkeley
Ian R. ...

October 10, 2018
Signsafe Project ID: PRJ-2104


Haiti EQ, Oct 2018



PEER interns come from different backgrounds & get involved in a broad range of activities including *hybrid simulation*, *Φ -Net challenge*, *field reconnaissance*, *testing*, *analytical simulation* & *hands-on construction*.




Have an enjoyable PEER Annual Meeting!



PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

2019 ANNUAL MEETING

JANUARY 17-18, 2019 LOS ANGELES, CA



SEISMIC RESILIENCE **25** YEARS AFTER NORTHRIDGE:
ACCOMPLISHMENTS AND CHALLENGES

Seismic Resilience 25 Years after Northridge: Accomplishments and Challenges

“Seismic Resilience 25 Years after Northridge: Accomplishments and Challenges” will feature the role of multi-disciplinary performance-based engineering with seismic and related natural hazards to achieve community resiliency. The meeting will open on Thursday, January 17 with plenary sessions highlighting the role of PEER research in the fields of performance-based engineering and resilience, and to identify areas where research and development of technology and tools are needed for effective decision-making. On Friday, January 18 concurrent breakout sessions will be formatted for more detailed discussion and engagement of PEER-funded researchers and projects, with the goal of creating a synergy of resources and information.

Location

Mong Center
UCLA Campus
404 Westwood Boulevard
Los Angeles, California

Who Should Attend

Decision-making stakeholders, practicing professionals, researchers, faculty, students, and others interested in the practice of performance-based engineering for natural hazards are encouraged to attend. Program details can be found at:

peer.berkeley.edu/peer-2019-annual-meeting-program

Registration

Advanced registration is required for attendance at the 2019 PEER Annual Meeting. Registration details can be found at:

peer.berkeley.edu/peer-2019-annual-meeting-registration

**Early Bird Registration ends
December 7, 2018**

Poster Session & Reception

Emerging researchers and students are encouraged to apply to participate in the poster session. All accepted posters will be displayed during a reception on the evening of Thursday, January 17, 2019. Submit your poster at:

peercenter.wufoo.com/forms/m6g8y120dv9qmg/

	Thursday January 17, 2019	Friday January 18, 2019		
8:00 - 8:30 AM	REGISTRATION / BREAKFAST	REGISTRATION / BREAKFAST		
8:30 - 10:00 AM	PLENARY -1 PEER Overview Northridge Overview	PLENARY-5 Welcome Advances in Infrastructure Monitoring and Reconnaissance		
10:00 - 10:30 AM	BREAK	BREAK		
10:30 - 12:00 PM	PLENARY -2 Advances and Challenges since Northridge	CONCURRENT -1 Impact of Ground Motions on Bridge Performance and Design	CONCURRENT-2 Geo Hazards I	CONCURRENT-3 Computational Simulation of Geotechnical and Structural Systems
12:00 - 1:30 PM	LUNCH & Special Presentation	LUNCH		
1:30 - 3:00 PM	PLENARY -3 Regional PBEE - Lifeline Systems	CONCURRENT -4 New Trends in Seismic Design of Bridges	CONCURRENT-5 Geo Hazards II	CONCURRENT-6 PBEE to Promote Discounts for Single-Family Dwellings
3:00 - 3:30 PM	BREAK	BREAK		
3:30 - 4:30 PM	PLENARY -4 Computational Tools for Simulating Natural Hazard Effects and Community Resilience	PLENARY -6 Resilient Los Angeles		
4:30 - 5:00 PM	PLENARY -4a 2018 PEER Blind Prediction Contest & Phil Challenge Winners	PLENARY -7 Concurrent Summaries & Closure		
5:00 - 5:30 PM	BREAK			
5:30 - 7:30 pm	POSTER SESSION & RECEPTION (Open to the Public)			