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Seismic Safety Commission Meeting Materials

October 10, 2024



ALFRED E. ALQUIST SEISMIC SAFETY COMMISSION MEETING

October 10, 2024
10:00 am – 2:00 pm PST

In Person Location:
10370 Peter A. McCuen Blvd.
Mather, CA 95655
Building E: Santa Catalina Room

Virtual Information:
<https://us02web.zoom.us/j/88479123075>

Webinar ID: 884 7912 3075

Dial (Toll-free):
(888) 788-0099

For more information please contact:
Tanya Black 916-224-8819 or Tanya.Black@CalOES.ca.gov.



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| MEETING AGENDA | TIME EST.* | ACTION |
|---|-------------------|---------------------|
| 1. Call to Order and Roll Call | 5 mins. | Roll Call |
| 2. Chair Remarks | 5 mins. | Discussion |
| 3. Public Comment: Items on Agenda | 10 mins. | Discussion |
| 4. Approval of Seismic Safety Commission (SSC) July 18, 2024, Meeting Minutes | 5 mins. | Discussion & Action |
| 5. AB 100 Report—California Department of Transportation (Caltrans) - <i>Michael Keever, Chief Deputy Director, Caltrans</i> - <i>Rich Foley, Division of Engineering Services Chief, Caltrans</i> | 30 mins. | Discussion |
| 6. California Community Colleges—Presentation on Earthquake Readiness and Preparedness Activities - <i>Hoang Nguyen, Director of Facilities Planning, California Community Colleges</i> | 20 mins. | Discussion |
| 7. University of California, Berkeley—Pacific Earthquake Engineering Research Center (PEER) Projects - <i>Dr. Khalid Mosalam, PhD, PE, F.ASCE, Professor and Director, PEER UC Berkeley</i> | 10 mins. | Discussion |
| 8. Earthquake Early Warning & ShakeOut Update - <i>Lori Nezhura, Deputy Director Planning, Preparedness, Prevention, Cal OES</i> | 30 mins. | Discussion |
| Break | 15 mins. | Break |
| 9. Northridge30 Anniversary: Quake Heroes Expos and More - <i>Mark Benthien, Director for Communication, Education, and Outreach for the Southern California Earthquake Center</i> | 20 mins. | Discussion |
| 10. A Culture of Earthquake Resilience—Update on CRMP residential retrofit grant programs (EBB, ESS, and the new multi-unit EMR) - <i>Janiele Maffei, S.E., Chief Mitigation Officer, California Earthquake Authority (CEA)</i> - <i>Jennifer Hogan, Mitigation Director, CEA</i> | 25 mins. | Discussion |

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| | | |
|--|----------|---------------------|
| 11. Fire Following Earthquake—Reducing Post-Earthquake Ignitions - <i>Dr. Charles Scawthorn, S.E., SPA Risk LLC, PEER UC Berkeley</i> | 15 mins. | Discussion & Action |
| 12. Fire Following Earthquake—Improving Post-Earthquake Firefighting Water Supply Capacity Reliability - <i>Dr. Charles Scawthorn, S.E., SPA Risk LLC, PEER UC Berkeley</i> | 15 mins. | Discussion & Action |
| 13. Project Updates - <i>Annde Ewertsen, SSC Executive Director</i> | 15 mins. | Discussion |
| 14. Executive Director Hiring Process - <i>David Neill, Chief Counsel, California Governor's Office of Emergency Services</i> | 15 mins. | Discussion & Action |
| 15. Miscellaneous Announcements | 5 mins. | Discussion |
| 16. Public Comment: Items not on Agenda | 10 mins. | Discussion |
| 17. Adjourn | 5 mins. | Adjourn |

***AGENDA SCHEDULE:** The timing and order of the topics listed on the agenda are subject to change and will depend on the duration and discussion of the presentations and/or speaker's availability.

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STATEMENTS FROM THE PUBLIC: The public will be allowed to address the Seismic Safety Commission during Item 3 on any item on the agenda and Item 15 on any item not on the agenda. Questions posed to the Seismic Safety Commissioners may be answered after the meeting or during a future meeting. Dialog or extended discussion between the public and the Seismic Safety Commissioners or staff may be limited per the Bagley-Keene Open Meeting Act. Public comments will typically be limited to two (2) minutes per speaker; however, the Chair may decide to lengthen the public comment periods at their discretion. Although not required, speakers are requested to identify themselves by stating their name and city of residence for the official record. All remarks shall be addressed to the Seismic Safety Commission as a body. Speakers should be brief and are to limit their comments to the subject of discussion.

SIGN-UP & TIME LIMITS: If you wish to speak on an item and you are attending the meeting in-person or virtually and you know in advance that you'd like to comment on an item, please fill out a "Request to Speak" form and give it to a staff person before the meeting. The forms are available online with the current month's agenda here: <https://ssc.ca.gov/>. Submit any requests to speak to InfoSSC@caloes.ca.gov. If you attend virtually, the Chair will provide an opportunity to comment during the scheduled public comment section and after each item.

SUGGESTIONS FOR SUBMISSION OF WRITTEN MATERIALS: It is requested that written materials be submitted to the Commission staff prior to the meeting. If this is not possible, it is requested that at least 30 copies be submitted to the Commission. This material will be distributed to the Commission members. Applicants are responsible for presenting their projects at the public hearing. NO FAXES will be accepted at the meeting site. You may be able to make prior arrangements with staff by sending an email to InfoSSC@caloes.ca.gov but you will be responsible for paying the hotel or meeting site for its receipt.

ACCESS TO MEETING: Meeting facilities are accessible to persons with disabilities. If you require special assistance, please contact any staff member at the phone or email address below, prior to the meeting. An interpreter for the deaf will also be made available upon request to the staff at least five calendar days prior to the meeting.

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ALFRED E. ALQUIST
SEISMIC SAFETY COMMISSION MEETING
In-person and Teleconference Meeting
Thursday, July 18, 2024

1. Call to Order and Roll Call

Chair Rabbitt called the meeting to order at approximately 10:07 a.m.

Tanya Black conducted the roll call. The following table details each Commissioner's and Representative's attendance status.

| Commissioner | In-Person | Virtual | Absent |
|---|------------------|----------------|---------------|
| David Rabbitt, Chair, Local Government | X | | |
| Debra Garnes, Vice-Chair, Local Government | X | | |
| Stoyan Bumbalov, Building Standards Commission | X | | |
| Ida Clair, CA Division of State Architect | X | | |
| Alegría De La Cruz, Social Services | | X | |
| Representative Lori Nezhura for Nancy Ward, CA Governor's Office of Emergency Services (Cal OES) | X | | |
| Joone Kim-Lopez, Public Utility | | | X |
| Kevin McGowan, Emergency Services | | | X |
| Dr. H. Kit Miyamoto, Structural Engineer | | X | |
| Representative Astghik Hakobyan for Senator Portantino, CA Senate Member | | | X |
| Representative Allison Kustic for Assemblymember Rodriguez, Vice Chair, California (CA) Assembly Member | X | | |
| Cindy Silva, Local Government | X | | |
| Vincent Wells, Fire Protection | X | | |
| Total Attendance: | 8 | 2 | 3 |

2. Chair Remarks

Chair Rabbitt expressed gratitude for everyone's attendance, thanked former Chair Silva, and acknowledged the staff for their dedicated work.



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3. Public Comment: Items on Agenda

Chair Rabbitt opened the floor for public comments on the agenda items. There were no public comments.

4. Approval of Seismic Safety Commission (SSC) April 11, 2024 Meeting Minutes:

Commissioner Silva moved to approve the SSC meeting minutes of April 11, 2024, seconded by Representative Nezhura. A roll call vote was conducted, and the motion passed unanimously. The following table provides details on the vote.

| Commissioner | Yes | No | Abstained | Not Present |
|---------------------------------|----------|----------|-----------|-------------|
| David Rabbitt, Chair | X | | | |
| Debra Garnes, Vice-Chair | X | | | |
| Stoyan Bumbalov | | | X | |
| Ida Clair | X | | | |
| Alegría De La Cruz | X | | | |
| Representative Lori Nezhura | X | | | |
| Joone Kim-Lopez | | | | X |
| Kevin McGowan | | | | X |
| Dr. H. Kit Miyamoto | | | | X* |
| Representative Astghik Hakobyan | | | | X |
| Representative Allison Kustic | X | | | |
| Cindy Silva | X | | | |
| Vincent Wells | X | | | |
| Total Votes: | 8 | 0 | 1 | 4 |

*Note: Commissioner Miyamoto was present virtually but did not vote or abstain and thus was marked not present.



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5. Approval for SSC Website Update Ad-Hoc Committee - Annde Ewertsen, Executive Director, SSC

Executive Director Annde Ewertsen explained that while the website update process has started, no significant updates have been made. A Request for Offer (RFO) has been issued to find someone to help improve website content and navigation. The minor updates include earthquake activity reports and fixing broken links. In addition to content updates and reorganization, a primary goal is to update a 20-year-old seismic safety graphic to be more interactive.

A survey was conducted to find interested members for an Ad-Hoc Committee for this project. Commissioner Silva and Vice-Chair Garnes expressed interest.

Commissioner Wells motioned to approve Commissioner Silva and Vice-Chair Garnes as members of the SSC Website Update Ad-Hoc Committee, seconded by Commissioner Clair. A roll call vote was conducted, and the motion passed unanimously. The following table provides details on the vote.

| Commissioner | Yes | No | Abstained | Not Present |
|---------------------------------|-----|----|-----------|-------------|
| David Rabbitt, Chair | X | | | |
| Debra Garnes, Vice-Chair | X | | | |
| Stoyan Bumbalov | X | | | |
| Ida Clair | X | | | |
| Alegría De La Cruz | X | | | |
| Representative Lori Nezhura | X | | | |
| Joone Kim-Lopez | | | | X |
| Kevin McGowan | | | | X |
| Dr. H. Kit Miyamoto | X | | | |
| Representative Astghik Hakobyan | | | | X |
| Representative Allison Kustic | X | | | |



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| | | | | |
|---------------------|-----------|----------|----------|----------|
| Cindy Silva | X | | | |
| Vincent Wells | X | | | |
| Total Votes: | 10 | 0 | 0 | 3 |

6. Approval for SSC Staff to Participate on Advisory Panel and Committee - Annde Ewertsen, Executive Director, SSC

- a. United States Geological Survey (USGS) Grant—Influence of Climate Change on Earthquake Hazard & Risk, Universities of Berkeley and Merced—Advisory Panel Request
- b. National Aeronautics and Space Administration (NASA) NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) Research Opportunities in Space and Earth Science (ROSES) Grant—Estimating Damage in Seismic Multi-hazard Events (Causality informed Bayesian Frameworks for Cascading Seismic Multi-hazards and Impacts Estimation by Integrating Multi-modal Remote- and Crowd Sensing data), John Hopkins University, University of Florida, USGS, and NASA—Advisory Committee Request

SSC received two requests for support letters and participation on an advisory panel and a committee. The first request is for a USGS Grant to study climate change's influence on earthquake hazard and risk, specifically modeling a magnitude 7 earthquake on the Hayward fault under Diablo wind conditions.

The second request comes from a NASA NSPIRES Research Grant. This research aims to improve emergency management using technologies such as proxy damage maps, social media, and liquefaction and transportation data.

Vice-Chair Garnes motioned to authorize SSC staff to make any non-substantive Commission edits, finalize and approve the Letters of Support, and participate in the advisory panel and committee, seconded by Commissioner Silva. A roll call vote was conducted, and the motion passed unanimously. The following table provides details on the vote.



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| Commissioner | Yes | No | Abstained | Not Present |
|---------------------------------|-----------|----------|-----------|-------------|
| David Rabbitt, Chair | X | | | |
| Debra Garnes, Vice-Chair | X | | | |
| Stoyan Bumbalov | X | | | |
| Ida Clair | X | | | |
| Alegría De La Cruz | X | | | |
| Representative Lori Nezhura | X | | | |
| Joone Kim-Lopez | | | | X |
| Kevin McGowan | | | | X |
| Dr. H. Kit Miyamoto | X | | | |
| Representative Astghik Hakobyan | | | | X |
| Representative Allison Kustic | X | | | |
| Cindy Silva | X | | | |
| Vincent Wells | X | | | |
| Total Votes: | 10 | 0 | 0 | 3 |

7. Earthquake Reconstruction in Türkiye and New Zealand: Lessons for California - Dr. H. Kit Miyamoto, S.E., Global CEO & Humanitarian Coordinator Miyamoto.

Dr. Miyamoto shared insights from the February 2023 Türkiye earthquakes, noting that outdated codes led to significant damage, but base isolation in new hospitals proved effective. Dr. Miyamoto praised Türkiye's swift response, including rapid contractor mobilization and temporary shelters, and highlighted the use of real-time satellite imagery for damage assessment.

Dr. Miyamoto pointed out Türkiye's efficient building assessment using QR codes but mentioned a gap in addressing lightly and moderately damaged buildings.



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Dr. Miyamoto also discussed the 2011 Christchurch earthquake, where 90% of downtown buildings were lost despite strong building codes. To expedite recovery for California, Dr. Miyamoto suggests focusing on functional codes, reducing restrictive red zones, and streamlining building permits.

Discussion:

Commissioner Silva inquired about Dr. Miyamoto's use of "red zone." Dr. Miyamoto explained that excessive red-tagging delayed recovery and emphasized the need for realistic risk assessments in California.

Representative Nezhura asked if Christchurch's building standards have become stricter. Dr. Miyamoto confirmed they have, driven by public demand and stressed that California needs improved standards and recovery planning.

Chair Rabbitt asked whether insurance contributed to Christchurch's extended post-earthquake closure and why fires were not a major issue after the earthquakes. Dr. Miyamoto explained that Christchurch had ample insurance but encountered bureaucratic delays in reconstruction. Noting that concrete structures in Christchurch and Türkiye reduced fire risk and recommended measures like automatic gas shutoff valves to prevent post-earthquake fires in California.

8. Adaptive Reuse - Annde Ewertsen, Executive Director, SSC and Jia Wang-Connelly, Senior Structural Engineer, SSC

Executive Director Ewertsen introduced the topic of adaptive reuse. This involves repurposing existing buildings to optimize their use, considering factors like structure, functional needs, regulatory compliance, and market demand.

The Los Angeles Adaptive Reuse Ordinance is being updated due to high commercial vacancy rates. Additionally, two bills are updating the Mills Act: AB 2909 extends tax incentives for commercial buildings over 30 years old, and AB 2910 allows Los Angeles to adopt alternative regulations for converting commercial properties to residential use. Both bills are currently in the first chamber.



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Presentation: Adaptive Reuse - Ryan Kersting, Structural Engineers Association of California (SEAOC)

Ryan Kersting, a practicing structural engineer in Sacramento and a member of SEAOC, discussed the adaptive reuse of commercial buildings into residential spaces. While California's existing building codes address adaptive reuse, they often do not mandate code updates unless certain thresholds are met. These include significant changes in design load, structural configuration, or risk category.

Local ordinances, like those in San Francisco and Los Angeles, have introduced additional triggers to improve building performance. These cities require evaluations when significant alterations are made, even if structural components are unaffected.

Ryan Kersting highlighted that while converting office buildings to residential use does not alter the risk category, it does increase the amount of time occupants spend in the building, raising their exposure to seismic risks. Building codes currently do not address this increased risk exposure.

Finally, Ryan Kersting stressed the need for uniform policies across California to address adaptive reuse and ensure building safety and resilience, urging mandatory programs to improve existing building stock and support vulnerable populations.

Discussion:

Dr. Miyamoto stressed that affordability is crucial for effective adaptive reuse and public support and noted that while the soft-story ordinance retrofit code programs were successful because these retrofits have cost-effective upgrades, current programs demanding 75% seismic design forces are too expensive.

Ryan Kersting advocated focusing on long-term costs and performance, not just initial expenses, to ensure buyers understand the full implications of their investments.



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Commissioner Silva raised concerns about the challenges in converting office buildings to residential use, stressing the need for clear communication with legislators.

Commissioner Rabbit inquired about safety standards for residential high-rises. Ryan Kersting confirmed that while standards are similar, they vary with risk categories and occupant load, highlighting the importance of adapting to changing building needs.

9. San Francisco Concrete Building Safety Program - *Brian Strong, Chief Resilience Officer and Director Office of Resilience and Capital Planning, City and County of San Francisco and Laurel Matthews, Senior Earthquake Resilience Analyst City and County of San Francisco*

Brian Strong discussed San Francisco's resilience planning, including hazard mitigation, capital planning, and retrofitting programs. Brian Strong highlighted efforts to incentivize earthquake-resilient buildings, such as public evaluations and mandatory retrofits, and emphasized the importance of integrating various strategies to improve building performance and resilience.

Laurel Matthews discussed San Francisco's concrete building safety program, which aims to identify, evaluate, and retrofit vulnerable concrete buildings to prevent structural failures. The program targets non-ductile concrete buildings and tilt-up structures. Laurel Matthews noted the program's extensive stakeholder engagement and highlighted key recommendations, including financing, communication, tenant relocation, and process streamlining. Recent progress includes a directive to draft legislation for mandatory screening and establish building code retrofit standards.

Brian Strong highlighted the importance of adaptive reuse for concrete building retrofits, suggesting pre-occupancy retrofitting to save costs. The main challenges are financing and improving building inventories. Brian Strong stressed ongoing stakeholder engagement, citing San Francisco's soft-story program's success due to early communication and extended timelines.



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Discussion:

Dr. Miyamoto noted the simplicity of retrofitting soft-story and masonry buildings compared to concrete structures. Financial constraints remain a major hurdle and financial incentives, such as property tax credits for seismic strengthening, would be beneficial.

Brian Strong recognized the financial limitations, emphasizing the need for long-term planning. Commercial buildings, especially Class B and C, need incentives, and condo owners face challenges in affording necessary retrofits. Laurel Matthews mentioned an upcoming hazard mitigation grant program aimed at developing a financing strategy for building owners.

Commissioner Rabbitt emphasized the themes of financing and affordability, commending San Francisco's soft-story program for successfully incentivizing upgrades and adding accessory dwelling units (ADUs).

10. **Earthquakes, Climate, Fire, Water – California's Needs - Dr. Charles Scawthorn, S.E., SPA Risk LLC, Pacific Earthquake Engineering Research Center, University of California at Berkeley**

Dr. Charles Scawthorn delivered a pre-recorded video presentation focused on the impact of earthquakes on water supply systems. Research found that earthquakes significantly reduce the service life of buried water pipes, potentially by up to 40 years. The 2014 Napa earthquake highlighted this, leading to massive economic losses.

Dr. Scawthorn emphasized the critical role of water supply in firefighting after earthquakes, using examples from San Francisco, Kobe, and Los Angeles to demonstrate how water system failures increase fire risks. Dr. Scawthorn advocated for better coordination between water and fire agencies and recommended implementing systems like San Francisco's high-pressure auxiliary water supply, underground cisterns, and portable water supplies for firefighting.



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He also discussed the importance of Seismic Gas Shut-off Devices (SGSDs) to prevent post-earthquake fires, noting Japan's success with these devices. California's building codes do not currently mandate SGSDs.

Dr. Scawthorn concluded by urging the commission to promote policies that ensure water agencies and local jurisdictions are better equipped to manage the impacts of future earthquakes so California can substantially mitigate the risks associated with earthquakes.

11. Fire Following Earthquake - Darius Luttrupp, Deputy Chief of Operations San Francisco Fire Department

Darius Luttrupp highlighted San Francisco's comprehensive preparations for post-earthquake fires. The Auxiliary Water Supply System (AWSS) is a specialized network with high-pressure hydrants, cisterns, and fireboats, offering independent water sources. High-pressure hydrants can triple firefighting capacity by using gravity-fed water from reservoirs and tanks, while cisterns provide localized water reserves throughout the city.

Darius Luttrupp noted the importance of early fire detection and the challenges faced by post-earthquake communication. The department's strategy includes decentralizing command for faster decision-making. They maintain a robust staffing level and high-capacity equipment to handle potential conflagrations. Additionally, they have initiatives like the Neighborhood Emergency Response Team (NERT) to aid in fire reporting and response.

The fire department's Portable Water Supply System (PWSS) acts as a backup, bridging gaps in the water supply network with portable hoses and pumps. They have contracted with Rosenbauer for modern Hose Tenders, significantly enhancing their firefighting capabilities. These Hose Tenders can pump 5,600 gallons per minute and are mobile, functioning like "land fireboats." However, due to budget constraints, there are challenges in maintaining and expanding this fleet.



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Discussion:

Commissioner Wells asked about navigating post-earthquake road hazards and fallen structures. Darius Luttrupp replied that addressing these issues requires proactive planning and situational awareness.

Chair Rabbit compared San Francisco's preparedness favorably to other areas, mentioning ongoing challenges in Sonoma County and the need for continued investment in hazard mitigation and infrastructure upgrades.

12. Project Updates - *Annde Ewertsen, Executive Director, SSC*

a. Ferndale & Türkiye

Part 1: Executive Director Ewertsen acknowledged the completion of the Ferndale Earthquake Sequence Report and introduced John Catching from the California Specialized Training Institute. John Catching presented a new recovery training program for local governments, covering public and individual assistance. The program will begin with proclamation and damage estimate training, followed by sessions on assistance programs. It will cover all disaster types to enhance understanding of state and federal resources.

Executive Director Ewertsen also discussed the SSC's request to consult the Office of Rural Advocate on threshold requirements and considerations. Staff is working with Cal OES recovery experts to prepare a document for SSC approval.

Part 2: Doublet/Triggered Scenarios: Pacific Earthquake Engineering Research (PEER) is working on Vol 1 and 2 of the report. The presentation has been delayed until the SSC January 2025 meeting.

Part 3: Resilience/Recovery Project Scenarios: The contract with the IN-CORE team has been executed, and the kick-off meeting has been held. This project is also delayed and will be presented to SSC in January 2025.



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b. Fire Station Inventory

The fire station inventory project surveyed 3,200 stations and received 435 responses by July 16th. Initial HAZUS runs have been completed. Key findings include: 34% of buildings were built between 1941 and 1973, 71% are urban, and 60% are interested in Earthquake Early Warning (EEW). Most stations are single-story and rectangular, with 74% not remodeled and 97% not retrofitted. Emergency power is connected to 67% of front bay doors but is less frequently installed for additional doors.

c. Northridge Anniversary—Quake Heroes

The Quake Heroes project approved nearly a year ago, had its first kickoff meeting last week. The project includes dubbing films into Spanish and Chinese. Planning dates for related events will be provided soon. This project is part of the Northridge 30th Anniversary campaign promoting earthquake preparedness.

Quake Heroes Events have already occurred independently, and details about upcoming events will be shared with Commissioners. Through May 2025, SSC will fund ten events in yet to be identified underserved communities.

d. Shake Table Project

The Shake Table Project is progressing with no significant updates. The contract is extended through December 31, 2025, with Shake Table testing expected in the summer of 2025.

e. Mobile Home Building Code Project

The Mobile Home Building Code Project was submitted through the Building Resilient Infrastructure and Communities (BRIC) Building Code Plus-Up Program. It was selected for Round One review on July 2, 2024. 129 nationwide projects were selected for further review. The next step is awaiting Round Two reviews from FEMA Region 9, with no estimated date for decision-making.



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f. Earthquakes and Climate Change Workshop

Planning for the Earthquakes and Climate Change Workshop, approved at the last meeting, is ongoing. United States Geological Survey (USGS), California Geological Survey (CGS), and FEMA Region 9 are holding monthly meetings. Topics are being developed, and details on dates and times will be provided soon.

Discussion:

In response to the Fire Station Inventory project update, Commissioner Silva noted that fire stations built before the 1970s may need retrofitting. Executive Director Ewertsen replied that the data will be reviewed against current building codes.

13. Misc. Announcements - *Annde Ewertsen, Executive Director, SSC*

Executive Director Ewertsen introduced the new commissioner and staff person: Commissioner Stoyan Bumbalov, with 15 years of building code experience, and Nicole Mendoza, the new program manager. Executive Director Ewertsen also recognized Commissioner Miyamoto for his global contributions and awards. California State University sent a thank-you note to the SSC. Executive Director Ewertsen acknowledged the departing staff, Trinity Gleckler and Chris Lozano, and wished them well in their new roles.

14. Public Comment: Items Not on Agenda

No public comments were submitted regarding items not on the agenda.

Comments from Commission during Public Comment: Dr. Miyamoto highlighted Dr. Scawthorn's presentation on California hazard mitigation, emphasizing cost-effective solutions and the potential role of the insurance industry in reducing hazards.

Chair Rabbitt commented on insurance agencies using water restrictors and suggested gas shut-offs for earthquake-prone areas.



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15. **Adjourn**

Chair Rabbitt adjourned the meeting at approximately 1:46 p.m.

To view the full meeting recording, please visit the following links:

<https://www.youtube.com/watch?v=VP-YGqJihjU>

<https://www.youtube.com/watch?v=GdU-Jso1WmU>



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ALFRED E. ALQUIST
SEISMIC SAFETY COMMISSION MEETING

Memorandum

To: Seismic Safety Commissioners
From: Annde Ewertsen, Executive Director
Date: October 10, 2024
Subject: AB 100 Report: California Department of Transportation (Caltrans)

Recommendation:

Staff recommends Commissioners review the background information and be prepared to provide comments/questions on the presentation.

Background:

Assembly Bill 100 (Committee on Budget), enacted as Chapter 20 of the Statutes of 2020, established the Seismic Safety Commission's (SSC) annual reporting requirement. The Legislature finds that numerous agencies at various levels of government have substantial responsibilities in the fields of earthquake preparedness and seismic safety. To provide a consistent policy framework to track and monitor those activities and to identify key activities and responsibilities related to seismic safety, 10 entities are specifically called out in the legislation, and the SSC requests information from other entities voluntarily. Caltrans is one of the ten entities specified in AB 100 legislation. They are the twelfth entity to come before the SSC to underscore the value of its seismic programs to the public.

July 31, 2024

SEISMIC SAFETY OF CALIFORNIA BRIDGES



July 31, 2024

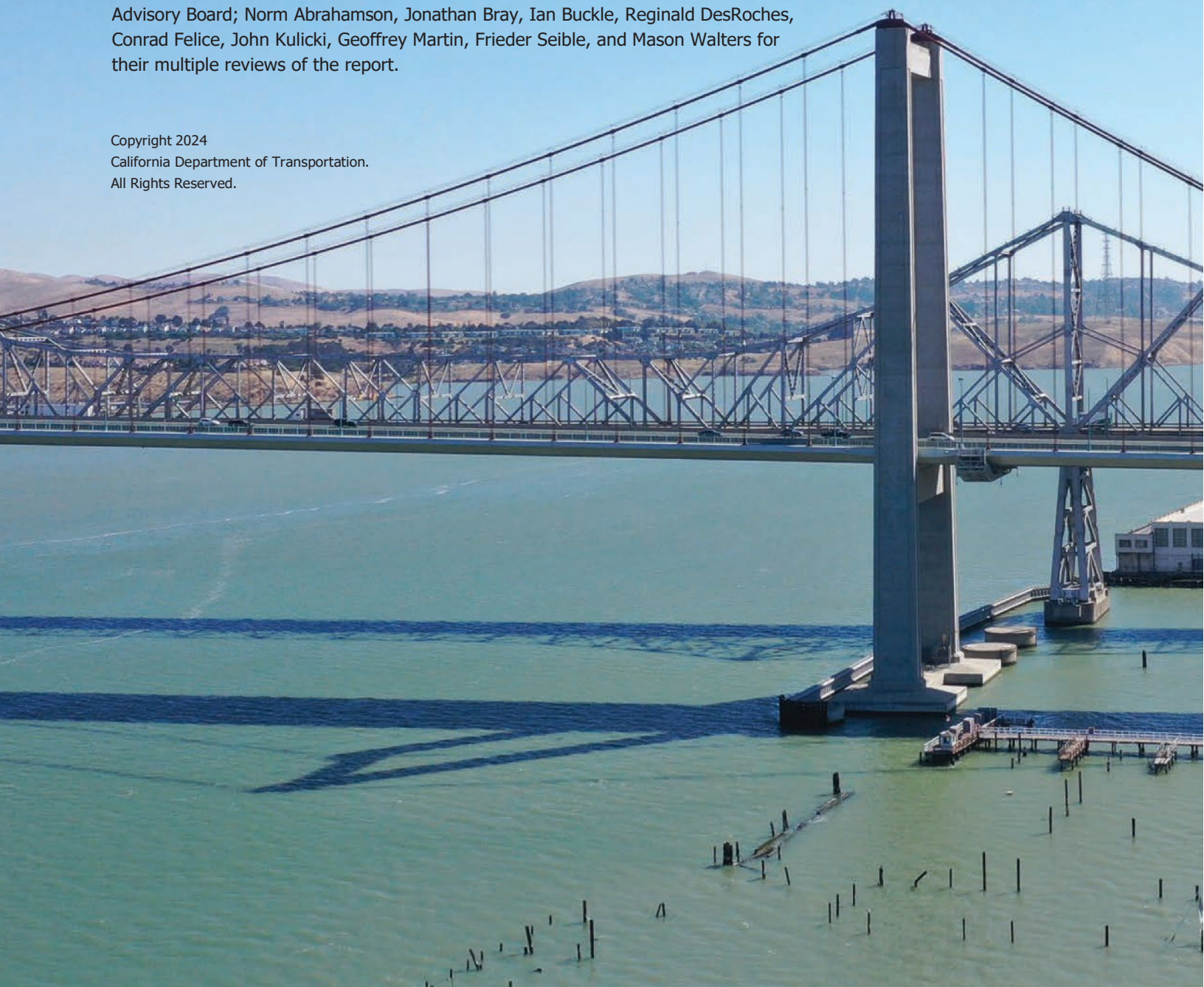
SEISMIC SAFETY OF CALIFORNIA BRIDGES

JULY 2024

ACKNOWLEDGMENTS

The California Department of Transportation extends its thanks to all those who assisted in preparing this self-assessment report. The individuals who deserve special recognition are Caltrans managers Thomas Ostrom, Rich Foley, Ruth Fernandes, Jim Foster and Chris Traina for direction and oversight, and Charles Sikorsky, Mark Mahan, and Mark Yashinsky for technical input and support. Also, a special thanks goes out to past and present members of the Caltrans Seismic Advisory Board; Norm Abrahamson, Jonathan Bray, Ian Buckle, Reginald DesRoches, Conrad Felice, John Kulicki, Geoffrey Martin, Frieder Seible, and Mason Walters for their multiple reviews of the report.

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EXECUTIVE SUMMARY

Caltrans recognizes that improving the seismic resilience of the State's transportation network requires a long-term commitment. It has been more than 30 years since the last catastrophic earthquake occurred, causing considerable damage, and it is highly probable that another major earthquake will occur in the near future. It is therefore critical that Caltrans keeps seismic safety a priority, continues a vigorous, solution-focused seismic research program, and remains diligent in the development of improved seismic policy, standards, and design provisions.

Caltrans continually evaluates the seismic vulnerabilities of its highway bridges and regularly reports to the Seismic Advisory Board (Board), which was established by Caltrans after the 1989 Loma Prieta earthquake, on the progress made in reducing the risk of major damage or even collapse of its bridges after a major earthquake. The number of bridges with seismic vulnerabilities continues to change due to:

- Advances in seismology, geotechnical practices, and knowledge of seismic structural vulnerabilities
- Aging bridges with associated deterioration affecting seismic performance
- Retrofits or replacements of existing bridges with seismic vulnerabilities

It has been several years since Caltrans formally published a report documenting the progress made and the continuing efforts needed to improve the seismic resilience of bridges on the State transportation system. This report addresses the following three questions and provides recommendations on the continuing efforts needed to improve the seismic resilience of highway bridges.

What has Caltrans done to improve the seismic safety of the State's bridges?

Caltrans has invested over \$12.2 billion in the retrofitting or replacing of 2,279 of the 13,214 bridges on the State Highway System using updated seismic design codes. Additionally, local agencies have invested more than \$1.4 billion toward retrofitting or replacing approximately 1,190 of their 13,400 locally-owned bridges.

Caltrans has worked with the U.S. Geological Survey, California Geological Survey, Pacific Earthquake Engineering Research Center, and academia to quantify and update the potential seismic hazards California bridges are exposed to.

Caltrans has developed the Seismic Design Criteria, a compilation of state-of-the-art seismic design and analysis methodologies for designing new design bridges in California. Many of the methodologies in the Seismic Design Criteria have evolved from Caltrans' extensive research and seismic retrofit programs.



What is the expected performance of new and retrofitted bridges?

Expected performance depends on the type of bridge and the service that it provides. After a large earthquake, new bridges categorized as “important” or “recovery” are expected to perform well, but may be closed for a short time for inspection and to complete any minor repairs before being quickly returned to service. Bridges constructed or widened using post-1990 Seismic Design Criteria are expected to perform well with a minimal potential for collapse during a large earthquake.

The performance of retrofitted bridges is expected to be significantly better than those that have not been retrofitted. Bridges not retrofitted during the Seismic Safety Retrofit Program were evaluated and deemed, at that time, as likely to be able to withstand a design-level earthquake without collapsing.

It is expected that most bridges will not collapse, but past earthquakes have demonstrated that the variability in ground motions at any given location could lead to a bridge collapse. Bridges near the earthquake epicenter could have extensive damage and be out of service for several months and possibly require replacement.

What is Caltrans doing to further reduce the seismic risk to the State’s bridges?

Since the 1989 Loma Prieta and 1994 Northridge earthquakes, continual improvements in seismic design strategies and methodologies for new and retrofitted bridges have drastically reduced the probability of a bridge collapse due to an earthquake. Improving seismic safety is an ongoing effort, and since many older bridges continue to remain vulnerable to seismic activity, Caltrans continues to:

- **Perform risk assessments of existing bridges.** Caltrans is continually assessing and identifying seismically-vulnerable bridges based on evolving knowledge, seismic research, and lessons learned from earthquakes that have occurred within and outside of California. Through research and testing, Caltrans continues to gain a better understanding of the seismic vulnerabilities of bridges.
- **Fund the seismic retrofit of bridges.** Although the Seismic Safety Retrofit Program has been completed, approximately 620 additional bridges on the State Highway System have been identified as being vulnerable to seismic activity through recent seismic screenings. Many of these bridges may need retrofitting or replacement. Caltrans continues to fund the seismic retrofit of these bridges through the State Highway Operation and Protection Program (SHOPP), with the goal of reducing this number by 70 percent by 2028.
- **Improve the seismic performance of new and retrofitted bridges.** Through the research and development of new and improved standards, the performance of new and retrofitted bridges will continue to improve. Caltrans has been at the forefront of seismic research and the development of design and construction standards and continues to fund research projects and further develop new seismic design standards.



INTRODUCTION

Following the 1989 Loma Prieta earthquake, Caltrans established the Seismic Advisory Board (Board), an independent body whose role is to advise Caltrans on seismic policy and best technical practices. In 2010, the Board released *Closing the Gap in the Race to Seismic Safety* [1]. In this report, the Board acknowledged Caltrans' progress in its efforts to achieve a safe transportation system. The Board also made the following recommendations:

- Complete the Toll Bridge Retrofit Program as expeditiously as possible
- Work with local agencies to complete the Local Agency Bridge Retrofit Program
- Work with the Board and the State government to keep seismic funding a priority
- Take an active role in the seismic assessment of all California transportation structures and systems
- Continue a vigorous, solution-focused seismic research program

This report documents the status and ongoing progress of Caltrans' efforts toward implementing the Board's recommendations from 2010. It also addresses the expected performance of the bridges that have been retrofitted or replaced and the continuing efforts needed to further reduce the seismic risk to the State transportation system.

MOVING PEOPLE AND GOODS

California's transportation system consists of a wide variety of physical assets. The most significant assets in terms of cost and extent are pavement and bridges. The California State Highway System consists of 50,259 lane miles of pavement and 13,189 bridges with an estimated bridge replacement cost of over \$188 billion. [2].

Highway bridges are integral to the transportation system due to their function of carrying roadways over natural and manmade obstacles. Severe earthquake damage to California's bridges would greatly impact the State Highway System and would adversely impact the State's economy and the well-being of all Californians. When a bridge is out of service, it severs the system, disrupting traffic, preventing access to communities, and impacting post-earthquake emergency response. Extensive bridge repairs and construction can significantly delay the recovery of an affected region.

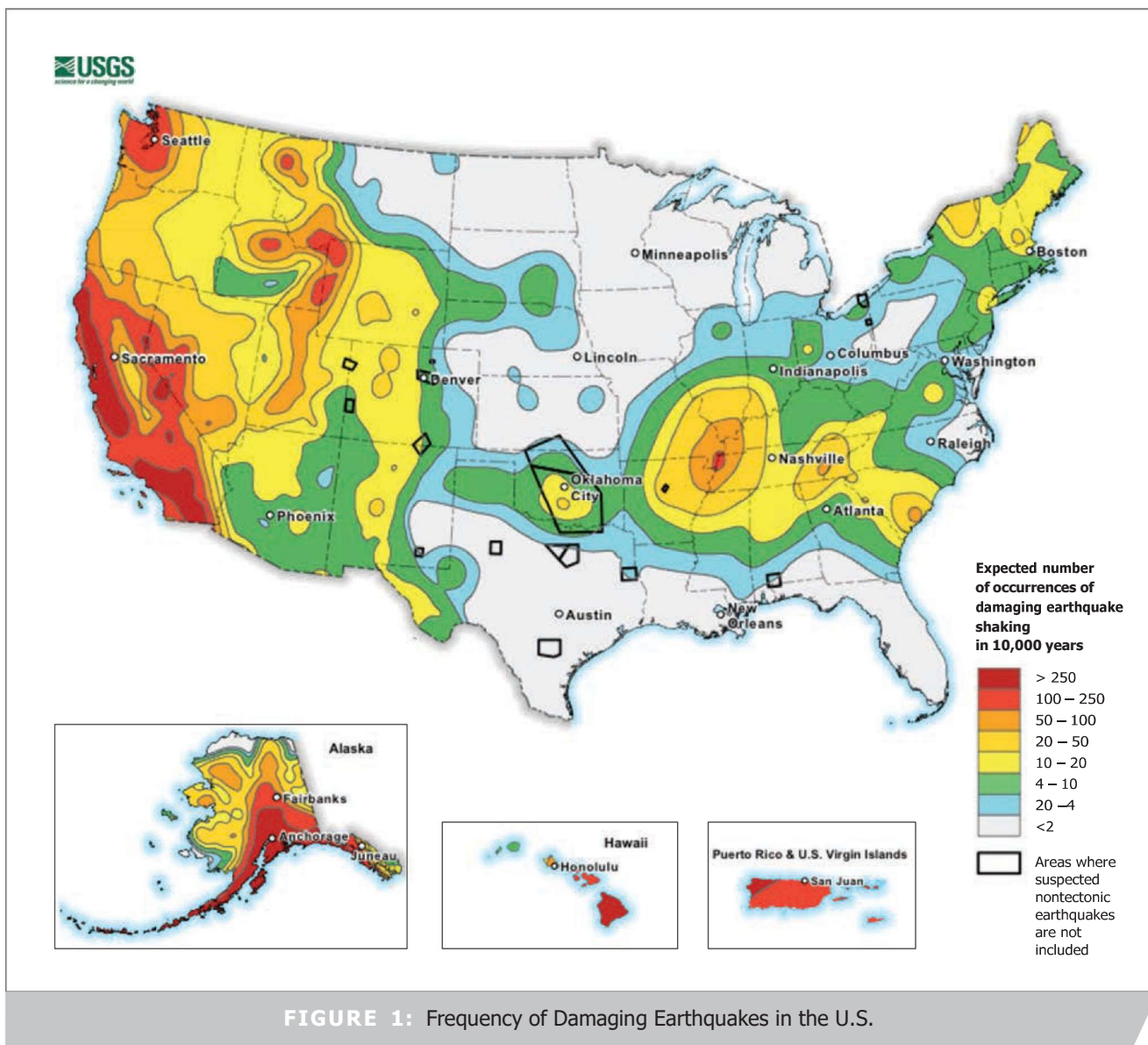
California's transportation system also includes assets owned by cities and counties, toll authorities, tribal governments, and state and federal agencies, including 13,400 locally-owned bridges [2].

Other highway structures, such as highway embankments, retaining walls, and pavement, are also vulnerable to earthquake damage but, in comparison to bridges, are less likely to threaten life safety. Disruption from bridge damage or loss is apt to be more expensive and of longer duration than similar damage to other transportation assets.

WHY ARE CALIFORNIA BRIDGES

AT RISK FOR EARTHQUAKES?

Bridges are often located in areas with poor soil conditions near rivers or bays or have an irregular geometry, leading to the bridge experiencing complex responses during an earthquake. Adding to the complexity, California is one of the most geologically diverse states in the country and has more earthquakes that cause damage to bridge and structures than any other state.



3 SEISMIC SAFETY OF CALIFORNIA BRIDGES

California has the following major seismic regions:

- Cascadia Subduction Zone.** This zone is a tectonic plate boundary that stretches from Vancouver Island in Canada to Cape Mendocino in Northern California. It is a long, sloping subduction zone where the Juan de Fuca and Gorda plates move to the east and slide below the much larger continental North American plate. Megathrust earthquakes can occur at subduction zones with magnitudes exceeding 9.0.
- San Francisco Bay Area.** This area straddles the boundary where two of the Earth's largest tectonic plates meet and are slowly moving past one another. When boundary faults break and the North American and Pacific plates move past each other, an earthquake occurs. At least eight faults in the Bay Area can produce earthquakes of magnitude 6.7 or larger.
- Southern California Coastal Area.** This area is highly susceptible to earthquakes and their related effects. Numerous earthquake faults crisscross Southern California, and most people in this region live within 10 miles of an active fault. In this region, the San Andreas Fault system is capable of producing powerful earthquakes as big as magnitude 8.0.
- Inland Empire.** This area is located along the San Andreas Fault from San Bernardino through the Coachella Valley to the Salton Sea. A large portion of the region's population lives within 50 miles of the San Andreas Fault and could be exposed to earthquakes as large as a magnitude 8. Many other faults such as the San Jacinto fault create smaller yet more frequent earthquakes.

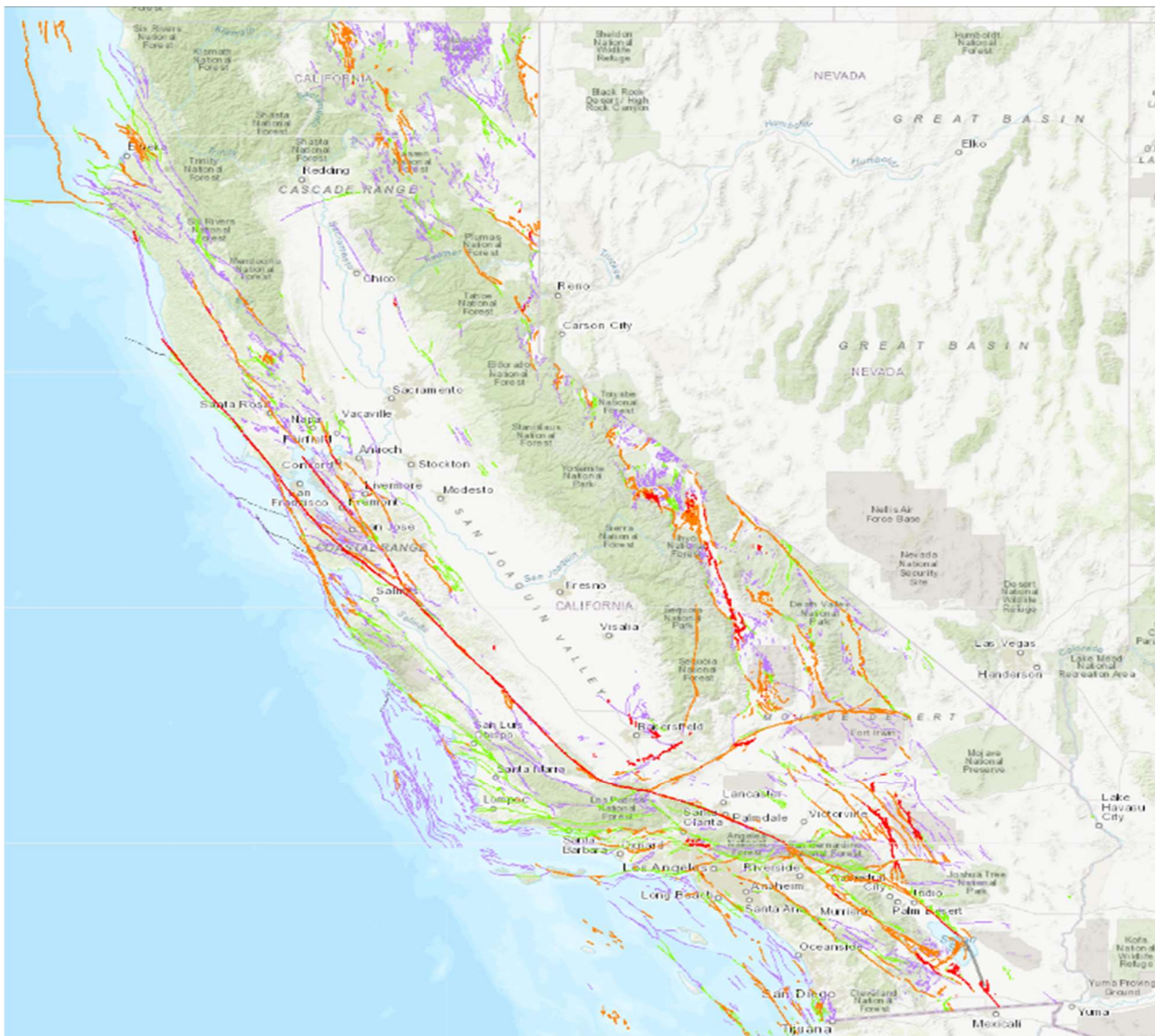
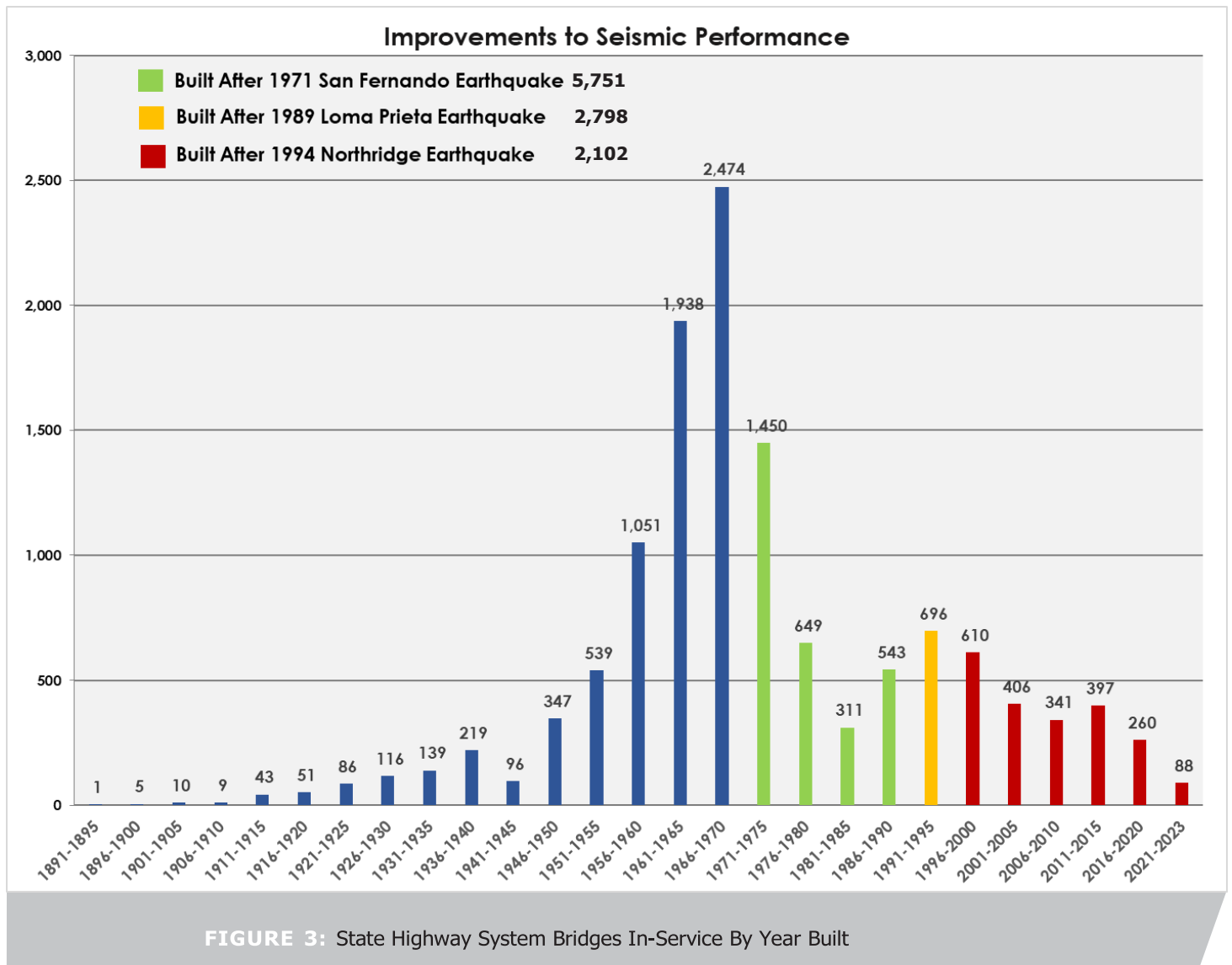


FIGURE 2: Major California Faults

IMPROVING DESIGN STANDARDS

TO MEET SEISMIC RISK

Approximately 8,500 of the 13,214 bridges on the State Highway System were built between 1945 and 1975, before California had developed robust seismic design standards for its bridges. Figure 3 shows the number of bridges built between 1890 and 2023 that are still in service, and the number constructed using the modern seismic design criteria standards developed by Caltrans after the 1971 San Fernando, 1989 Loma Prieta, and 1994 Northridge earthquakes.



5 SEISMIC SAFETY OF CALIFORNIA BRIDGES

The San Fernando, Whittier Narrows, Loma Prieta, and Northridge earthquakes caused collapse or severe damage to bridges in California. After each of these earthquakes, Caltrans addressed significant seismic-performance deficiencies and dramatically changed seismic design standards for bridges to reduce future vulnerabilities and damage. Below are summaries of key findings and actions taken from these major earthquakes:

1971 San Fernando Earthquake (Magnitude 6.6)

The significance of highway earthquake safety was first identified in 1971, when the I-5/I-14 interchange and the Route I-210/I-5 separation and overhead in the San Fernando Valley collapsed. At the time of the earthquake, the I-5/I-14 interchange was under construction, which reduced the loss of life. Post-event investigation determined that there were four principal failure modes:

- Failure of the rebar lap splices at the base of columns
- Failure of the rocker bearings
- Collapse of the bridge spans due to excessive movement at the bridge joints, causing unseating of spans
- Shear and bending failure of the columns

These key findings led to a statewide Caltrans seismic retrofit program to install cable restrainers on existing highway bridges to limit the relative displacement across joints and prevent individual spans from falling. Other seismic issues relating to state and local bridges were also identified, and research to address these issues was initiated. However, budget limitations in the late 1970s limited seismic retrofitting solely to the installation of cable restrainers.



FIGURE 4: Lap Splices at the Column Base Caused Collapse at Route I-210/I-5 Separation and Overhead

1987 Whittier Narrows Earthquake (Magnitude 6.0)

In 1987, the Whittier Narrows earthquake nearly caused the collapse of the I-5/I-605 separation structure in Downey, CA. This magnitude 6.0 earthquake generated ground motions significantly smaller than what engineers commonly believed at the time to be a threat to bridges.

The key finding from this earthquake was that short columns were vulnerable to shear damage, as shown in Figure 5. This unexpected damage caused Caltrans to accelerate efforts to understand how bridges perform in earthquakes and how to improve future designs.



FIGURE 5: Shear Damage of Short Columns at I-5/I-605 Separation

1989 Loma Prieta Earthquake (Magnitude 6.9)

The Loma Prieta earthquake caused unprecedented damage to bridges throughout the San Francisco Bay Area, resulting in huge economic losses and disruption as far as 60 miles from the earthquake's epicenter. The collapse of a 1.6-mile section of the two-level, elevated Cypress Street Viaduct in Oakland took 41 lives. This collapse led to these key findings:

- Need for better structural framing requirements for bridges
- Inadequate transverse reinforcement detailing and reinforcement development in the multilevel viaduct joints contributed to the failures of the joints, as shown in Figures 6 and 7
- Recognition of the important and detrimental role of soft clay sites in amplifying earthquake shaking of bridges

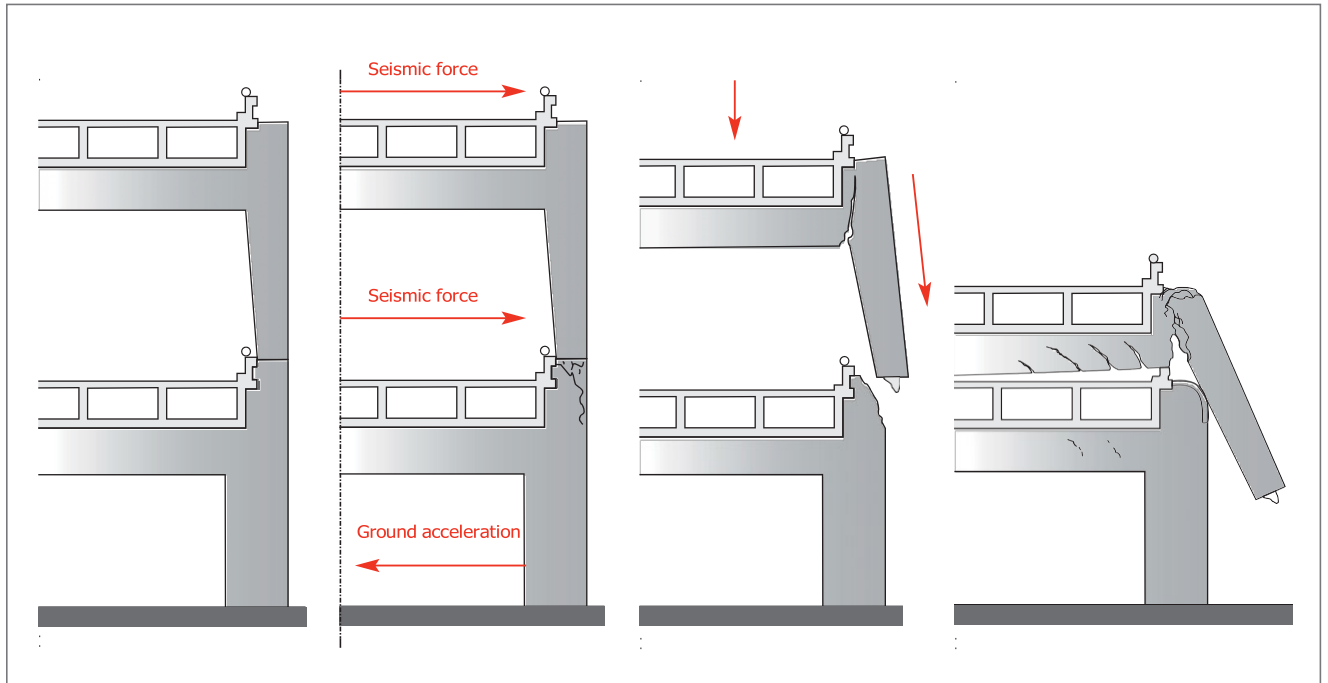


FIGURE 6: Collapse Sequence of the Cypress Street Viaduct



FIGURE 7: Collapsed Section of the Cypress Street Viaduct

Additionally, a section of the east span of the San Francisco–Oakland Bay Bridge unseated and collapsed onto the lower deck span, as shown in Figure 8. The unseating was due to structural framing issues at the junction of a flexible frame and a shorter stiffer frame, resulting in an insufficient hinge seat. The collapse led to one fatality and the closure of the bridge for 30 days to complete the repairs.

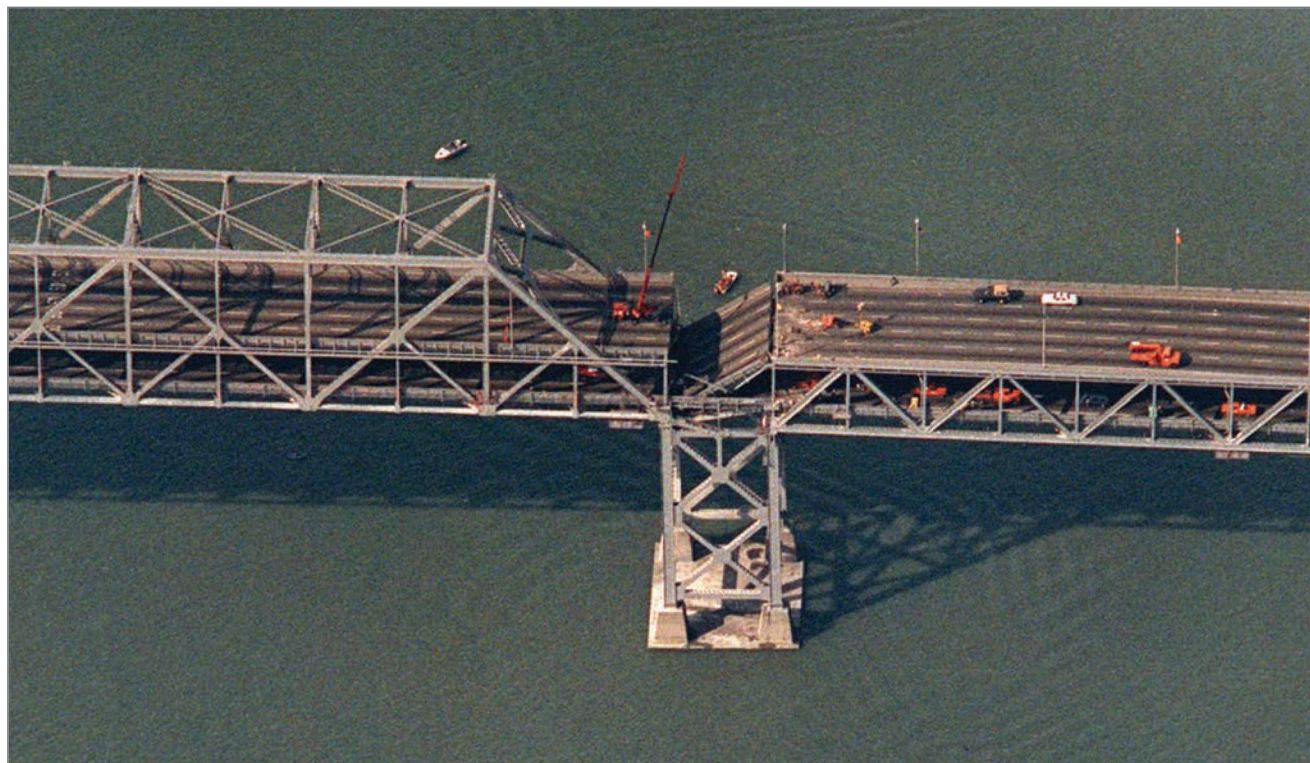


FIGURE 8: San Francisco–Oakland Bay Bridge Insufficient Hinge Seat

After the Loma Prieta earthquake, it was recognized that improving the seismic resistance of California’s bridges would require a substantial and sustained investment in both research and retrofitting. Then-Governor Deukmejian appointed a Board of Inquiry to assess the State Highway System’s deficiencies and provide recommendations for seismic safety. In 1990, the Board of Inquiry published *Competing Against Time* [3], which provided findings and recommendations for improving the seismic safety of California’s transportation system. Governor Deukmejian issued Executive Order D-86-90 to implement the principal recommendations. The order stated:

“seismic safety shall be given priority consideration in the allocation of resources for transportation construction projects, and in the design and construction of all state structures, including transportation structures and public buildings.”

Subsequent executive orders set the performance objectives for the seismic retrofit programs, established the Caltrans Seismic Advisory Board, and laid the groundwork for a robust seismic research program for transportation structures. Bonds approved by both the legislature and public provided the resources needed for the seismic retrofit programs.

1994 Northridge Earthquake (Magnitude 6.7)

The 1994 Northridge earthquake caused the collapse of seven state highway bridges and damaged an additional 230 bridges with damage ranging from serious column cracks and abutment failures to bridge-approach pavement settlements. The damage to highway bridges was greater than expected; however, the 24 retrofitted bridges located in the area of strong ground shaking performed well. Many of the damaged bridges had already been identified as requiring retrofit, but this work had not been completed before the earthquake occurred. Figure 9 shows the lack of confinement reinforcement in a column built before 1971, which resulted in the failure of the Santa Monica Viaduct.



FIGURE 9: Failure of the Santa Monica Viaduct Column

Key findings from the Northridge earthquake include:

- Lack of balance in stiffness and mass from bridge support to bridge support
- Intense pulse-like ground motions near the ruptured fault exceeded the anticipated design motions and contributed to the collapse of several bridges
- High skews on bridges create seismic vulnerabilities
- Longer seat widths at supports are needed to accommodate seismic displacements



FIGURE 10: Failure of a Short Column at the I-14/I-5 Connector Separation and Overhead

After the Northridge earthquake, a design requirement for similar stiffnesses for columns in an individual bent and for bents in a longitudinal frame was implemented. Figure 10 shows the failure of a short column at Bent 2 at the I-14/I-5 Connector Separation and Overhead. The structure's other columns were longer and more flexible. Figure 11 shows a schematic of a bridge with varying column heights in both a frame and an individual bent. The shorter stiffer columns are less flexible and will attract higher forces during an earthquake.

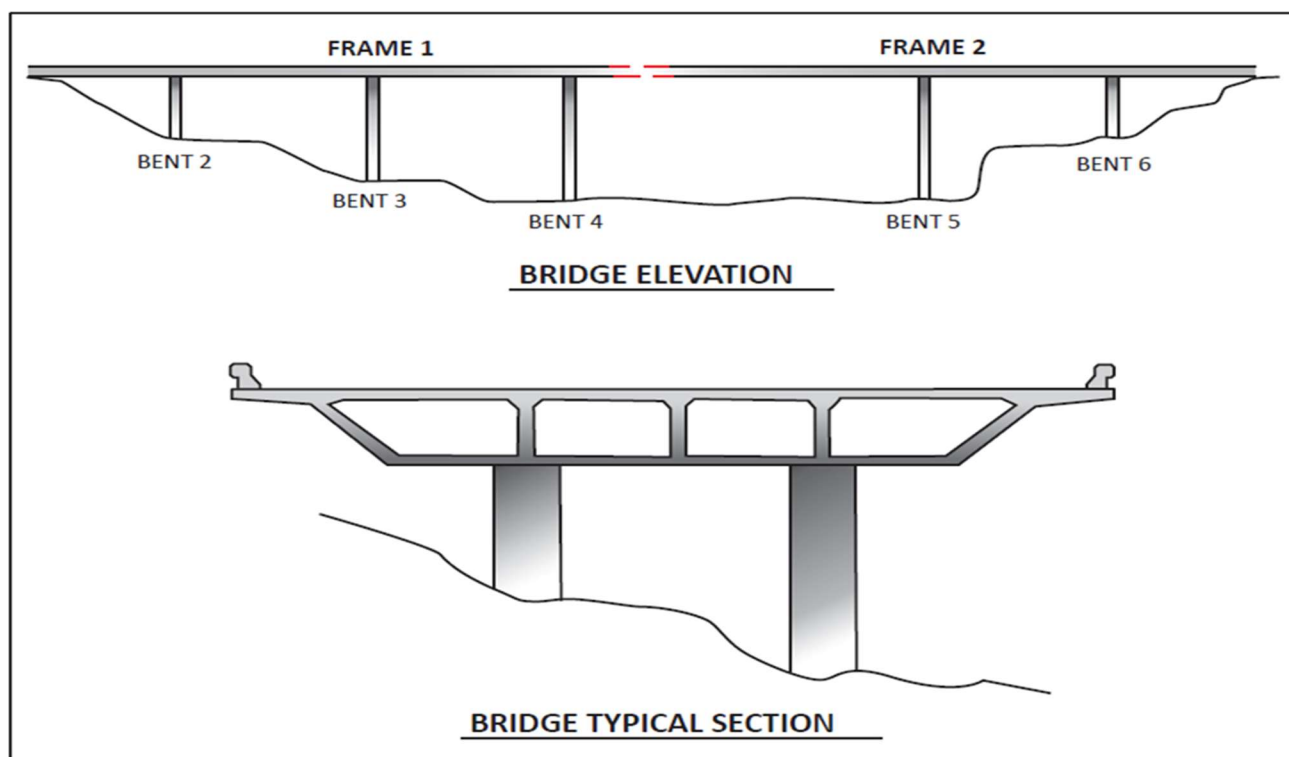


FIGURE 11: Bridge with Varying Column Heights

11 SEISMIC SAFETY OF CALIFORNIA BRIDGES

Figure 12 shows the unseating of bridge spans at Gavin Canyon Undercrossing on I-5, north of the I-14/I-5 interchange. The collapse can be attributed to complexities arising from the 66-degree skew of the abutments and expansion joints, as well as the 8-inch expansion joint seat widths. The bridge had been retrofit with expansion joint restrainers; however, these were not sufficient to keep the spans from unseating.

After the Northridge earthquake, Caltrans renewed its efforts to mitigate the seismic hazards posed to California bridges with a significant seismic retrofit program.



FIGURE 12: Unseated Highly-Skewed Bridge Spans at the Gavin Canyon Bridge

IMPROVING THE SEISMIC SAFETY OF BRIDGES

Since the 1971 San Fernando earthquake, Caltrans has continued to develop and improve seismic design standards for new construction based on the lessons learned from each subsequent major earthquake. These improvements include:

- Increasing the transverse reinforcement and improving the continuity of main reinforcement in bridge columns
- Eliminating vulnerable lap splices in reinforcement that connect footings to the columns
- Increasing the minimum seat widths at expansion joints, abutment seats, and hinges
- Developing site-specific ground-shaking hazards for designing bridges and a capacity-based design method that relies on structural column fuses to limit seismic forces
- Requiring similar stiffness for columns in an individual bent and for bents in a longitudinal frame
- Establishing improved seismic requirements for the development lengths and splices in reinforcement

After the 1989 Loma Prieta earthquake, new legislation mandated and funded programs to seismically retrofit—or replace—State Highway System, toll, and local bridges. Although the Bridge Seismic Retrofit Programs have concluded for bridges on the State Highway System, Caltrans continues to fund Bridge Seismic Restoration Projects through its State Highway Operation and Protection Program (SHOPP).

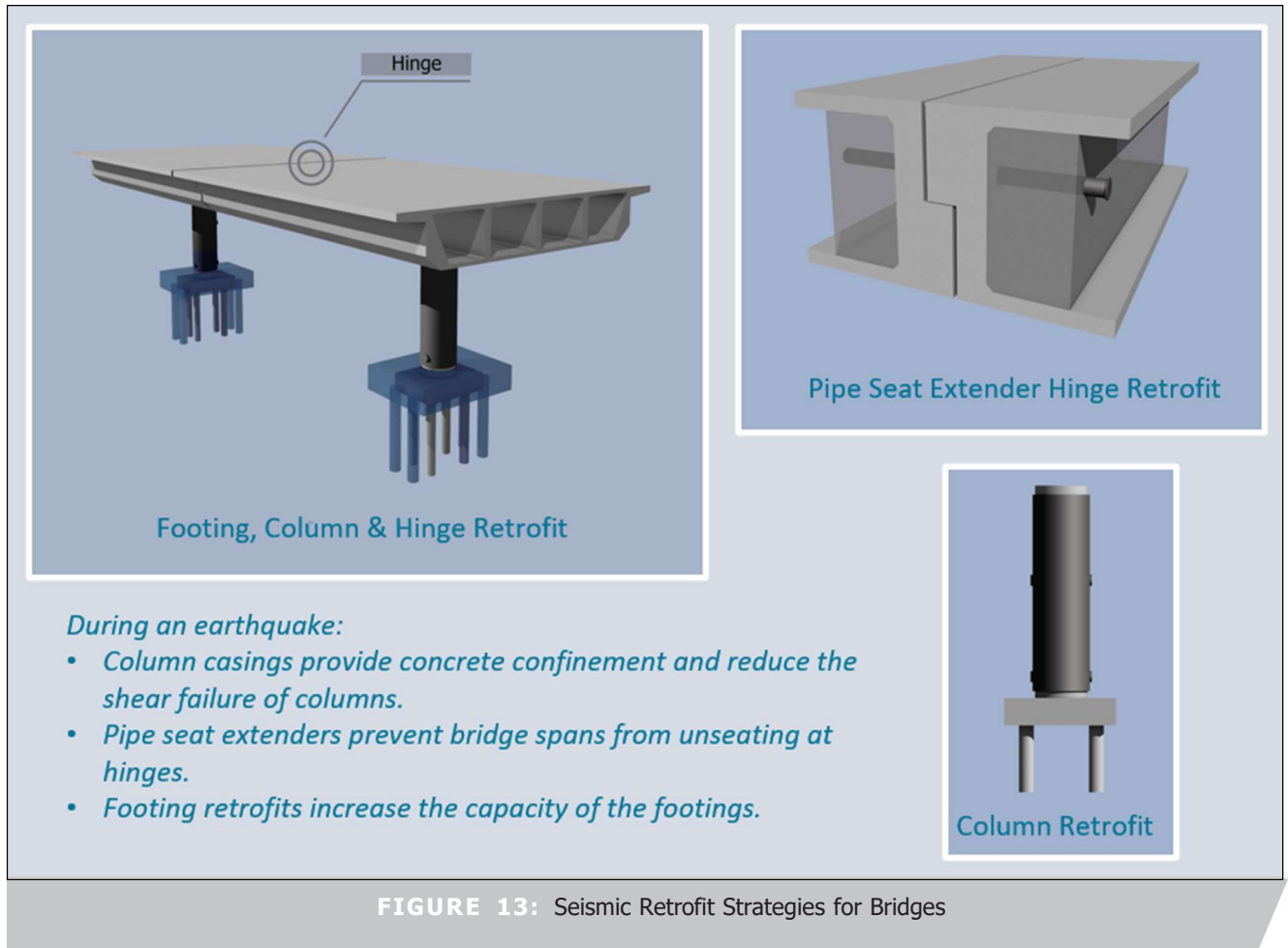
| | Number of Bridges | Bridges Retrofitted or Replaced | Cost (Billions)* |
|-----------------------------|-------------------|---------------------------------|------------------|
| State Highway System | 13,214 | 2,278 | \$3.2 |
| Toll Bridges | 9 | 9 | \$9.4 |
| Local Bridges | 13,400 | 1,192 | \$1.4 |

*Retrofit costs are approximate since some retrofitting was combined with other rehabilitation work.

Retrofitting State Highway System Bridges

In 1990, Caltrans screened all State Highway System bridges for seismic vulnerabilities that could potentially lead to a bridge collapse during a large earthquake. These seismic vulnerabilities included poor structural details and proximity to known earthquake faults, where strong ground shaking could occur. The bridges were evaluated using a risk-based algorithm. At the time of the initial screening, most bridges were deemed adequate to survive the then design-level earthquake without retrofitting. A design-level earthquake is a theoretical earthquake event used to check the seismic resilience of a structure. Over 25 percent of the approximately 12,000 State Highway System bridges in service at the time of the original screening were retrofitted or replaced to lower or significantly minimize the probability of a collapse during a large earthquake. Figure 13 shows typical bridge retrofit strategies including column casings, enlarged foundations, and pipe seat extenders.

Since 1990, Caltrans has diligently implemented the directions set forth in Governor Deukmejian's Executive Order D-86-90 through the Seismic Safety Retrofit Program. In March 1996, voters approved Proposition 192 (Seismic Retrofit Bond Act of 1996), which provided \$2 billion to finance the retrofit of State highway bridges, overpasses, and interchanges. These programs have improved the performance and life safety of the State's bridges through improvements to the seismic design standards for new bridges and retrofitting existing bridges.



Improving the Seismic Performance of Toll Bridges

In 1994, Caltrans initiated the Toll Bridge Seismic Safety Program to improve the seismic performance of seven of the State's nine toll bridges. In March 1996, voters approved Proposition 192 (Seismic Retrofit Bond Act of 1996), providing \$2 billion to finance the retrofit of State highway bridges, overpasses, and interchanges, of which \$650 million was dedicated to the seven San Francisco Bay Area toll bridges. Senate Bill 60 (August 1997), Assembly Bill 1171 (September 2001), and Assembly Bill 144 (July 2005) provided additional funding to complete the Toll Bridge Program retrofit projects. In 2009, Assembly Bill 1175 added the Dumbarton and Antioch toll bridges to the program. The Antioch Bridge retrofit was completed in 2012, and the Dumbarton Bridge retrofit was completed in 2013. The seismic retrofit of the Vincent Thomas Bridge, San Diego–Coronado Bay Bridge, Carquinez Bridge, Benicia-Martinez Bridge, San Mateo–Hayward Bridge, Richmond–San Rafael Bridge, West Spans of the San Francisco–Oakland Bay Bridge, and the replacement of the East Spans of the San Francisco–Oakland Bay Bridge have all been completed.



The design basis for the Toll Bridge Seismic Safety Program was well developed and benefited from research findings. The engineering models and analysis procedures were state-of-the-art and laid the groundwork for what is now the state of the practice for earthquake engineering of long-span bridges. The nine toll bridges are expected to meet the projected performance of life safety and serviceability after an earthquake. In the case of the new section of the Bay Bridge and the new Benicia-Martinez Bridge, an even higher performance standard was implemented with an expectation of no or minimal damage and a return to full service immediately following a major earthquake [4].

Retrofitting California's Locally-Owned Bridges

A Local Bridge Seismic Safety Retrofit Program was initially mandated by Senate Bill 36X in 1989. This emergency legislation provided funding assistance for public bridges owned by local agencies to achieve compliance with current seismic safety standards. All 12,500 locally-owned bridges in service at that time were evaluated for earthquake vulnerabilities, of which 1243 bridges were identified as having potential earthquake vulnerabilities. In November 2006, voters passed Proposition 1B (Highway Safety, Traffic Reduction, Air Quality and Port Security Bond Act of 2006), which established a \$125 million Local Bridge Seismic Retrofit Account to provide matching funds to complete bridges in the Local Bridge Seismic Retrofit Program. As of December 31, 2023, 1,205 local bridges have been retrofitted, replaced, or removed from the program, with an additional 25 bridges in construction and 13 bridges in design that remain in this program. Caltrans provides oversight and assistance to this program through its Local Assistance Highway Bridge Program.

Caltrans Seismic Design Criteria

Caltrans Seismic Design Criteria (SDC) [5] is a compilation of state-of-the-art seismic design and analysis methodologies for designing new bridges in California. Many of the methodologies in the Seismic Design Criteria have evolved from Caltrans' extensive research and seismic retrofit programs.

The 1999 Seismic Design Criteria adopted a performance-based approach by specifying minimum levels of structural system and component performance, analysis, and design practices for ordinary standard bridges. Ordinary standard bridges are designed for life safety and might experience major damage during an event, but have a minimal probability of collapse. Bridges with nonstandard features or operational requirements above and beyond the ordinary standard bridge will require project specific seismic design requirements in addition to those specified by the Seismic Design Criteria.

The Caltrans 1999 Seismic Design Criteria changed the fundamental design philosophy for new bridges, shifting from a force-based assessment of seismic demand and capacity to a displacement-based assessment of seismic demand and capacity—designing for flexibility rather than strength. More flexible bridge components attract less earthquake energy, but because of their ductile nature, they must be designed to handle greater deflections during an earthquake.

Caltrans Seismic Design Criteria includes the following design principles:

- Earthquakes and the resulting ground shaking are assessed using probabilistic scientific tools
- Bridges are designed to dissipate the seismic energy while accommodating the deformation demands
- Critical components of bridges, such as the superstructure, column cores, and foundations, are designed to be capacity protected to carry their self-weight, thus minimizing the probability of collapse
- Seismic energy is directed to predesignated locations (called plastic hinges) in columns and shafts and to soils behind abutments
- Plastic hinges must be resilient (ductile) and tolerate large rotations without degradation, while limiting the force transfer to other bridge components

EXPECTED SEISMIC PERFORMANCE OF NEW AND RETROFITTED BRIDGES

The seismic resilience of California's bridge system is measured by the ability to decrease the probability of failure and minimize the length of time that a bridge is out of service after an earthquake. The goal is to diminish the consequences of a failure, such as loss of life and economic and social hardships, and to be able to recover quickly and reestablish normal services.

Most of the older bridges evaluated in the early 1990s were deemed capable of withstanding a major earthquake without retrofitting, although those near the epicenter could be damaged enough to be out of service for several months, and some would likely require replacement. Collapse is not expected for most of these bridges. However, past earthquakes have demonstrated that the extreme variability in ground motions at any given location could lead to a bridge collapse. [4]

EXPECTED SEISMIC PERFORMANCE OF NEW BRIDGES

New bridges designed to meet the seismic design standards developed after the Loma Prieta earthquake are expected to have a low probability of collapse. However, bridges categorized as "important" or "recovery" are designed to higher seismic standards and are expected to perform well with little damage or no damage, although they may be closed for a short period of time for inspection and while minor repairs are being performed.

Investigations of bridges after the 2023 magnitude 7.8 Turkey earthquake found that the bridges performed well with some damage but there was no knowledge of any bridge collapses. These bridges were designed using similar seismic design standards to that of California, which bodes well for the expected seismic performance of new bridges in California. [6]

EXPECTED SEISMIC PERFORMANCE OF RETROFITTED BRIDGES

The seismic performance of bridges assessed and retrofitted is expected to be significantly better than those that have not been retrofitted. However, prior to the Northridge earthquake, only the most vulnerable components of bridges were retrofitted. These partially-retrofitted bridges were reevaluated as part of Caltrans' 2015 seismic screening of the bridges on the State Highway System, and those bridges deemed vulnerable have been earmarked for additional evaluation and potentially further retrofit.

Existing bridges are retrofitted to only reduce the probability of collapse and loss of life, since it is not typically economically feasible to retrofit a bridge that has been in service for several decades to the performance level of a new bridge. Designers must balance retrofit costs to achieve the goal of no collapse with the cost of constructing a new bridge. In some circumstances, the cost to retrofit a bridge was nearly that of replacement, so many older bridges have been replaced in lieu of retrofitting.

California has not had a major earthquake in a heavily populated area of the state since the 1994 Northridge earthquake. A survey completed after the Northridge earthquake found that all 63 seismically-retrofitted bridges within the area of strong shaking performed well.

Additionally, in the 2014 magnitude 6.0 South Napa earthquake, all 54 of the retrofitted bridges within the area of strong shaking performed well. Before the earthquake, all 412 State Highway System bridges in Solano, Napa, and Sonoma counties had been screened for seismic vulnerabilities. The Route 37 Napa River Bridge, which was extensively retrofitted in 1996, experienced minimal damage and was reopened to traffic shortly after inspection. The Sonoma Creek Bridge, which was retrofitted in 1999, also had no damage. The performance retrofitted bridges in recent earthquakes demonstrates an increase in the seismic resilience of these bridges.

CALTRANS EFFORTS TO REDUCE SEISMIC RISK

Caltrans Office of Earthquake Engineering, Analysis, and Research supports the effort to reduce the seismic risk to the bridges on the State Highway System through their continual seismic assessments of existing bridges. These seismic assessments are updated regularly to include knowledge gained from the seismic research program, lessons learned from past earthquakes, and the development of improved seismic policy, standards, and design provisions. The Office of Earthquake Engineering, Analysis, and Research also manages the Caltrans Seismic Research Program and provides seismic-design-related support to Caltrans' and consultant bridge designers.

Assessing and Prioritizing Seismically Vulnerable Bridges

Seismically-vulnerable bridges have the potential for damage and even the possibility of collapse. Caltrans regularly assesses the seismic hazard and performance of the State Highway System bridges to ensure that bridges built or retrofitted with earlier seismic design standards can be expected to perform sufficiently to prevent collapse. The Caltrans seismic-screening database contains the latest resiliency data for each bridge in the state bridge inventory.

In the 2015 seismic screening [7], Caltrans applied a newly-developed algorithm to better identify weaknesses and prioritize seismically-vulnerable bridges, which considered:

- Bridges crossing active faults
- Bridges located in soils with high liquefaction potential
- Bridges with increased ground-shaking hazards
- Improvements in seismology and seismic analysis
- Bridge vulnerabilities not addressed in previous retrofit programs

In the 2015 screening, 553 bridges were identified as seismically vulnerable. In the 2019 seismic screening [8], Caltrans identified additional bridges with potentially vulnerable lap splices in the main reinforcement at the base of columns and prioritized their retrofit, bringing the number up to 642 bridges.

As of this writing, there are approximately 620 bridges identified as being seismically vulnerable. This number is constantly changing as retrofits or bridge replacements are completed, or identified bridges are further analyzed and deemed to not need a retrofit.

Caltrans' performance target in the 2019 State Highway System Management Plan is to reduce the number of seismically-vulnerable bridges by 70 percent by 2028. The 2020 State Highway Operation and Protection Program (SHOPP) funds the repair and preservation, emergency repairs, safety improvements, and limited highway operational improvements on the State Highway System. For the 2020 SHOPP, Caltrans will fund \$2.4 billion in bridge projects over four years. These projects include bridge rail upgrades, bridge and tunnel rehabilitation, bridge scour mitigation, bridge seismic restoration, and bridge goods movement upgrades. On average, Caltrans spends \$56 million each year on bridge seismic restoration projects.

Current policies also require that bridge engineers assess the seismic performance of every bridge that is widened or undergoes major rehabilitation. If needed, bridge retrofit work is either incorporated into the project or earmarked for a follow-up bridge retrofit project.

World-Leading Seismic Research

Since the 1971 San Fernando earthquake, Caltrans has been recognized as both a national and international leader in seismic research and the development of seismic policy, standards, and design provisions for bridges. Caltrans takes this vital role seriously as part of its core mission of managing California's transportation-related assets, and continues to advocate for and advance further innovations to better protect the well-being of its people and the prosperity of the State. Achieving these objectives requires continual investment in research and development of analytical procedures and tools, and learning from major seismic events.

State-of-the-art analytical procedures and tools are essential to accurately assess a bridge's seismic performance to ensure that engineers are designing bridges that minimize the probability of loss of life and reduce the cost associated with a severely impaired or inoperable transportation system after a major earthquake. These tools include simulation modeling to better predict the seismic response of the bridge; advanced probability-based risk-assessment methods that consider uncertainties in seismic hazards and structural performance; and more efficient field evaluation methods for bridge condition assessment, maintenance, and rapid post-earthquake damage assessment and repair.

Caltrans continues to work with the U.S. Geological Survey, California Geological Survey, Pacific Earthquake Engineering Research Center, and academia to quantify and update the potential seismic hazards bridges are exposed to, including ground shaking, fault crossing, liquefaction and lateral spreading, and tsunamis, to develop a database of representative site-specific design spectra, ground-motion histories, and possible surface offsets due to fault rupture. This information will be used for future seismic vulnerability assessments and design. Additionally, through a partnership with the U.S. Geological Survey, Caltrans implemented the ShakeCast tool, a post-earthquake bridge inspection prioritization system that highlights bridges and buildings most likely to be damaged after an earthquake.

Probabilistic Methodology and Performance Criteria

Caltrans no longer designs or retrofits bridges to a specific earthquake magnitude. Instead, Caltrans uses a probabilistic methodology that evaluates a multitude of earthquake scenarios for a given bridge location. For example, the methodology considers the bridge's distance from earthquake faults, the expected ground motion intensity at the bridge site, and the soil characteristics beneath the bridge.

The seismic hazard used to design ordinary highway bridges corresponds to an annual return period of 975 years. Another way of describing the seismic hazard is an earthquake large enough to induce ground shaking at the bridge has a 5 percent probability of occurring or being exceeded over any 50-year period.

Caltrans, in collaboration with the Seismic Advisory Board, created the following seismic performance criteria categories for bridges:

Important Bridges

Important bridges are essential for regional emergency response. An important bridge is designed to meet the highest standards and is expected to remain in service with no or minimal damage, even after a large earthquake. The San Francisco–Oakland Bay Bridge East Span replacement and the new Benicia-Martinez Bridge have been both designated as important bridges since they are complex bridges located on lifeline routes. The State's other toll bridges were retrofitted to withstand earthquakes of similar magnitude and intensity as an important bridge, but they are not expected to be immediately put back into service after a large earthquake.

Recovery Bridges

Recovery bridges serve as vital links for rebuilding damaged areas and providing access to the public shortly after an earthquake. They are designed for enhanced performance above "ordinary" bridges but less than the performance of "important" bridges. This category was added to the 2019 Seismic Design Criteria, version 2.0 [5]. Recovery bridges are expected to have minimal to moderate damage with service limited to emergency vehicles for bridges with moderate damage.

Ordinary Bridges

Ordinary bridges are categorized as either standard or nonstandard. Bridge engineers design standard bridges, such as typical highway undercrossings and overcrossings, to minimize the probability of collapse by following standardized seismic design and analysis methodologies. The Seismic Design Criteria that Caltrans developed in the 1990s primarily addressed ordinary standard bridges. Even though an ordinary bridge designed to the current SDC might suffer significant damage, it is expected to be able to return to service within a reasonable amount of time.

Nonstandard or complex bridges, like cable-supported, arch, or other unusual structure types, are often designed for enhanced seismic performance, reflecting their complex response, cost, and the monetary cost to repair or replace them after a major earthquake. Additionally, the SDC requires that a Safety Peer Review team be established for these nonstandard or complex bridges.



FIGURE 15: New Benicia-Martinez Bridge Is Designed to Meet Highest Standards

Accelerated Bridge Construction

In partnership with the Federal Highway Administration, Caltrans is developing bridge structures that are faster and more economical to construct that are also resilient to earthquakes. Accelerated bridge construction techniques allow for faster recovery from a major earthquake with the use of precast concrete components to construct bridges quickly while still meeting Caltrans seismic design standards and performance requirements.



FIGURE 16: Echo Summit Bridge Replacement Project

The Echo Summit Bridge Replacement was completed in October 2022. The project replaced a bridge that had served motorist travelling to and from Lake Tahoe since 1939. This project incorporated precast, prestressed girders, concrete overlays, precast columns, and precast abutments. Seven 96-foot girders were connected with ultra-high performance concrete to enhance the durability of the structure. The new bridge replaced a 24-foot road width with a 30.75-foot road width to provide for safer 12-foot lanes and increased shoulder widths.



FIGURE 17: Echo Summit Precast Girders



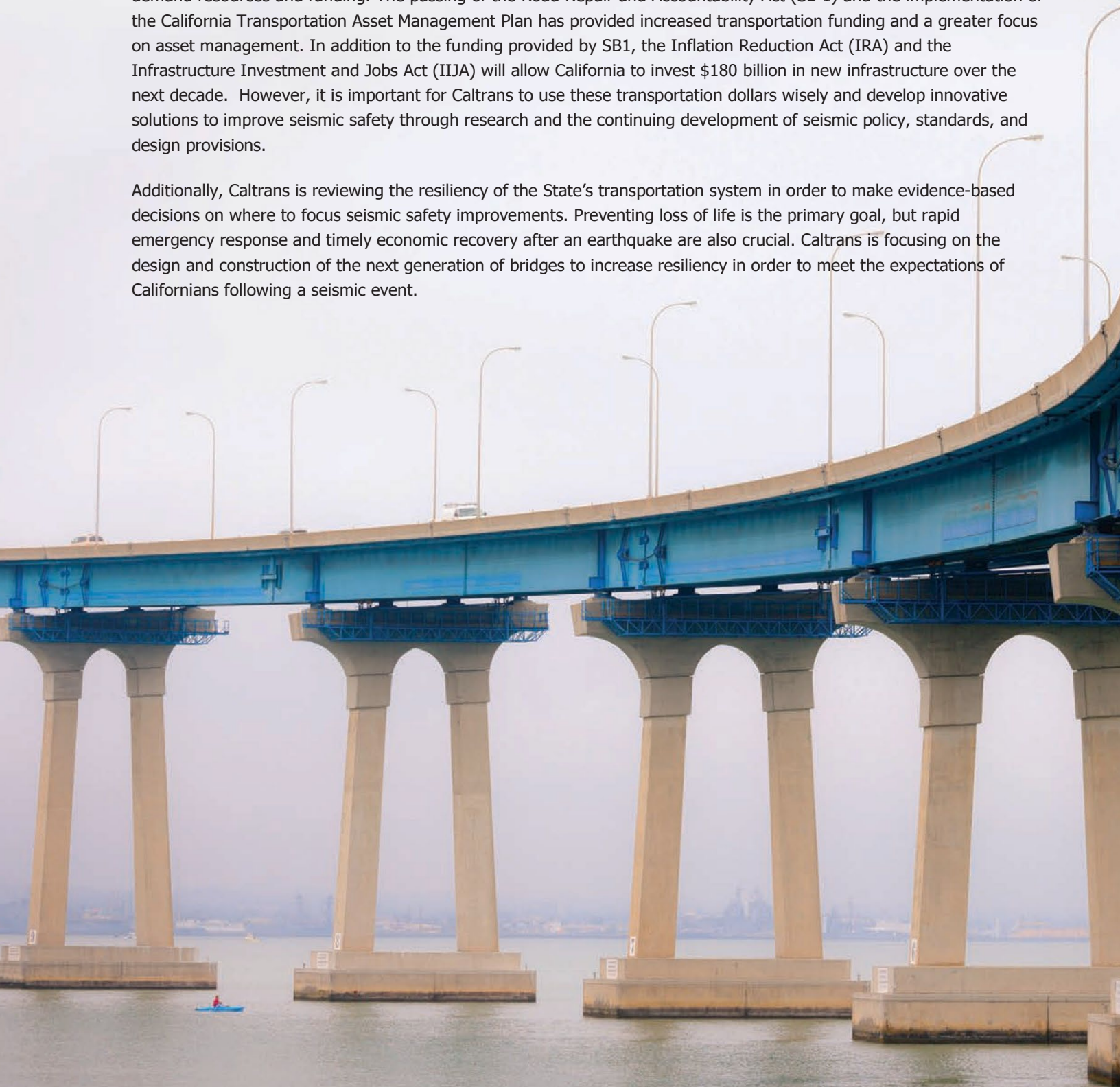
FIGURE 18: Completed Echo Summit Bridge

MOVING FORWARD

Since the 1971 San Fernando, 1989 Loma Prieta, and 1994 Northridge earthquakes, continual improvement in the seismic design of new bridges and the retrofitting of existing bridges has drastically reduced the probability of a bridge collapse due to an earthquake. However, recent seismic screenings have shown that many older State Highway System bridges—most of them located in the Bay Area and Southern California—are seismically vulnerable.

Caltrans has had to balance the efforts of improving seismic safety against other significant transportation needs that demand resources and funding. The passing of the Road Repair and Accountability Act (SB 1) and the implementation of the California Transportation Asset Management Plan has provided increased transportation funding and a greater focus on asset management. In addition to the funding provided by SB1, the Inflation Reduction Act (IRA) and the Infrastructure Investment and Jobs Act (IIJA) will allow California to invest \$180 billion in new infrastructure over the next decade. However, it is important for Caltrans to use these transportation dollars wisely and develop innovative solutions to improve seismic safety through research and the continuing development of seismic policy, standards, and design provisions.

Additionally, Caltrans is reviewing the resiliency of the State's transportation system in order to make evidence-based decisions on where to focus seismic safety improvements. Preventing loss of life is the primary goal, but rapid emergency response and timely economic recovery after an earthquake are also crucial. Caltrans is focusing on the design and construction of the next generation of bridges to increase resiliency in order to meet the expectations of Californians following a seismic event.



There is no finish line for seismic resiliency of bridges on the State transportation system, and Caltrans recognizes the importance of making incremental improvements with a focus on investing in research that helps to evolve the state of practice in earthquake engineering and to incorporate lessons learned from seismic events around the world. Caltrans must also remain diligent about routinely evaluating the seismic vulnerability of its bridge inventory using updated risk assessment algorithms. These long-term investments ensure that Caltrans continues to advance seismic resiliency even when other extreme events vie for attention and resources.

Lastly, local bridges play an important role in the resiliency of the State transportation system. Caltrans must continue to work with local agencies to promote the importance of their seismic retrofit programs to ensure emergency response and mobility after a major earthquake.

CONCLUSION

This report provides an assessment of what has been done to improve the seismic resilience of bridges in California, describes how bridges are likely to perform during the next major earthquake, and what is being done to further reduce the probability or risk of major damage to or collapse of bridges during a large earthquake. To that end, this report answers the following three questions.

What has Caltrans done to improve the seismic safety of the State's bridges?

- Caltrans has invested \$12.2 billion in retrofitting or replacing 2,279 of the 13,214 bridges on the State Highway System, using updated seismic design standards. Additionally, local agencies have invested more than \$1.4 billion toward retrofitting or replacing 1,204 of the 13,400 locally-owned bridges.
- Caltrans has worked with the U.S. Geological Survey, California Geological Survey, and academia to quantify and update the potential seismic hazards bridges are exposed to.
- Caltrans has developed the Seismic Design Criteria, a compilation of state-of-the-art seismic design and analysis methodologies for designing new bridges in California. Many of the methodologies in the Seismic Design Criteria have evolved from Caltrans' extensive research and seismic retrofit programs.

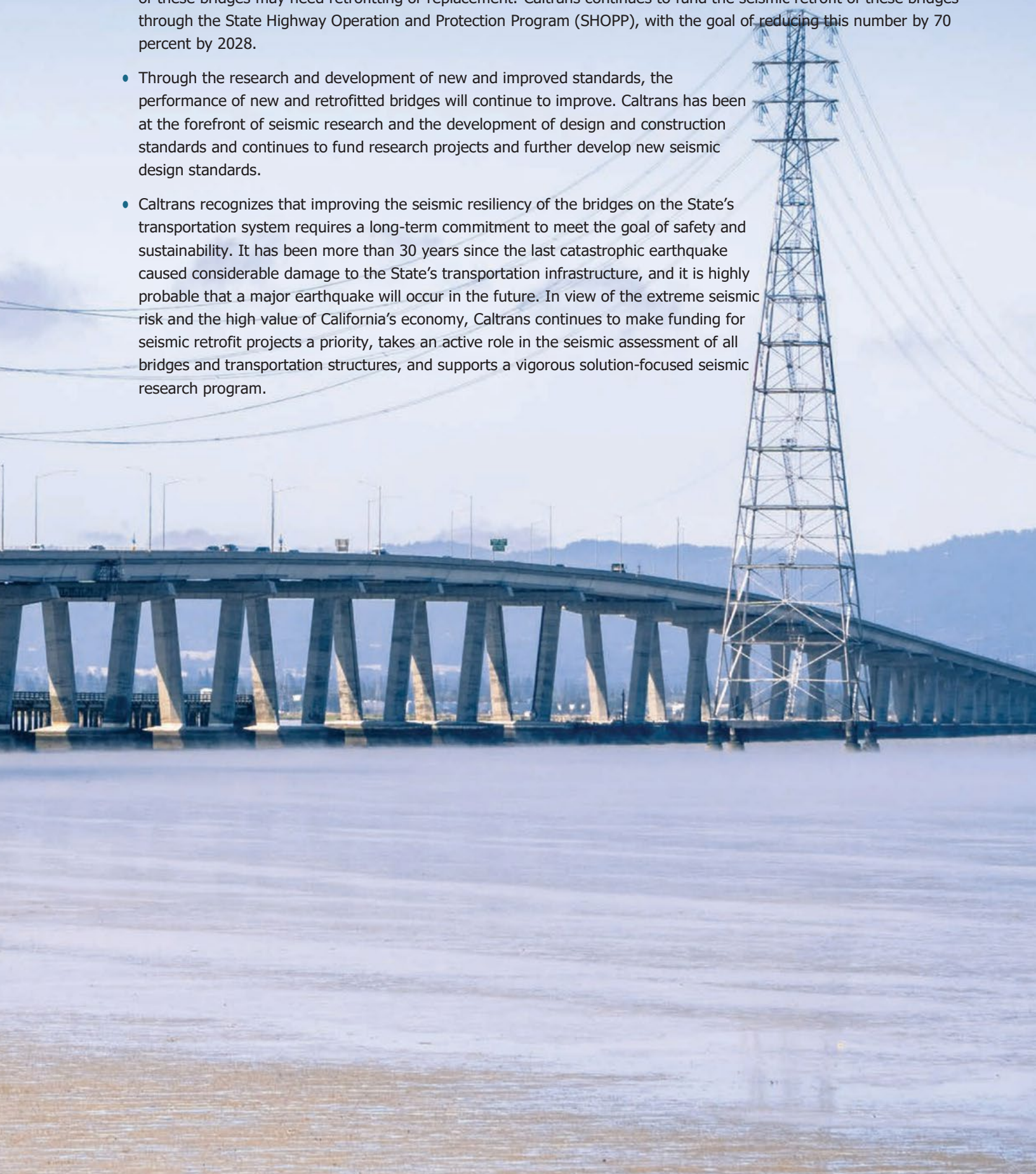
What is the expected performance of new or retrofitted bridges?

- After a large earthquake, new bridges categorized as "important" or "recovery" are expected to perform well, but may be closed for a short time for inspection and to complete any minor repairs before being quickly returned to service.
- Bridges constructed or widened using post-1990 Seismic Design Criteria are expected to perform well with a minimal potential for collapse during a design-level earthquake.
- The performance of retrofitted bridges is expected to be significantly better than those that have not been retrofitted.
- It is expected that most bridges will not collapse, but past earthquakes have demonstrated that the variability in ground motion at any given location could lead to a bridge collapse. Additionally, bridges near the earthquake epicenter could have extensive damage and be out of service for several months and possibly require replacement.

What is Caltrans doing to further reduce the seismic risk to the State transportation system?

- Caltrans is continually assessing and identifying seismically-vulnerable bridges based on evolving knowledge, seismic research, and lessons learned from earthquakes that have occurred within and outside of California. Through research and testing, Caltrans continues to gain a better understanding of the seismic vulnerabilities of bridges.

- Although the Seismic Safety Retrofit Program has been completed, approximately 620 additional bridges on the State Highway System have been identified as being vulnerable to seismic activity through recent seismic screenings. Many of these bridges may need retrofitting or replacement. Caltrans continues to fund the seismic retrofit of these bridges through the State Highway Operation and Protection Program (SHOPP), with the goal of reducing this number by 70 percent by 2028.
- Through the research and development of new and improved standards, the performance of new and retrofitted bridges will continue to improve. Caltrans has been at the forefront of seismic research and the development of design and construction standards and continues to fund research projects and further develop new seismic design standards.
- Caltrans recognizes that improving the seismic resiliency of the bridges on the State's transportation system requires a long-term commitment to meet the goal of safety and sustainability. It has been more than 30 years since the last catastrophic earthquake caused considerable damage to the State's transportation infrastructure, and it is highly probable that a major earthquake will occur in the future. In view of the extreme seismic risk and the high value of California's economy, Caltrans continues to make funding for seismic retrofit projects a priority, takes an active role in the seismic assessment of all bridges and transportation structures, and supports a vigorous solution-focused seismic research program.



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- [1] Caltrans Seismic Advisory Board, *Closing the Gap in the Race to Seismic Safety*, report submitted to the Director, California Department of Transportation, May 2010.
- [2] Caltrans, *California Transportation Asset Management Plan*, January 2018.
- [3] Governor's Board of Inquiry, *Competing Against Time*, report to Governor George Deukmejian on the 1989 Loma Prieta earthquake, May 1990.
- [4] Caltrans Seismic Advisory Board, *The Race to Seismic Safety – Protecting California's Transportation System*, report submitted to the Director, California Department of Transportation, December 2003.
- [5] Caltrans, *Seismic Design Criteria Version 2.0*, April 2019.
- [6] Dowell, Robert, *Reconnaissance Report of Observed Structural Bridge Damage Mw 7.8 Turkiye (Turkey) Earthquake of 2023*, SDSU Structural Engineering Research Project, Report No. SERP – 23/03, March 2023.
- [7] Caltrans, *2015 Seismic Screening of California State Bridges (Executive Summary)*, memorandum to Thomas A. Ostrom and Dolores Valls, July 2017.
- [8] Caltrans, *2019 Seismic Screening of California State Bridges (Executive Summary)*, memorandum to Ruth Fernandes and Dolores Valls, April 2019.





FOR MORE INFORMATION:

California Department of Transportation
www.dot.ca.gov
Division of Engineering Services





AB 100 Report-Alfred E. Lundquist Seismic Safety Commission



Seismic Safety of California Bridges

Assembly Bill 100 Report to the Alfred E. Lundquist Seismic Safety Commission

Richard Foley, PE, Division Chief
Division of Engineering Services
California Department of Transportation
October 10, 2024

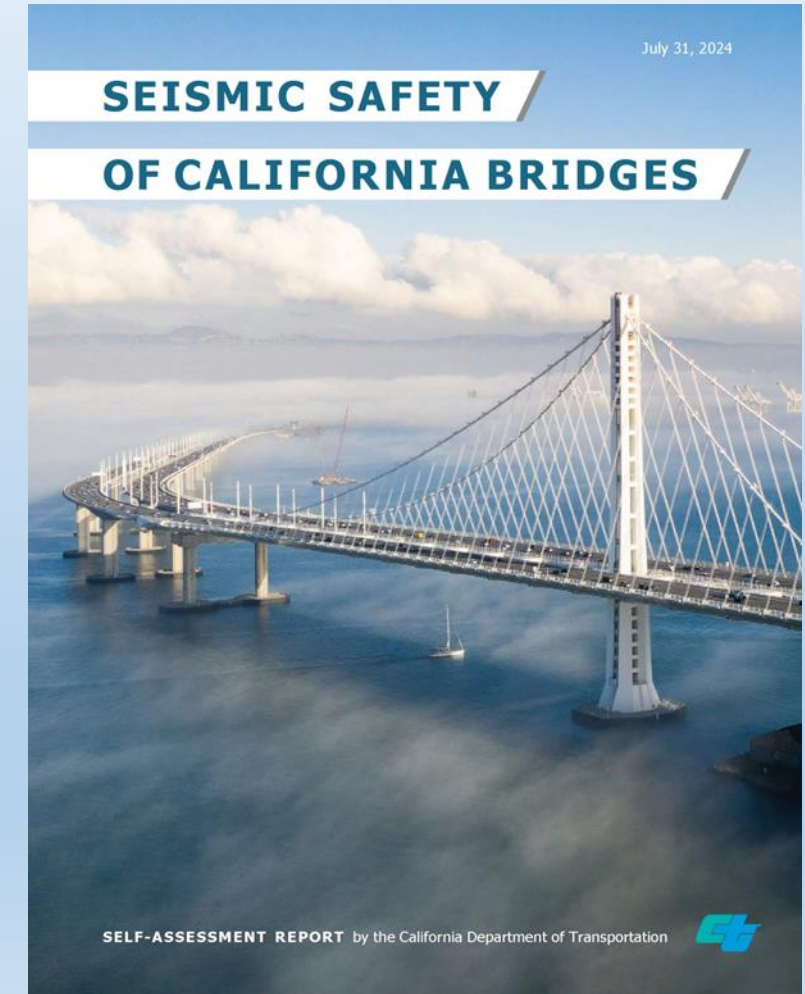


AB 100 Report-Alfred E. Lundquist Seismic Safety Commission



Presentation Topics

- Seismic Safety of California Bridges
- Emergency Response Planning and Post-Earthquake Investigations
- Strategic Planning Efforts
- Risk-Based Seismic Design





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Why are investments in seismic resilience necessary?

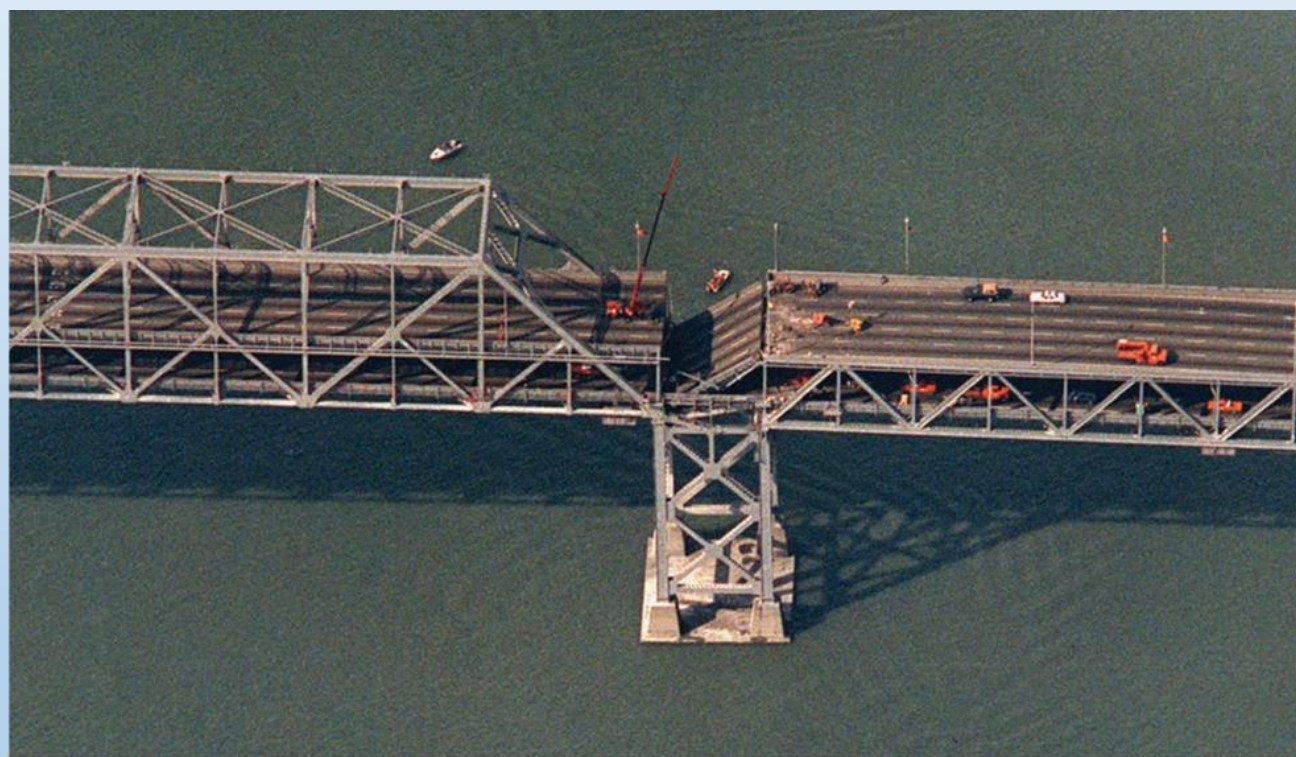


FIGURE 8: San Francisco-Oakland



FIGURE 7: Collapsed Section of the Cypress Street Viaduct



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Seismic Safety of California Bridges

The intent of the report is to:

- Paint a realistic picture of what Californians can expect in terms of the seismic performance of bridges on the State Highway System after a major earthquake.
- Outlines measures Caltrans is currently undertaking and planning to do in the future to continue to improve the seismic safety of California's bridges.
- Document the improvements made in the seismic safety of California's bridges since the 1971 San Fernando Earthquake.



Seismic Safety of California Bridges

The report answers three questions posed by the Caltrans Seismic Advisory

Board:

- What has Caltrans done to improve the seismic safety of the state transportation system since the Loma Prieta Earthquake in 1989?
- What is the expected performance of bridges on the state transportation system that have been retrofitted?
- What should Caltrans be doing to further reduce the seismic risk to the state transportation system?



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- What has Caltrans done to improve the seismic safety of the state transportation system since the Loma Prieta Earthquake in 1989?
 - ✓ \$12 .2 billion investment towards the retrofit or replacement of seismically vulnerable bridges on the State Highway System.
 - ✓ \$1.4 billion investment in local agency bridges
 - ✓ \$125 million investment in seismic research.
 - ✓ Development of Caltrans Seismic Design criteria and critical seismic design guidance.



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- What is the expected performance of bridges on the state transportation system that have been retrofitted?
 - ❖ Important and Recovery Bridges are expected to perform well.
 - ❖ May be closed for a short period of time to complete minor repairs before quickly being returned to service (hours to days).
 - ❖ Bridges constructed after 1990 using post 1990 seismic design guidance are expected to perform well with a minimal potential for collapse during a large earthquake.
 - ❖ Retrofitted bridges could have extensive damage but will not collapse.
 - ❖ Retrofitted bridges will be out of service for several months or need replacement.



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- What should Caltrans be doing to further reduce the seismic risk to the state transportation system?
 - ❖ Continuous risk assessment of the California bridge inventory.
 - ✓ 2015 and 2019 Seismic Screening of State Highway System bridges.
 - ✓ 2024 Local Agency Bridge Screening program
 - \$3.5 million in Federal funding



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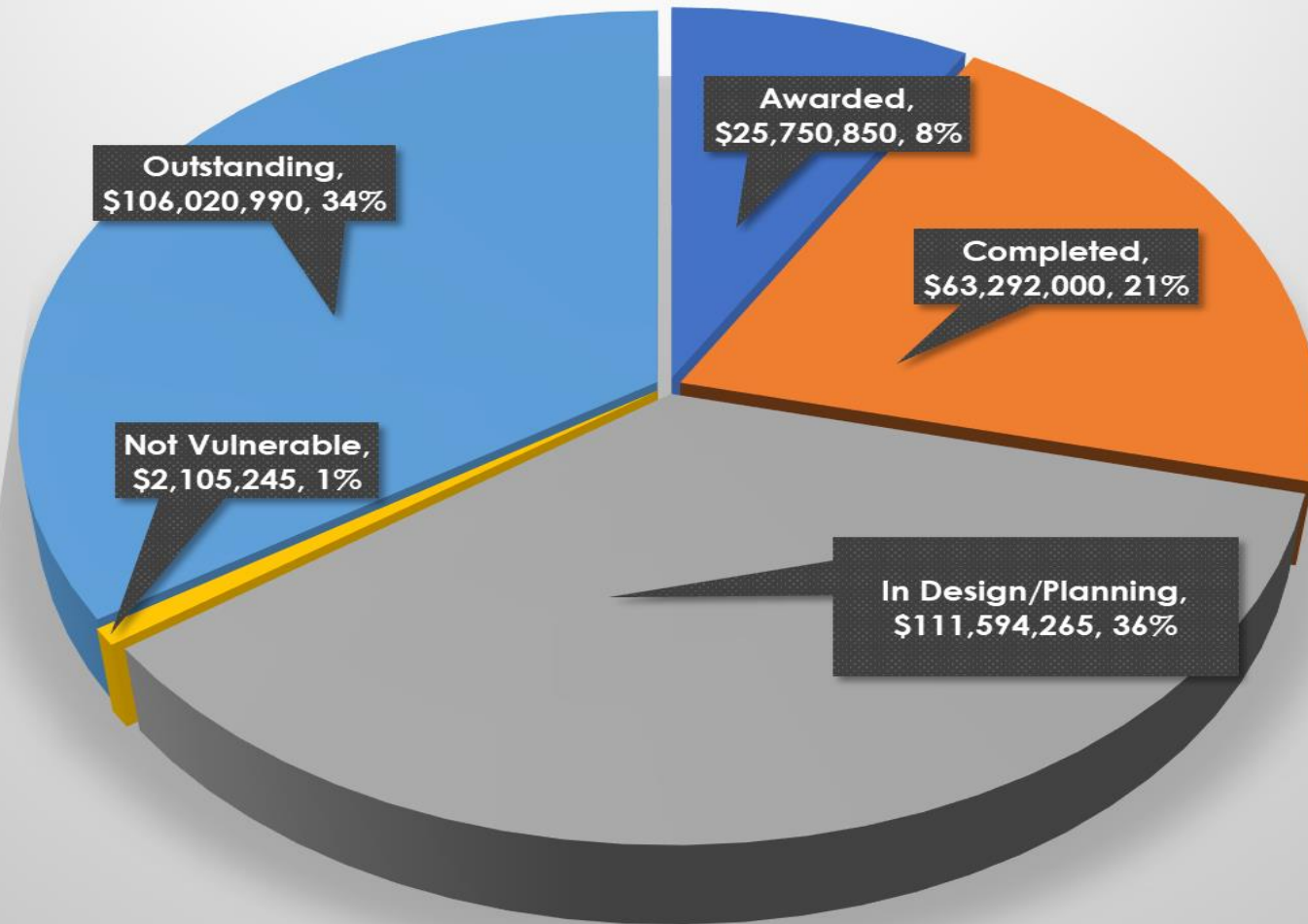
- What should Caltrans be doing to further reduce the seismic risk to the state transportation system?
 - ❖ Fund the seismic retrofit of bridges in the Caltrans Transportation Asset Management Plan (TAMP).
 - ✓ 642 bridges with seismic vulnerabilities identified.
 - ✓ Seismic Retrofit Priority list has been developed.
 - ✓ State Highway System Management Plan will provide \$62 million over the next five years.
 - ✓ State Highway Operation and Protection Program (SHOPP) will fund \$2.2 billion in bridge projects over four years.



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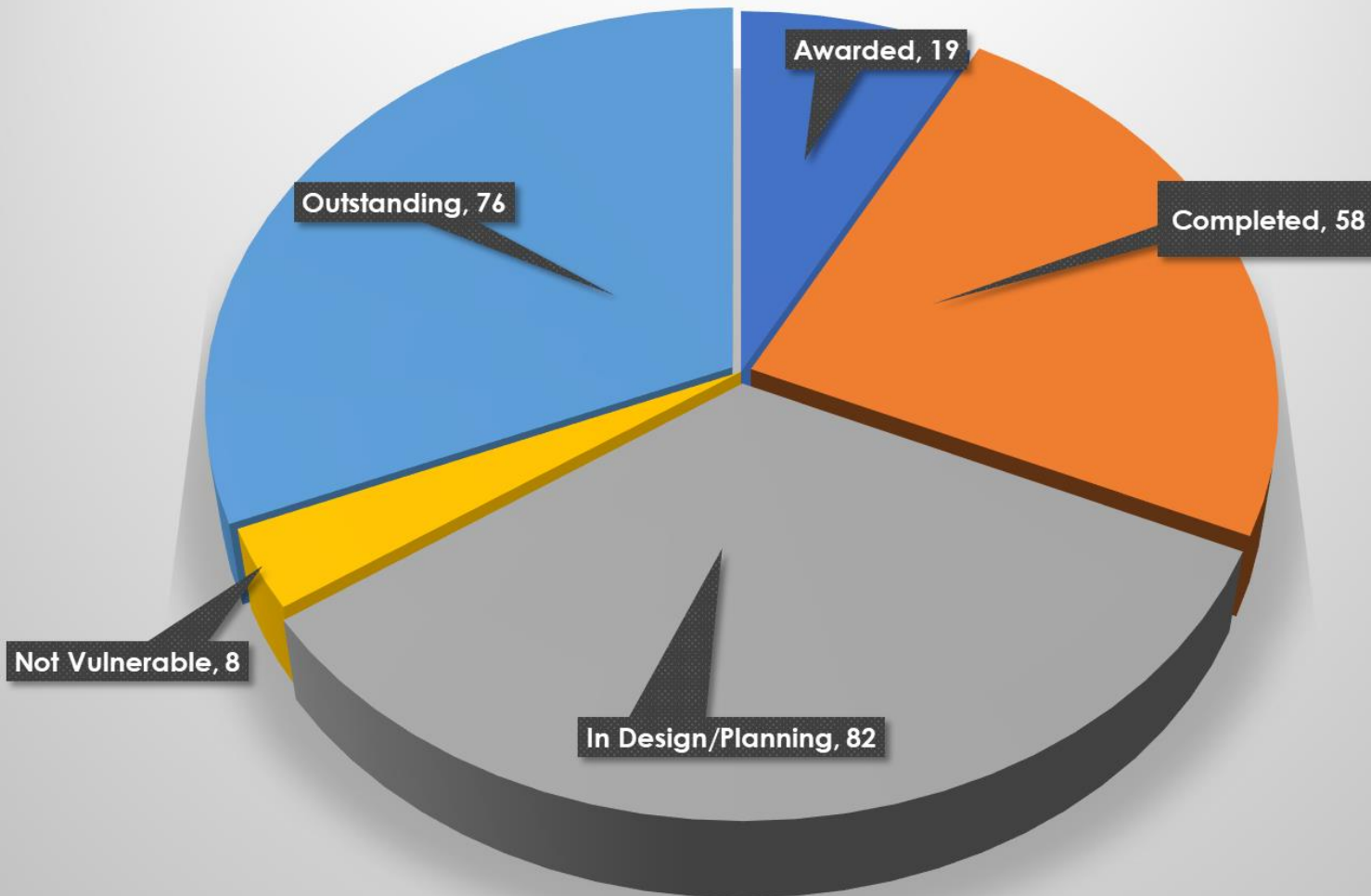


Bridge Seismic Retrofit Priority List Project Expenditures by Category



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Bridge Seismic Retrofit Priority List
Number of Bridges by Category-2020 Baseline List





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Seismic Safety of California Bridges

Publishing Timeline

- Report will be published following this presentation.
- Report will be available to public on DES and SSC webpage.



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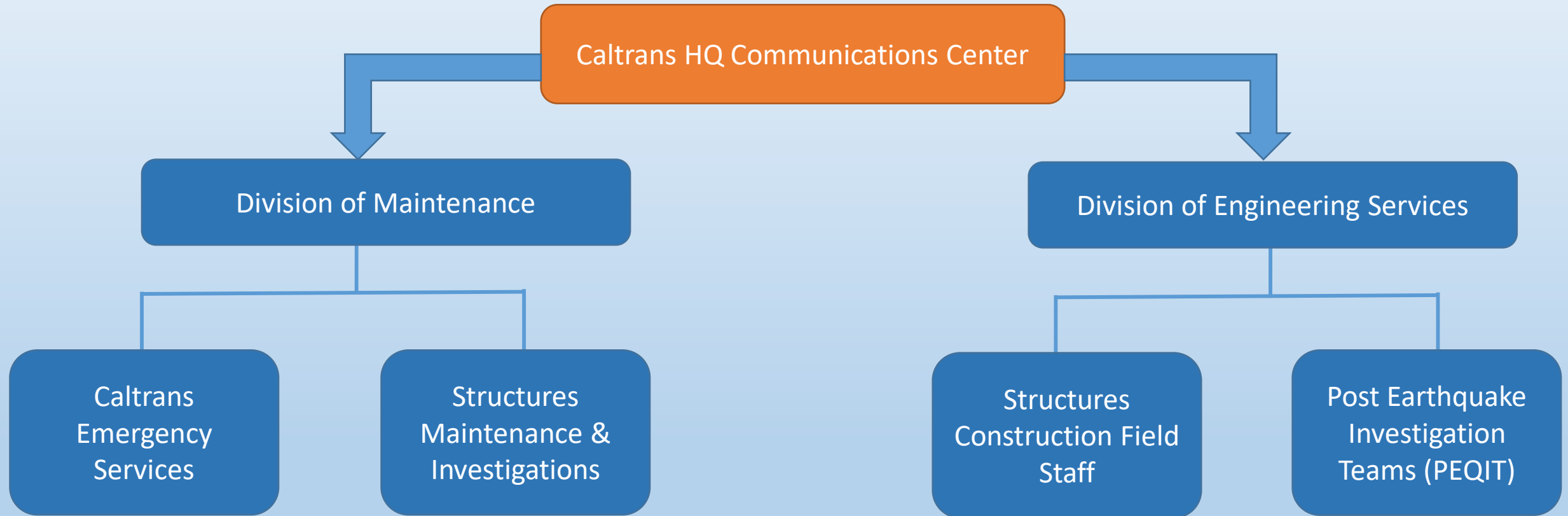
Structure Emergency Response and Post Earthquake Investigation Teams (PEQIT)



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Structure Emergency Response Organization





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Structure Emergency Response Notification

- Members of the Caltrans Emergency Response Teams are notified through Shakecast E-mails for Earthquakes larger than 4.5 magnitude.
- Magnitude 5.5 or larger-The Caltrans HQ communication center notifies all key Emergency Response Team staff by e-mail and phone.
 - ✓ Staff confirms receipt of notification.
- Bridge Emergency Response Center is activated when significant damage to bridges occurs.
- Responds to CalOES structure-related mission tasks as necessary.

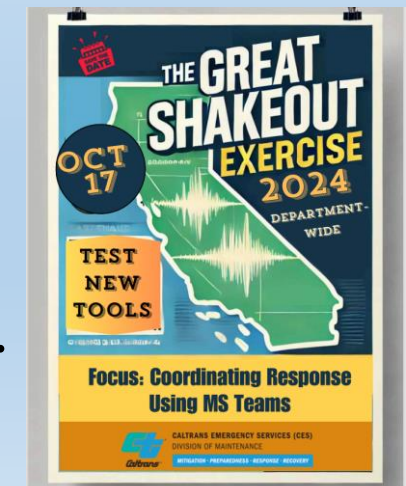
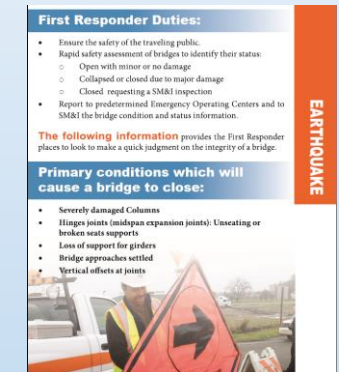
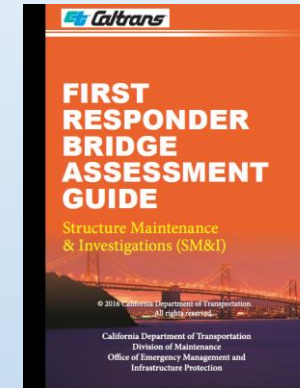


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Structure Emergency Response Workgroup Collaboration & Training

- ✓ Annual training meetings with review of the First Responder Bridge Assessment Guide.
- ✓ Annual and specific incident related meetings with Structures Emergency Response Working group.
- ✓ Currently focusing on collaboration to ensure cross-Division policy and guidance are consistent and current for training of new staff.
- ✓ Incorporating lessons learned from I-10 Santa Monica Viaduct response in November 2023.
- ✓ Annual participation in Great Shakeout exercises.





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DES Post Earthquake Investigations (PEQIT)

- The PEQIT effort is led by the Office of Earthquake Engineering, Analysis, and Research (OEEAR) in conjunction with our counterparts at Structure Maintenance & Investigations.
- PEQIT gathers field information about the performance of damaged bridges and highway structures and uses this information to improve Caltrans seismic design guidance and retrofit procedures.
- 32 DES engineers will support 8 PEQIT teams
 - ❖ Six 4-person teams (24 total PEQIT members) are based in Sacramento.
 - ❖ Two 4-person teams (8 total PEQIT members) are based in the DES Southern California Diamond Bar Office.
- DES PEQIT currently has seven FAA licensed pilots and two pilots in-training new pilots to support PEQIT response efforts.
 - ❖ Pilots attend monthly training sessions.
 - ❖ The Structure Construction and Geotechnical Services Subdivisions at DES have additional drone assets.



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Recent PEQIT Activity

- 2014 South Napa (Mw 6.0)
- 2019 Ridgecrest (Mw 7.1)
- 2021 Little Antelope Valley (Mw 6.0)
 - ❖ First use of UAS Inspections
- 2022 Ferndale (Mw 6.4)



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Drone Inspection of Mill Creek Bridge 2021 Little Antelope Valley Earthquake





AB 100 Report-Alfred E. Lundquist Seismic Safety Commission



Drone Inspection of Eel River Bridge 2022 Ferndale Earthquake





AB 100 Report to Alfred E. Lundquist Seismic Safety Commission



Future Innovation in Earthquake Engineering at Caltrans

➤ **DES Seismic Strategies and Implementation Plan**

- ✓ Develops a roadmap of the future of earthquake engineering efforts at the Division of Engineering Services and Caltrans.

➤ **Risk-Based Seismic Design**

- ✓ Risk-Based Seismic Design (PBSD) is an innovative method that will be utilized to assess the risk of bridge collapse and will be utilized to tailor the seismic-design of bridges to achieve certain target performance and post earthquake functionality.
- ✓ Will be the basis for the future Caltrans Seismic Design Criteria version 3.0.



AB 100 Report to Alfred E. Lundquist Seismic Safety Commission



Questions?





Cal OES
GOVERNOR'S OFFICE
OF EMERGENCY SERVICES



ALFRED E. ALQUIST
SEISMIC SAFETY COMMISSION MEETING

Memorandum

To: Seismic Safety Commissioners
From: Annde Ewertsen, Executive Director
Date: October 10, 2024
Subject: AB 100 Report: California Community Colleges

Recommendation:

Staff recommends Commissioners review the background information and be prepared to provide comments/questions on the presentation.

Background:

Assembly Bill 100 (Committee on Budget), enacted as Chapter 20 of the Statutes of 2020, established the Seismic Safety Commission's (SSC) annual reporting requirement. The Legislature finds that numerous agencies at various levels of government have substantial responsibilities in the fields of earthquake preparedness and seismic safety. To provide a consistent policy framework to track and monitor those activities and to identify key activities and responsibilities related to seismic safety, 10 entities are specifically called out in the legislation, and the SSC requests information from other entities voluntarily. California Community Colleges is providing information voluntarily and is the thirteenth entity to come before the SSC to underscore the value of its seismic programs to the public.



California Community Colleges

California Community Colleges Chancellors Office

Report to the Seismic Safety Commission

2024

To: California Seismic Safety Commission

Dear Members of the Seismic Safety Commission,

On behalf of the California Community Colleges Chancellors Office (Chancellor's Office), this is the Annual Report as required by Assembly Bill 100 (AB 100). This report is an overview of the previous and current efforts by the Chancellor's Office in regards to earthquake risk reduction within the community college system.

The Chancellor's Office oversees the State Capital Outlay program which is the foundation for helping California community colleges ensure that students, faculty, and staff have a campus that is safe and secure to learn and teach on. The program involves other State agencies such as the Division of State Architects that does the review of the facilities plans to ensure the structural integrity of each building, according to Field Act.

In the past, the Chancellor's Office with the help of the Department of General Services, Real Estate Division did perform a seismic safety survey of the community college system. Since then, there hasn't been any other need for a survey as those older facilities in need have been modernized or demolished. With the State Capital Outlay program, the community college system has the ability to correct any facilities with seismic safety issues as it arises.

Sincerely,

Dr. Sonya Christian
Chancellor
California Community Colleges Chancellor's Office

Introduction

The California Community Colleges is the largest postsecondary educational system in the United States, serving nearly 2 million students annually. California Community Colleges students represent 20% of the nation's community college students and more than 70% of California's public postsecondary undergraduate students.

The California Community Colleges consists of 73 community college districts encompassing 116 colleges, 79 approved off-campus centers and 24 separately reported district offices. The system's assets include more than 25,000 acres of land, 6,000 buildings and 87 million gross square feet, which includes approximately 56 million assignable square feet of space. In addition, the system has many off-campus outreach centers at various locations.

The Chancellor's Office and the Facilities Planning Unit assists and supports the districts in matters related to infrastructure and capital outlay. The capital outlay program is dedicated to acquiring, maintaining, building, repairing or upgrading fixed assets such as land, facilities, machinery and the like. Assistance and support is provided to the districts for the construction new buildings, remodeling current buildings, and centers.

State Capital Outlay Program

In 2021, the California Community Colleges Board of Governors had updated both priority-criteria and -funding categories scoring system to assist community college districts with local capital planning efforts so that their project proposals reflect the state's priorities. The Board of Governors' priority-criteria metrics primarily evaluate how a capital outlay project proposal meets the campus's instructional need, its use of space, and the condition of its existing facilities.

Community college districts have the responsibility to maintain, modernize, and expand the facilities at their institutions on behalf of the students they serve. To accomplish these objectives, community college districts are authorized to seek local and state financing for their facilities. In addition to local efforts, the state's capital outlay program provides voter-approved statewide general obligation bonds through grants to fund capital outlay projects on community college campuses. These grants are developed pursuant to the annual state capital outlay grant application process and approved by the Board of Governors of the California Community Colleges.

The Chancellor's Office facilities planning and utilization unit administers the state capital outlay grant application process for the community college system on behalf of the Board of Governors. Districts must plan these projects using their educational plan which ties to their

facilities plan. The district's facilities plan evaluates existing land, infrastructure, facilities and systems in relationship to the colleges' purposes, plans, and needs, specifying the capital outlay projects necessary to meet these needs.

These projects fall into three categories:

1. Category A - Life and Safety
2. Category M – Modernization
 - Modernization of instructional and institutional support space
3. Category G – Growth.
 - Growth of instructional and institutional support space

Projects in Category A are the state's highest priority projects because they address life and safety issues. Category A projects are ranked according to the number of people threatened or affected by the condition of a facility or site. Category A projects are divided even further, they are the following:

Category A1 – Health and Safety

- Mitigate critical health and life safety issues that are of imminent danger or health and life safety issues citable by a governing agency

Category A3 – Seismic Retrofit

- Seismically retrofit structures subject to structural failure during a seismic event. The intent of this category is to seismically retrofit structures subject to the likely probability of collapse during a seismic event of greater than 6.0.

Category A4 - Infrastructure

- Repair or replace the immediate failing infrastructure within a structure or system

As for Category A3 – Seismic Retrofit projects, they are projects that are structures subject to structural failure during a seismic event of greater than 6.0. These projects are of the highest priority of the state capital outlay program. These projects are limited to General Obligation (GO) bond funds. Districts can also fund these projects using their local general or bond funds as well.

Field Act

The Field Act (California Education Code Section 17280) mandates seismic safety standards for K-12 public schools and community colleges. These standards were approved as a result of the 6.3 earthquake that hit Long Beach and surrounding areas in 1933. The earthquake destroyed 70 schools with hundreds of other buildings damaged.

Assemblyman Don Field saw the destruction and drafted a bill with State Architect George McDougall. This bill would place the State Architect and the Division of State Architects (DSA) in charge of building safe schools. With the passage of Assembly Bill 2342 in a unanimous vote, the resulting law has been known as the Field Act.

The Field Act has stricter structural code requirements and architect drawings undergo a strict process of review. All community college facility projects must go through this review process at the Division of State Architects. The structural design work must be completed by licensed structural engineers rather than civil engineers. The structural plan review is also completed by structural engineers. The approved projects have continuous on-site inspection by a DSA approved project inspector and must undergo observation from project architect and engineers. At the end of construction, a report must be filed by the project architect, engineers, inspectors, testing labs, and the contractor to ensure the safety of the building.

Seismic Study

The 1996 Budget Act appropriated \$900,000 from Proposition 203 for the California Community Colleges to perform seismic risk assessments for buildings on community college campuses. This seismic survey of the California community colleges' facilities was required by the Legislature to prioritize buildings for funding. The Legislature wanted to have information to assess the risk posed by each building based on a uniform procedure and risk assessment system applied to all buildings.

The Department of General Services (DGS) Real Estate Division, in consultation with the Seismic Review Board and its Professional Advisory Committee, developed a system that was used to evaluate the risk for all state buildings. The survey aimed to assess earthquake risks and safety measures within our region. The survey covered various aspects, including building structures, infrastructure, and emergency response systems. The survey criteria included the following:

- Building size
- Age
- Type of construction
- Function
- Occupancy

Data collection involved collaboration with experts and stakeholders. The findings are crucial for enhancing our preparedness and resilience. Approximately 4,100 community college buildings were evaluated to determine their susceptibility to earthquakes. Approximately 80 buildings were identified in this survey as potentially having a high-risk level and most in need of some form of structural seismic retrofit. More than half of the projects identified in the report were addressed in the 1997-98 budget with special repair funds from the Scheduled Maintenance

and Special Repairs Program. Projects over \$400,000 went through the state capital outlay program or from the Office of Emergency Services (OES) Hazard Mitigation Grant Program.

Some buildings were already identified to be replaced or renovated. Several buildings were already vacated and plans for construction or acquisition of new facilities. Buildings that were unacceptable, occupants relocated to other facilities.

Conclusion

The Chancellor's Office does not oversee the seismic safety of the system through continuous surveys as there is a lack of funding for it. Instead, the agency is reliant on the community college districts to submit projects proposals that state that facilities need seismic safety retrofits or new facilities to replace seismically unsafe facilities. These facilities and others are funded through the General Obligation (GO) bonds that are approved by the voters.

These projects go through the State Capital Outlay program, which uses the GO bond funds to help fund new facilities and modernize current facilities. As projects are funded by the State, the Division of State Architects reviews all project submissions and ensures that fire, life, and safety and Field Act compliancy are met. DSA also have a 50% rule where the cost of a reconstruction, alteration, or addition of an existing building exceeds 50 percent of its replacement value, projects are required to meet seismic safety standards. This further ensures that safety standards are met.

It is the districts responsibility to maintain, modernize, and expand as necessary their facilities and infrastructure. This State Capital Outlay program has helped the community college system throughout the years and will continue to do so for the future.



California Community Colleges

Seismic Safety Commission AB 100 Reporting

California Community Colleges Chancellors Office

October 2024

Field Act

- 1933 - Enactment of the Field Act
 - As a result of the 1933 Long Beach earthquake
 - 6.3 earthquake hit Long Beach and the surrounding areas
 - 70 schools were destroyed
 - Assemblyman Don Field saw the destruction and drafted a bill with State Architect George McDougall
 - Assembly Bill 2342 was passed with a unanimous vote in the Assembly
 - State Senate approved AB 2342 on April 5, 1933
 - Governor James Rolph, Jr signed the bill into law on April 10, 1933

Field Act

- 1939 – Enactment of the Garrison Act
 - Enacted to protect public school children in structures built before 1933
- 1967 to present – Various amendments
 - Schools required to make necessary inspections and retrofitting or abandonment of unsafe structures

Provisions of the Field Act

Authorizes the State Architect to develop state-wide building code

Division of the State Architect (DSA) given authority to approve or reject plans for construction of new schools and alterations to existing buildings

California-licensed architect or structural engineer responsible for preparation of plans

DSA reviews plans and issues certificate of compliance once project is approved

Violation of the provision of the Act is a felony

Field Act Compliant



Field Act has stricter structural code requirements



Structural design work must be completed by structural engineers rather than civil engineers



Structural plan review is completed by structural engineers rather than civil engineers



Schools have continuous on-site inspection

1998 CCC Seismic Survey

- 1996 Budget Act appropriated funds from Proposition 203
 - Appropriated \$900K to perform seismic risk assessments for buildings
- DGS Real Estate Services Division evaluated approximately 4,100 buildings
- Consulted Seismic Review Board and their Professional Advisory Committee
- Developed criteria for determining which buildings shall be included in the structural evaluation



1998 CCC Seismic Survey

- Criteria included the following:
 - Building size
 - Age
 - Type of construction
 - Function
 - Occupancy
- Excluded the following as they are not eligible for state capital outlay funding
 - Large theaters
 - Stadia
 - Student Unions

1998 CCC Seismic Survey



- RESD established a “Five-Step Evaluation Process”
 - Development of an inventory data base and the application of filter exclusions
 - Each subsequent step entailed higher level of technical evaluation and filtering
 - After each step, buildings with higher risk forwarded to the next step for further evaluation
 - The report is the final step
- Patterned after the State Building Seismic Program
- The report evaluates the performance of the buildings as a result of a quake whenever one occurs

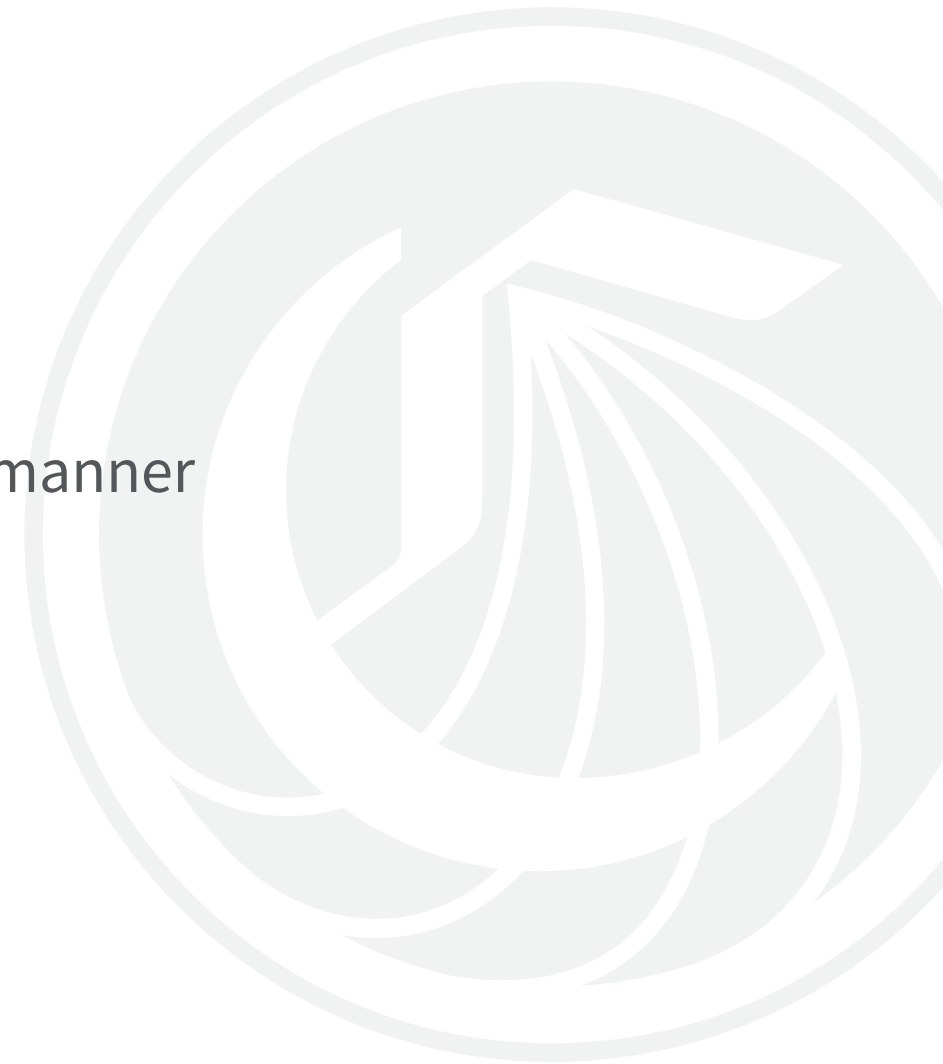
1998 CCC Seismic Survey

- RESD’s evaluation process and factors
 - Soil types
 - Potential ground shaking and other geotechnical factors
 - Location and proximity of the building to the fault
 - Structural, mechanical, and electrical systems capability to withstand earthquakes
 - Occupancy and function of the building
- RESD’s “Risk Levels” used to determine relative seismic risk
 - Ranging from I (nearly perfect performance) to VII (building considered unsafe)



1998 CCC Seismic Survey

- Acceptability of risk is based on the following:
 - Collapse is precluded
 - Occupants can exit safely
 - Function can be resumed or relocated in a timely manner

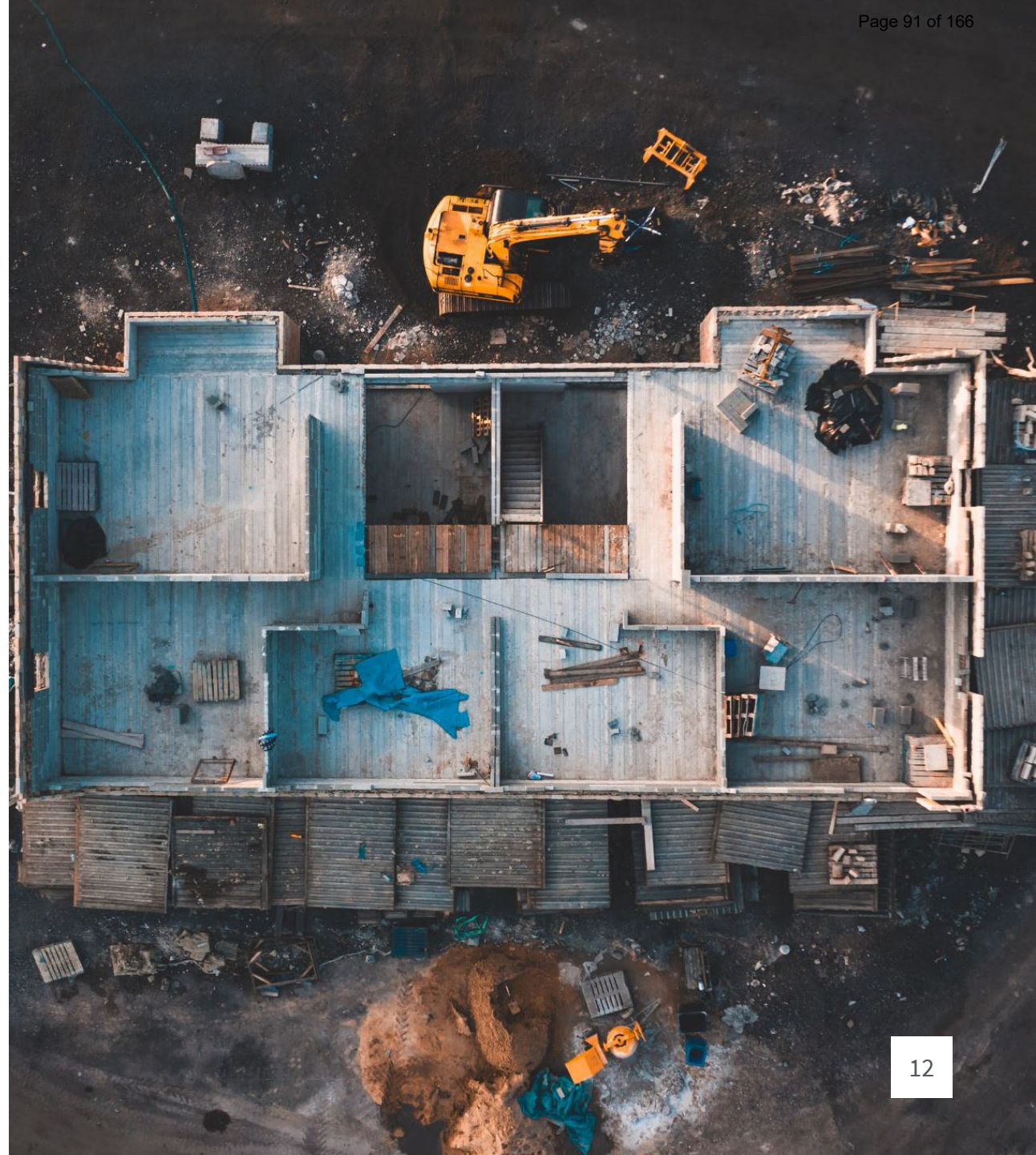


1998 CCC Seismic Survey

- Approximately 80 buildings identified as potentially high-risk level and needed structural seismic retrofit
- More than half identified to be addressed in the 1997-98 budget with special repair funds
- Projects over \$400K was considered for funding through Office of Emergency Services Hazard Mitigation Grant program
- Not all buildings included in the DGS report due to the criteria used

1998 CCC Seismic Survey

- Some buildings were already identified to be replaced or renovated
- Several buildings were already vacated and plans for construction or acquisition of new facilities
- Buildings that were unacceptable, occupants relocated to other facilities



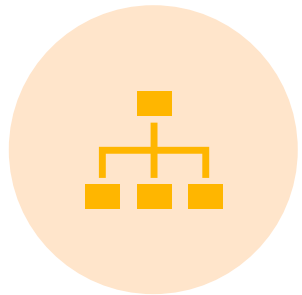
Scheduled Maintenance and Special Repairs Program



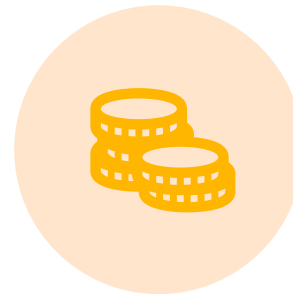
1997-98 budget appropriated \$39M from the scheduled maintenance program and \$20M from Prop 98 funds



The State's share was approximately \$118M of scheduled maintenance



A one-to-one match requirement for these projects



Total need was \$174M in 1997-98

CCC Seismic Survey Facilities Results

- A majority of the facilities were corrected using scheduled maintenance funds or through the capital outlay process
- Other facilities were demolished or corrected using local funding
- The 1998 list of facilities surveyed have been corrected by the state or by the district

CCC Current Status

- No further seismic surveys since 1998
- Chancellor's Office does not oversee seismic safety of the system
- Division of State Architects reviews all project submissions
 - Fire, life, and safety
 - Field Act compliancy
 - 50% rule - the cost of a reconstruction, alteration, or addition of an existing building exceeds 50 percent of its replacement value, projects are required to meet seismic safety standards
- Districts responsibility is to maintain, modernize, and expand as necessary
 - Educational Master Plan
 - Facilities Master Plan

CCC Current Status



- State Capital Outlay Program
 - Assist districts with local capital planning efforts to ensure project proposals reflect the state's priorities
 - Districts submit project proposals
- Project categories
 - Category A - Life and safety
 - Category M - Modernization of instructional and institutional support space
 - Category G - Growth of instructional and institutional support space

CCC Current Status

- Category A - Life and safety
 - A1 – Health and Life Safety
 - Mitigate critical health and life safety issues that are of imminent danger or health and life safety issues citable by a governing agency
 - **A3 – Seismic Retrofit**
 - Seismically retrofit structures subject to structural failure during a seismic event
 - A4 – Infrastructure
 - Repair or replace the immediate failing infrastructure within a structure or system

CCC Current Status

- Districts submit Category A projects, if any
 - Category A3 – Seismic Retrofit Projects are seismically retrofit structures subject to likely collapse during a seismic event of greater than 6.0
 - Highest priority of the state capital outlay program
- Projects limited to General Obligation (GO) bond funds
- Category A projects can take up to 50% of the GO bond
- Districts are limited to their local funds (general fund or local bond)



California Community Colleges

Thank you!

www.cccco.edu



Cal OES
GOVERNOR'S OFFICE
OF EMERGENCY SERVICES



ALFRED E. ALQUIST
SEISMIC SAFETY COMMISSION MEETING

Memorandum

To: Seismic Safety Commissioners
From: Annde Ewertsen, Executive Director
Date: October 10, 2024
Subject: University of California, Berkeley, Pacific Earthquake Engineering Research Center (PEER) Projects

Recommendation:

Staff recommends Commissioners review the background information and be prepared to provide comments/questions on the presentation.

Background:

Assembly Bill 100 (Committee on Budget), enacted as Chapter 20 of the Statutes of 2020, established the Seismic Safety Commission's (SSC) annual reporting requirement. The Legislature finds that numerous agencies at various levels of government have substantial responsibilities in the fields of earthquake preparedness and seismic safety. To provide a consistent policy framework to track and monitor those activities and to identify key activities and responsibilities related to seismic safety, 10 entities are specifically called out in the legislation, and the SSC requests information from other entities voluntarily. University of California Berkeley, PEER is providing information voluntarily and is the fourteenth entity to come before the SSC to underscore the value of its seismic programs to the public.

Update on Active Projects

Pacific Earthquake Engineering Research (PEER) Center

Khalid M. Mosalam, Amarnath Kasalanati & Selim Günay

October 10, 2024



Outline

- ✓ PEER introduction, sponsors, active collaborators
- ✓ PEER Transportation Research Program (TSRP)
- ✓ PEER-Bridge Program
- ✓ Major PEER Projects
- ✓ Upcoming Events and Activities
- ✓ Example of Non-PEER UC Project



PEER: University, Government, Professional & Industry Alliance










9 Educational Affiliates (EAs)

-  California Polytechnic State University, San Luis Obispo
-  California State University, Los Angeles
-  California State University, Northridge
-  San Jose State University
-  University of Hawaii
-  Johns Hopkins University
-  Southern Methodist University
-  Carnegie Mellon University
-  University of Alaska, Anchorage



11 Core Institutions (CIs)

Headquarters

-  University of California, Berkeley - Lead Institution
-  California Institute of Technology
-  Oregon State University
-  Stanford University
-  University of California, Davis
-  University of California, Irvine
-  University of California, Los Angeles
-  University of California, San Diego
-  University of Southern California
-  University of Nevada, Reno
-  University of Washington

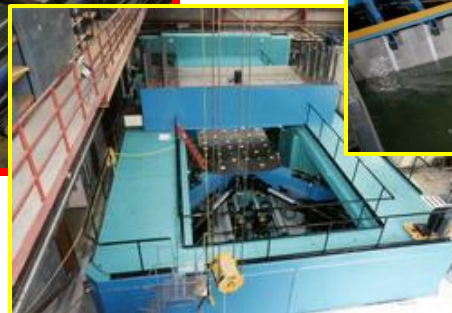


PEER combines resources of major research universities in western US where earthquake hazard is large.

PEER Experimental Facilities

PEER includes the major laboratories available in the US including:

- ✓ Two large 6 DOF shaking tables (UC Berkeley & UCSD)
- ✓ **The largest soil box mounted on a shaking table (UNR)**
- ✓ The largest geotechnical centrifuge (UC Davis)
- ✓ The largest field-testing facility (UCLA)
- ✓ The largest testing facility for seismic isolators & supplemental energy dissipation devices (UCSD)
- ✓ **The largest tsunami wave tank (OSU)**



"PEER is the primary earthquake engineering research arm of the State of California."

California Seismic Safety Commission
 "Review of the PEER Center,"
 March 8, 2007

PEER: University, Government, Professional & Industry Alliance

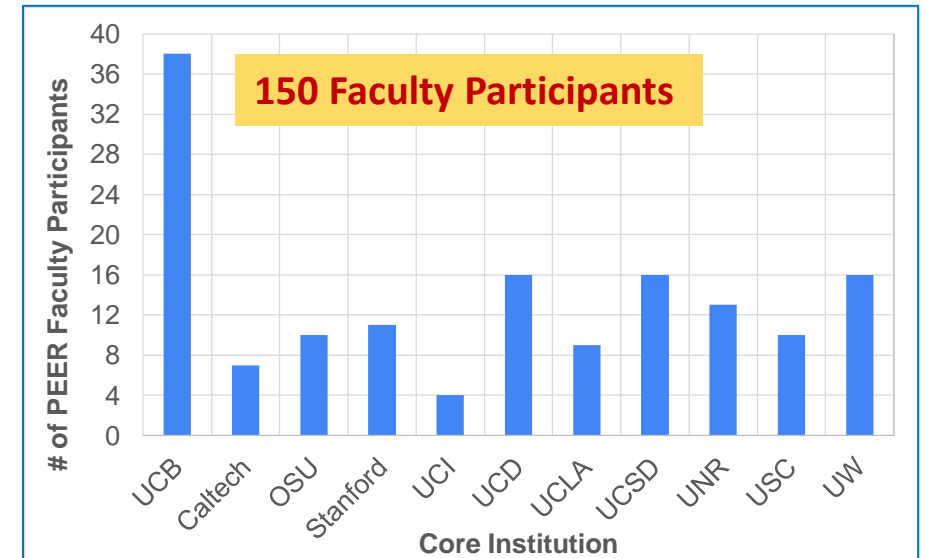
Mission: Develop methods & tools to achieve **Resilient Design for Extreme Events based on Integrated Performance-based Engineering**.

Expertise:

- Geo-hazards
- Networks
- Analysis
- Structures
- Experiments
- Monitoring (including AI)








- Institutional Board (IB): policy level guidance.
- Research Committee (RC): research agenda.
- Industry Advisory Board (IAB): future needs of the profession.
- Resource Identification Committee (RIC): new sources of funding.
- PEER Student Committee (PSC): connect PEER to students/postdocs.

<http://peer.berkeley.edu>



PEER: Organization

PEER Headquarters Staff

| | | | |
|--|---|---|---|
|  Prof. Khalid Mouallem Director (510) 642-3437 mouallem@berkeley.edu |  Anvarnath Kasalanati Associate Director (510) 642-6475 anvarnath1@berkeley.edu |  Christina Bodnar-Anderson Library Richmond Field Station cbodnarand@berkeley.edu |  Erika Donald Communications (510) 642-3437 erikad@berkeley.edu |
|  Zulema Lara Administrative Officer (510) 642-3437 slar@berkeley.edu |  Frank McKenna Manager OperGees fmckenna@cd.berkeley.edu |  Gabriel Vargas Database Administrator (510) 665-3531 Gabrielvargas7@berkeley.edu | |








Institutional Board

The Institutional Board consists of a representative from each of eleven core institutions, and one member to represent the nine educational affiliates. These members are appointed by the Dean of the College of Engineering or a Department Chair at the respective institution. The Institutional Board provides policy level guidance and oversight for the Center with a goal to help PEER fulfill its mission.

| | | | | | |
|--|--|--|--|---|--|
|  Michael Scott, Chair Oregon State University |  Domniki Asimaki California Institute of Technology |  Aida Athanassopoulos-Zekkos UC Berkeley |  Ian Buckle University of Nevada, Reno |  Greg Deerelein Stanford University |  Sashi Kunnath University of California Davis |
|  Dawn Lehman University of Washington |  Mo Li University of California, Irvine |  Patrick Lynett University of Southern California |  Nicos Makris Southern Methodist University |  Jose Restrepo University of California, San Diego |  Jian Zhang UC Los Angeles |










Research Committee

The Research Committee sets research agenda based on PEER's vision; works with stakeholders and industry partners to identify community needs and integrates them into the research plan; makes recommendations for funding grants; develops the topics and timeline for Request for Proposals (RFP) and reviews and evaluates proposals or identifies a pool of reviewers.

| | | | | | |
|--|---|--|--|---|---|
|  Eduardo Miranda, Chair Stanford University |  Henry Burton University of California Los Angeles |  Anhlan Le Caltrans |  Haeyoung Noh Stanford University |  Badi Rowshandel CEA |  Farzin Zareian University of California, Irvine |
|  Katerina Ziotopoulou University of California, Davis | | | | | |









Industry Advisory Board

The Industry Advisory Board identifies current and future needs of the profession and engineering community, advises on industry problems and applications with research potential; provides the bridge between research and industry; facilitates opportunities for PEER to pursue.

| | | | | | |
|--|---|---|---|---|---|
|  James Malley Chair, Degenkobb Engineers |  Jennie Watson-Lamprey (Vice Chair), Slate Geotechnical |  Matt Bowers SC Solutions |  Gayle Johnson Simpson Gumpertz & Heger |  Brian Kehoe Wiss, Janney, Elstner |  Peter Lee Skidmore, Owings & Merrill |
|  Steve Marusch Forell/Ebesser Engineers |  Don Scott PCS Structural Solutions |  Sharon Yen Caltrans | | | |

Resource Identification Committee

The Resource Identification Committee pursues existing opportunities and actively seeks out new sources of funding to help realize PEER's vision; identifies and facilitates funding opportunities for PEER leadership to pursue; provides recommendations and directions to increase chances of securing funding.

| | | | | | |
|---|---|---|---|---|--|
|  David McCallen, Chair University of Nevada, Reno |  Norm Abrahamsom UC Berkeley / UC Davis |  Jeffrey Bachhuber PG&E |  Chung-Soo Doo BART |  Marc Eberhard University of Washington |  Hamid Haddadi CGS |
|  Farhang Ostadan Bechtel Corporation |  Toorak Zokaie Caltrans | | | | |

Major Sponsors of Research at PEER

State of California: *TSRP*



California Geological Survey



University of California

Berkeley – College of Engineering



California Energy Commission



California Department of Transportation

Caltrans: *PEER-Bridge Program*



LBL – DOE



California Office of Emergency Services

CalOES



BART



Bay Area Rapid Transit

PEER: Active Collaborators

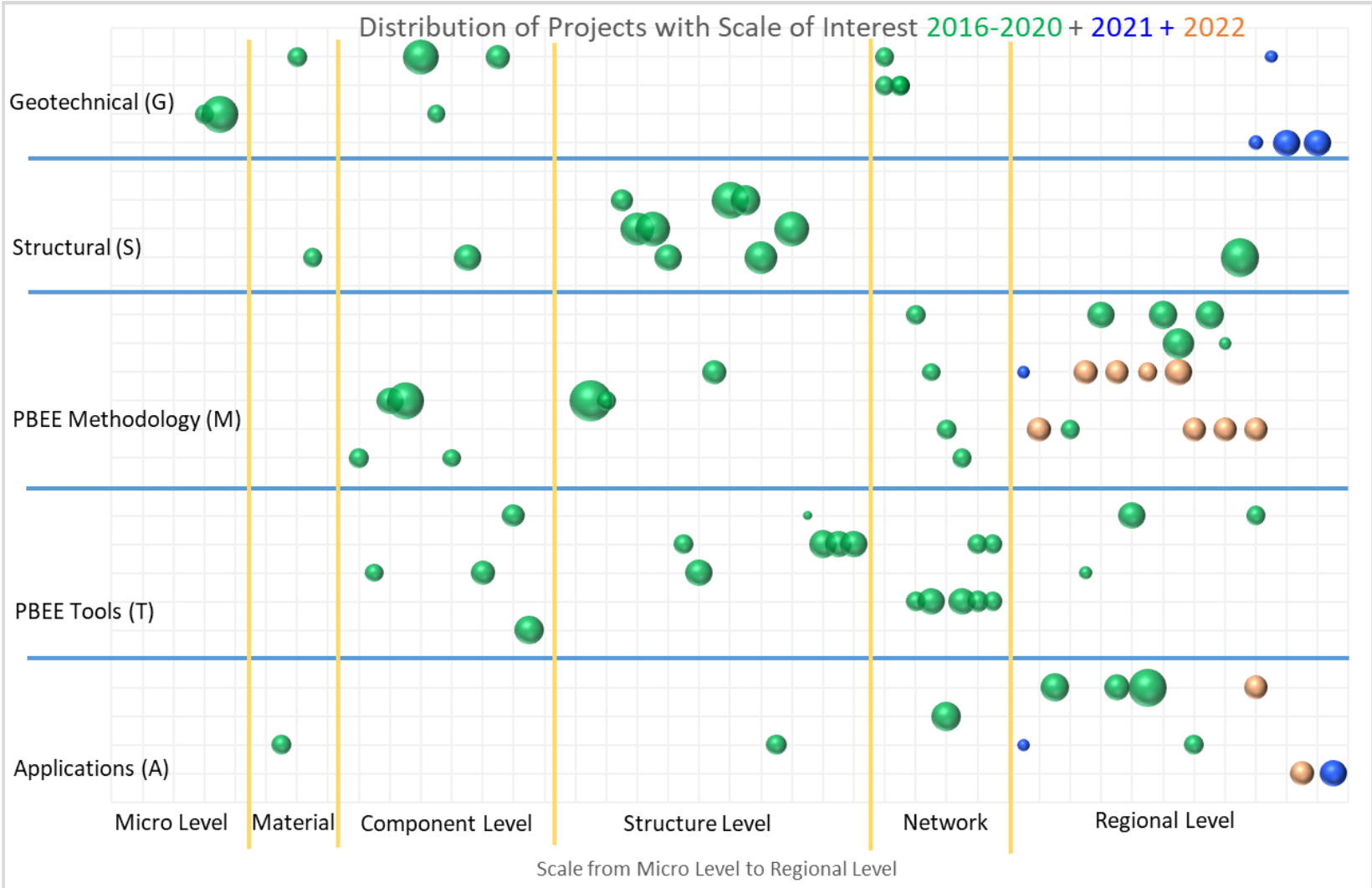
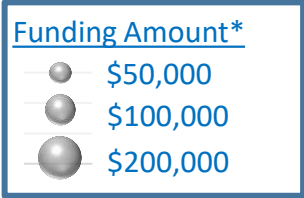
- Caltrans – Now the Biggest Sponsor
- CalOES – 3 Projects in 2 Years
- CGS – Data-sharing Agreements
- LBNL & DOE – Simulated GMs; Cosponsoring Workshops
- SCEC – Added to our RFP
- EERI, ATC & FEMA – Increased Interaction with Leadership
- NFPA & SFPE – Collaborating on AI & Fire Workshop, May 2025
- ASSISI – Co-sponsoring 19WCSI in Sept 2025



TSRP Awards 2016 – 2023

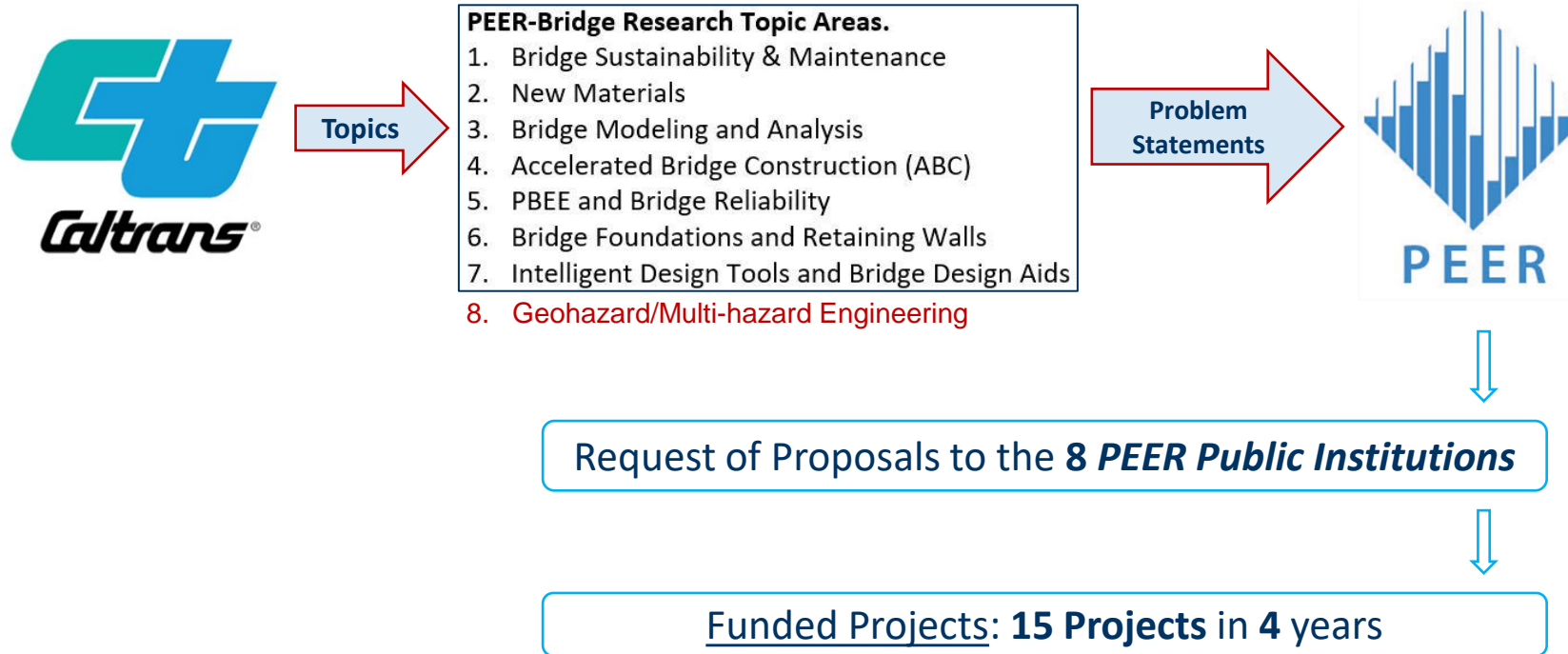
| <u>Year</u> | <u>Proposals</u> | <u>Funded</u> | <u>Percent</u> | <u>Solicited</u> | <u>Funded</u> | <u>Percent</u> |
|--------------|------------------|---------------|----------------|---------------------|--------------------|----------------|
| 2016 NoRFP | 7 | 7 | - | \$577,572 | \$577,572 | - |
| 2017 PreRFP | 4 | 4 | - | \$444,703 | \$444,703 | - |
| 2017 RFP | 47 | 17 | 36% | \$ 4,801,433 | \$1,498,723 | 31% |
| 2018 RFP | 47 | 11 | 23% | \$ 5,279,057 | \$1,471,309 | 28% |
| 2019 RFP | 44 | 14 | 32% | \$ 4,953,596 | \$1,210,466 | 24% |
| 2020 RFP | 34 | 12 | 35% | \$ 1,722,841 | \$ 594,449 | 35% |
| 2021 RFP | 19 | 9 | 47% | \$ 1,434,058 | \$ 488,391 | 34% |
| 2022 RFP | 28 | 10 | 36% | \$ 2,261,555 | \$ 750,949 | 33% |
| Total | 228 | 84 | 37% | \$21,474,815 | \$7,036,562 | 33% |

Research Focus – Regularly Revisited “RFP Announcements”



*Only TSRP projects are shown.

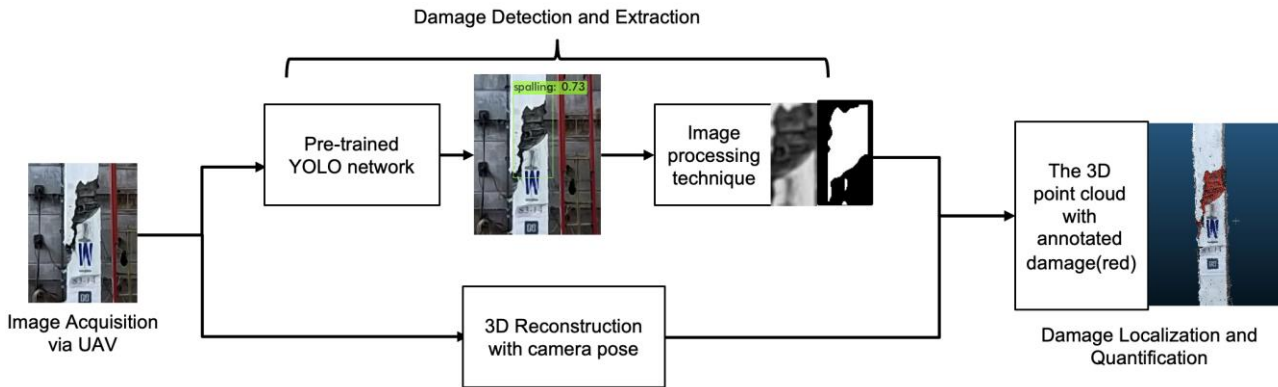
PEER – Bridge Program



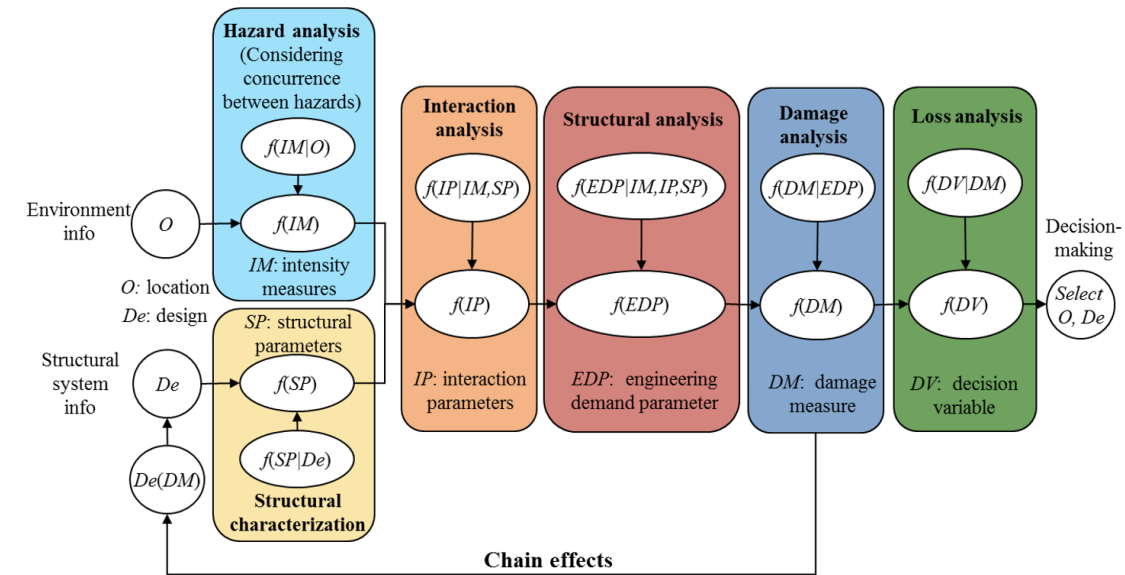
Program is currently being renewed for **\$5M+** for 5 years

PEER – Bridge Program – Project Highlights

Development of Autonomous Drone Inspection for Bridge Maintenance



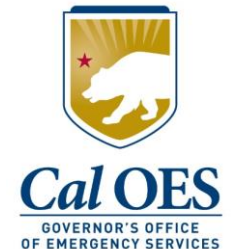
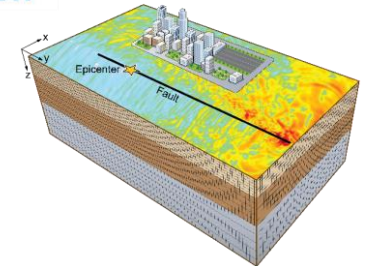
Development of Performance-Based Multihazard Engineering (PBME) Framework with Inclusion of Climate Change and Bridge Vulnerability



Flowchart for the existing PBHE framework to be extended for PBME

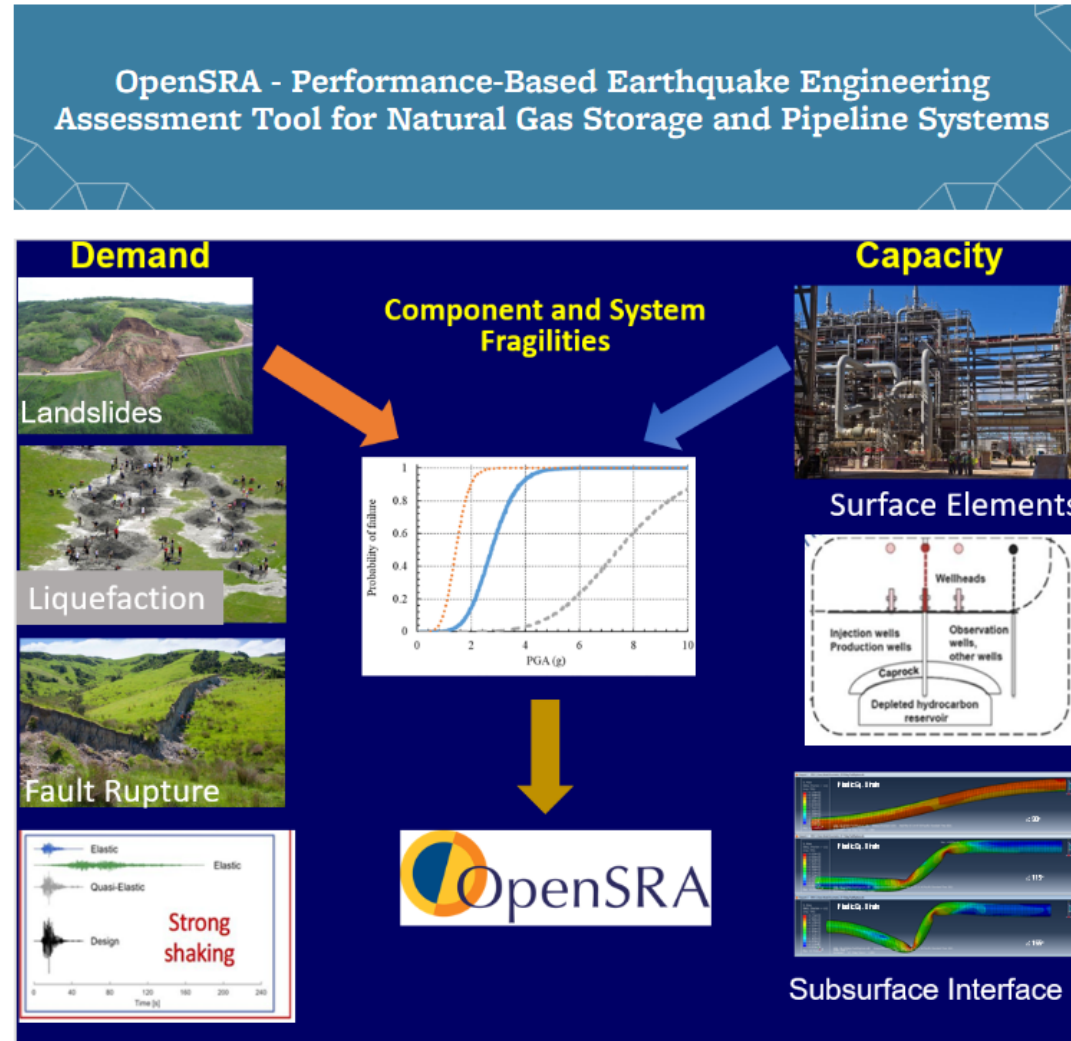
Highlights of Major Programs & Initiatives

- TSRP – Transportation Systems Research Program: **84 Projects in 8 Years**
- PEER – Bridge Program: **15 Projects in 5 Years**
- Simulated Ground Motions
- Next Generation Liquefaction
- CEC projects – OpenSRA Phases 1 & 2
- Cal OES Projects – **3 Projects**



Major PEER Projects: Open-source Seismic Risk Tool (OpenSRA)

OpenSRA adopts
PEER PBEE for the
regional scale simulations
of natural **gas storage**
and pipeline systems



<https://peer.berkeley.edu/OpenSRA>

Major PEER Projects: Simulated Ground Motions

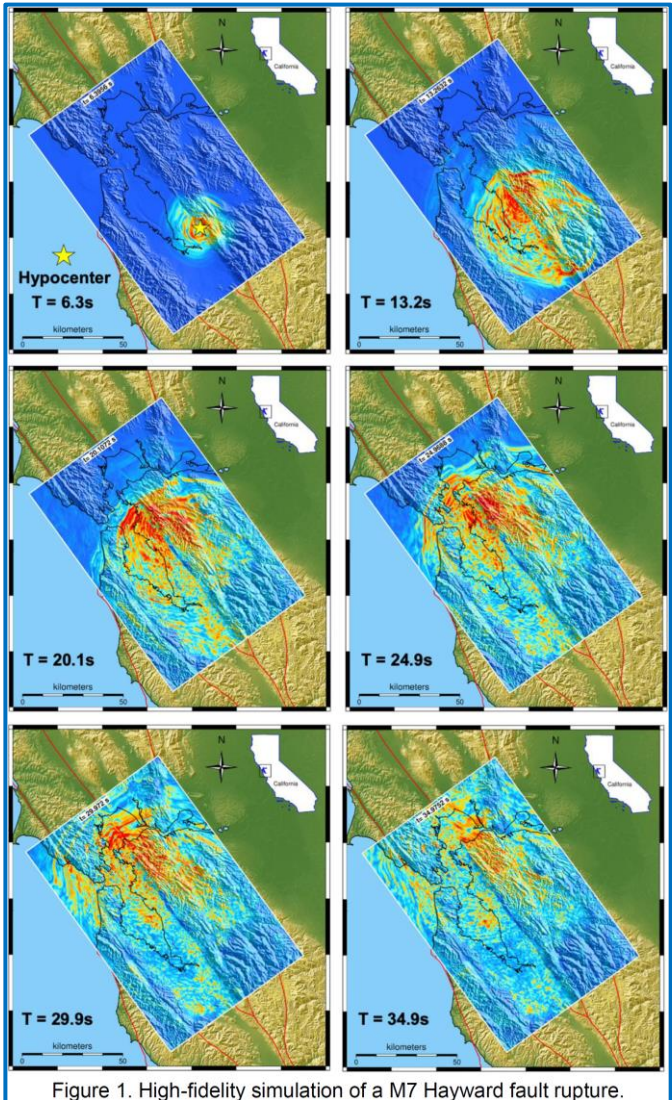
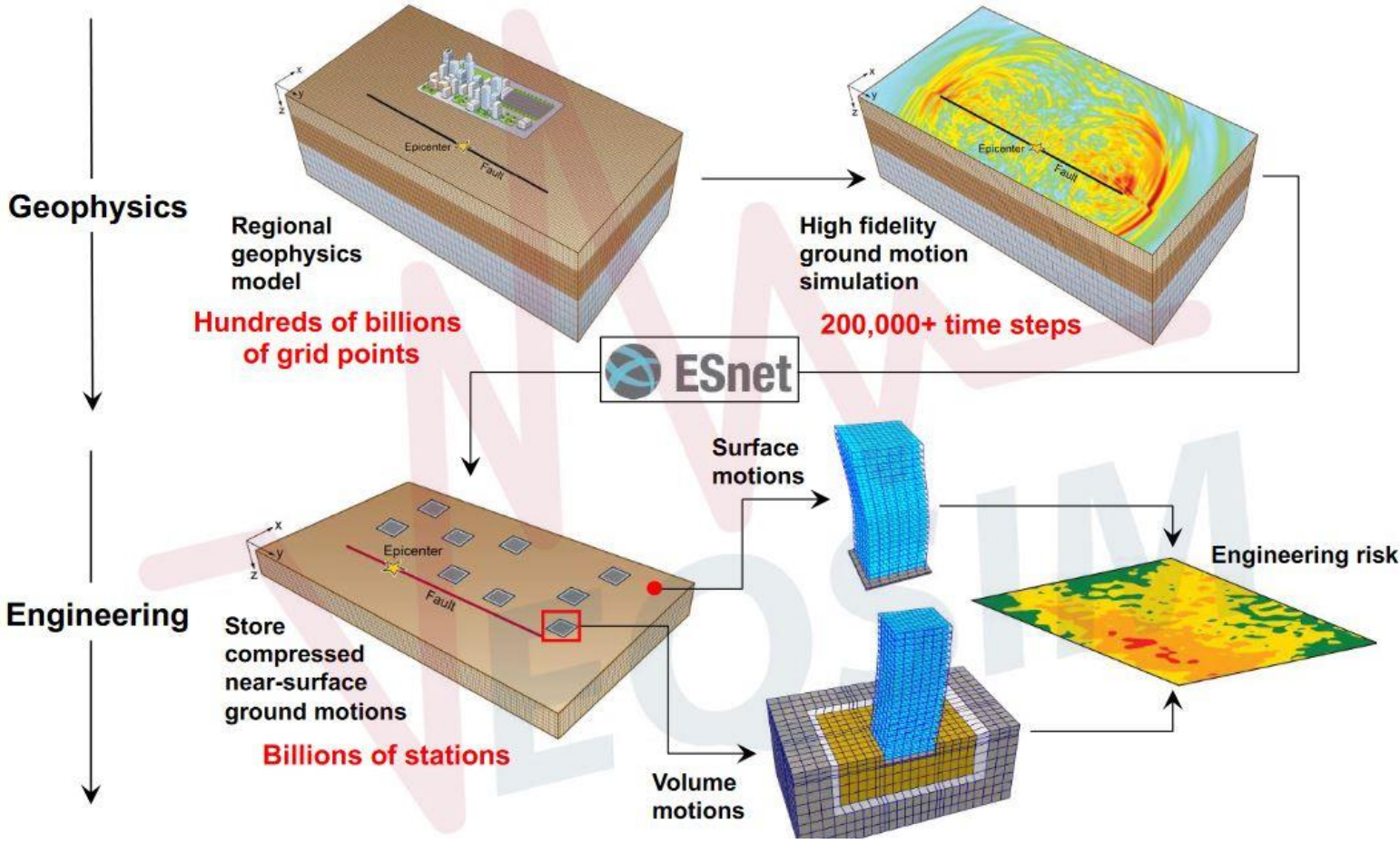


Figure 1. High-fidelity simulation of a M7 Hayward fault rupture.



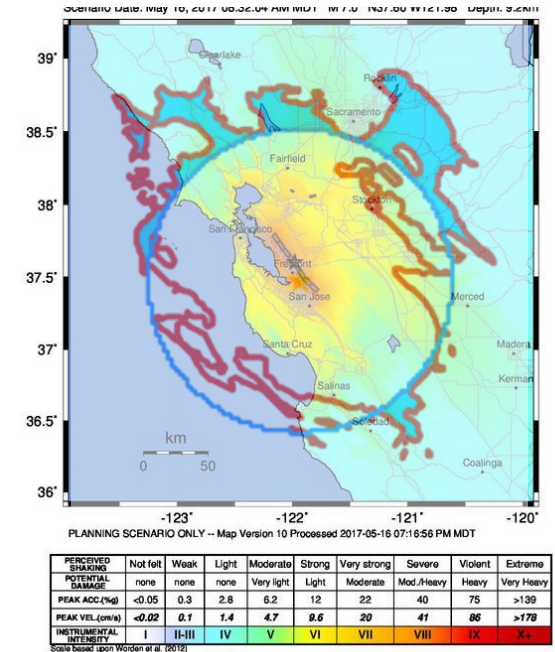
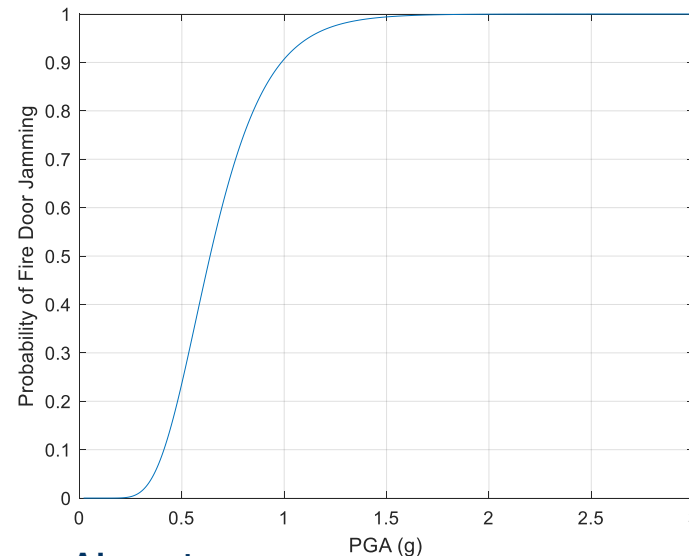
PEER Simulated Ground Motion Database (SGMD) – **Regional Earthquake Hazard**

Major PEER Projects: CalOES Projects

1. Benefit-Cost Assessment of California Earthquake Early Warning (EEW) System
2. Feasibility of Implementing Earthquake Early Warning at Airports
3. Regional Scale **Consequence Assessment of Earthquake** Sequence Scenarios in California

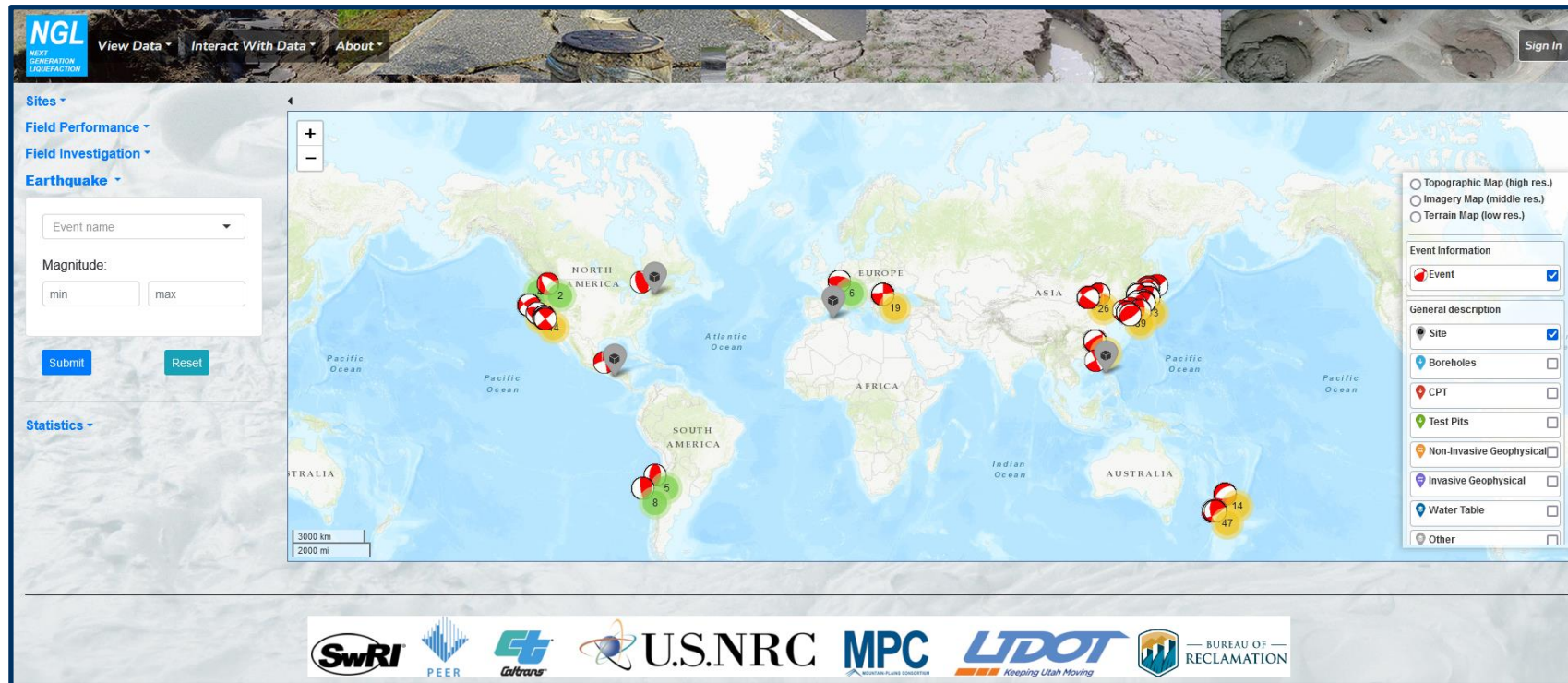


Palm Springs Airport



EEW benefit area for a South Bay Area scenario earthquake

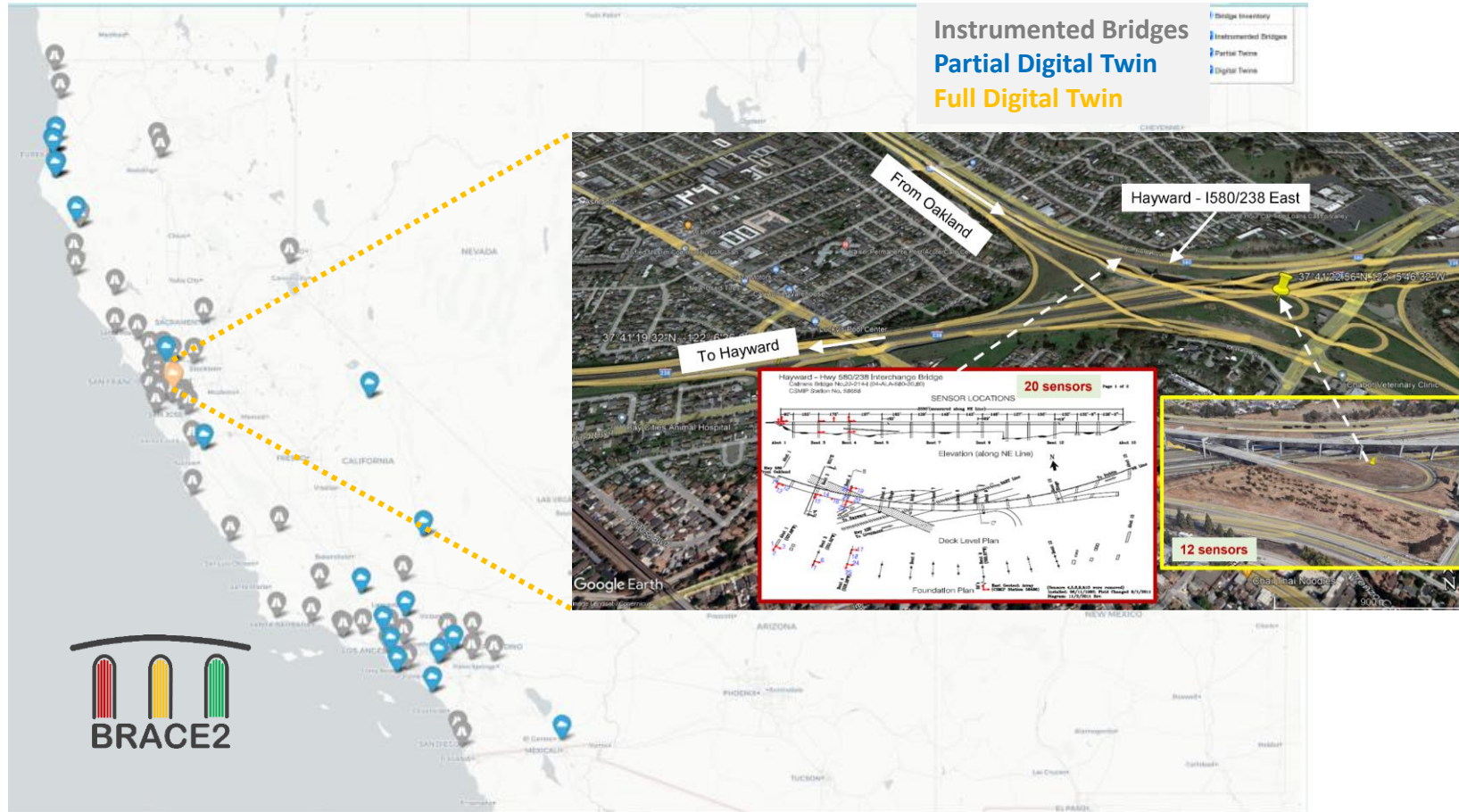
Major PEER Projects: Next Generation Liquefaction (NGL)



<https://www.nextgenerationliquefaction.org/>

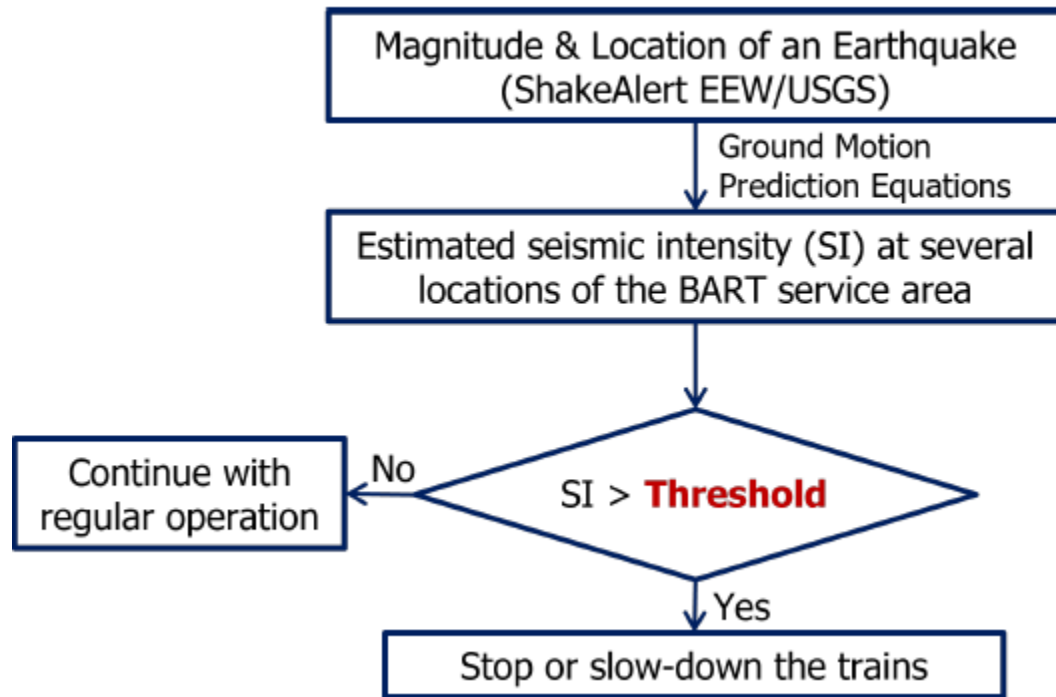
Extensive liquefaction data for **worldwide liquefaction hazard**

Major PEER Projects: Bridge Rapid Assessment Center for Extreme Events (BRACE²)

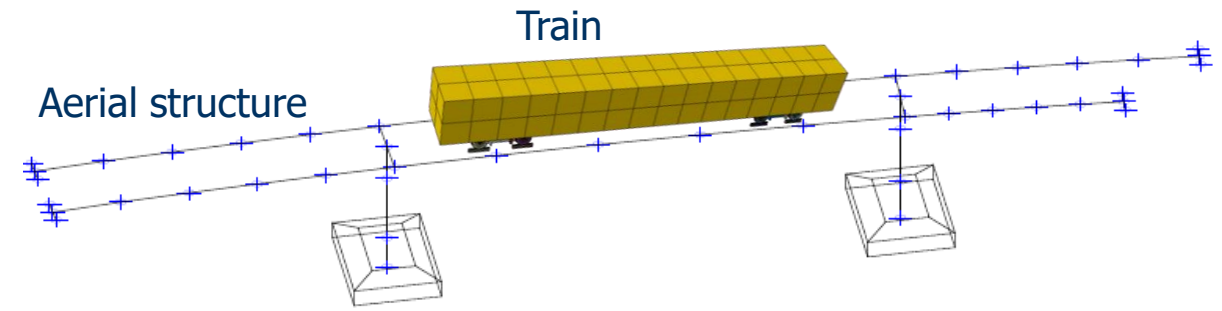


A data & simulation framework for “real time” comprehensive **assessment of instrumented bridges in California**

Major PEER Projects: BART EEW Thresholds



Evaluate and update EEW thresholds
computationally & experimentally



Numerical simulations of BART aerial structures & trains

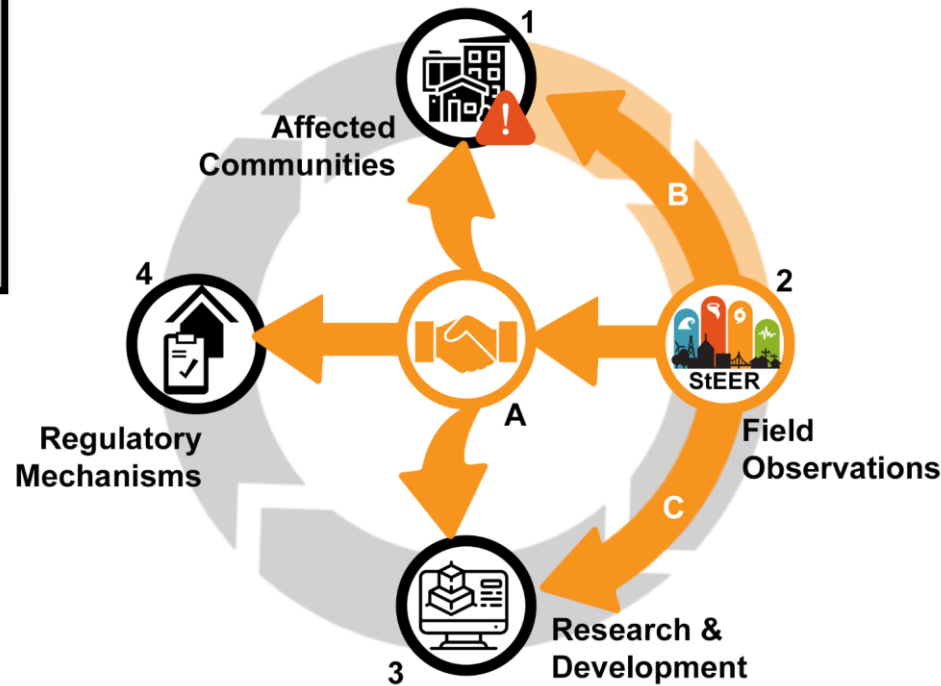
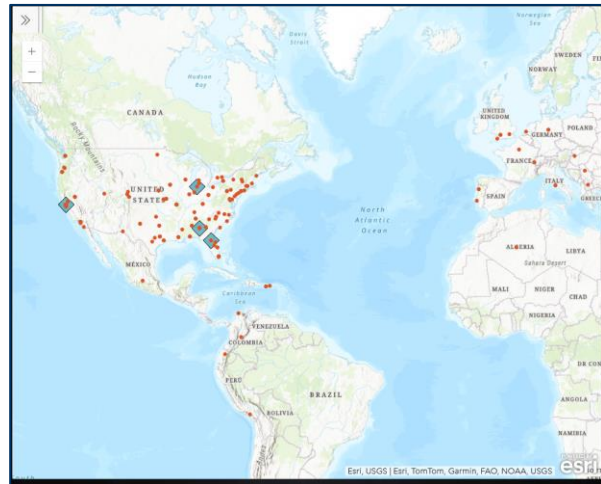


BART train at PEER labs for shaking table testing

Major PEER Projects: Structural Extreme Events Reconnaissance (StEER)

Coordinator Coastal Earthquake Wind Data

DIRECTORS & RESEARCH ASSOCIATES



<https://www.steer.network/>

PEER leads StEER's efforts in earthquake reconnaissance for local & international events

2023 Türkiye Earthquake Sequence
 Initiated 6 February 2023
 Released: March 29, 2023
 NHERI DesignSafe Project ID: PRJ-3824

EARTHQUAKE ENGINEERING RESEARCH INSTITUTE

JOINT PRELIMINARY VIRTUAL RECONNAISSANCE REPORT (PVRR)

| | |
|--|---|
| Joint Report Leads: | |
| Abdullah Dilisiz, Ankara Yıldırım Beyazıt University, Türkiye Selim Günay, University of California, Berkeley Khalid M. Mosalam, University of California, Berkeley | |
| Joint Report Section Leads: | |
| Eduardo Miranda, Stanford University Carlos Arteta, Universidad del Norte Erica Fischer, Oregon State University | Manny Hakhmaneshi, California High-speed Rail Authority Wael M. Hassan, University of Alaska |
| Joint Report Authors: (in alphabetical order) | |
| Bilal Alhawamdeh, Western Michigan University Samuel Andrus, Chapman University Jorge Archbold, Universidad del Norte Safak Arslantürkoglu, ETH Zurich Nurullah Bektaş, Szechenyi István University Luis Ceferino, New York University Jade Cohen, Exponent Burak Duran, University of New Hampshire Kalil Erazo, Rice University Gloria Faraone, San Diego State University Tal Feinstein, Exponent | Marko Marinković, University of Belgrade, Serbia Amory Martin, Exponent Yvonne Merino, Pontificia Universidad Católica de Chile, Chile Maziar Mivehchi, University of California, Davis Luis Moya, Pontificia Universidad Católica del Perú, Peru César Pájaro, Universidad del Norte Nicolas Quintero, Universidad del Norte |

Joint PVRR: 2023 Türkiye Earthquake Sequence
 PRJ-3824 | Released: 3/29/2023
 Building Resilience through Reconnaissance

Upcoming Events & Activities

- 2024 Blind Prediction Contest (*Due Oct 18, 2024*)
- Request For Proposal (RFP) (*Due Nov 15, 2024, focused on Experimental Work*)
- PEER-LBNL Workshop (*March 24, 2025*)
- PEER Annual Meeting (*March 25 & 26, 2025*)
- AI & Fire Workshop (Collaboration with NFPA & SFPE) (*May 28-30, 2025*)
- Workshop on PBSB for Bridges (*TBD in 2025*)
- Researchers workshop (*Aug 2025*)
- 19WCSI (*Sept 15-19, 2025*)



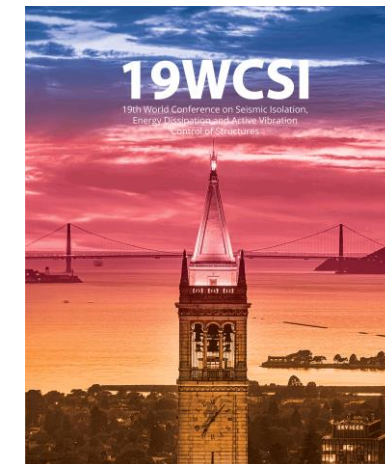
SAVE the DATE – March 25-26, 2025: PEER Annual Meeting



The 2025 PEER Annual Meeting will be held at the UC Berkeley campus on Tuesday, March 25, and Wednesday, March 26, 2025.

The meeting will feature PEER research in the fields of performance-based engineering and resilience, with focus on buildings and infrastructure subjected to various geohazards, tsunamis and fire. In addition, sessions will be formatted for more detailed discussion and engagement to identify areas where research and development are needed.

Decision-making stakeholders, practicing professionals, researchers, faculty, students and others interested in performance-based engineering are encouraged to attend. PEER will release additional program details and online registration information in the near future.



Example of Non-PEER UC Project: Tallest Wood Building Tested in the World at UCSD Shaking Table



- The tallest wood building tested in the world
- Mass timber
- Rocking walls

10-story wood frame building tested on the 6DOF UCSD outdoor shaking table



Cal OES
GOVERNOR'S OFFICE
OF EMERGENCY SERVICES



**ALFRED E. ALQUIST
SEISMIC SAFETY COMMISSION MEETING**

Memorandum

To: Seismic Safety Commissioners
From: Annde Ewertsen, Executive Director
Date: October 10, 2024
Subject: Earthquake Early Warning & ShakeOut Update

Recommendation:

Staff recommends Commissioners review the background information and be prepared to provide comments/questions on the presentation.

Background:

Lori Nezhura, Deputy Director of Planning, Preparedness, and Prevention, Cal OES, will provide an update on Cal OES Earthquake Early Warning and ShakeOut activities.



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OF EMERGENCY SERVICES



ALFRED E. ALQUIST
SEISMIC SAFETY COMMISSION MEETING

Memorandum

To: Seismic Safety Commissioners
From: Annde Ewertsen, Executive Director
Date: October 10, 2024
Subject: Northridge30 Anniversary: Quake Heroes Expo & More

Recommendation:

Staff recommends Commissioners review the background information and be prepared to provide comments/questions on the presentation.

Background:

Mark Benthien, Director of Communication, Education, and Outreach, SCEC, will share the activities supported by the SSC to commemorate the 30th Anniversary of the Northridge Earthquake. These activities include promoting and conducting events to reach additional audiences statewide and target underserved communities. The events will include screenings of the Quake Heroes film in various languages.



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ALFRED E. ALQUIST
SEISMIC SAFETY COMMISSION MEETING

Memorandum

To: Seismic Safety Commissioners

From: Annde Ewertsen, Executive Director

Date: October 10, 2024

Subject: A Culture of Earthquake Resilience – Update on California Residential Mitigation Program (CRMP) Residential Retrofit Grant Programs (EBB, ESS, and the new multi-unit EMR)

Recommendation:

Staff recommends Commissioners review the background information and be prepared to provide comments/questions on the presentation.

Background:

Janiele Maffei, Chief Mitigation Officer, California Earthquake Authority (CEA), and Jenn Hogan, Managing Director, CRMP, CEA, will provide an update on CRMP's residential retrofit grant programs. More than 23,000 California homeowners have completed a code-compliant seismic retrofit on their raised-foundation houses utilizing the CRMP's Earthquake Brace & Bolt (EBB) Program. CRMP recently launched the Earthquake Soft-Story (ESS) Program for single-family residences with soft-story vulnerabilities and is developing a Multi-Family Soft-Story Program.

Janiele Maffei was hired as CEA's first Chief Mitigation Officer in May 2011 and became Director of Research in 2015. Her current responsibilities include managing the CRMP and that program's first retrofit incentive program, Earthquake Brace and Bolt (EBB); various research projects that will benefit CEA's strategic insurance, mitigation, and education goals; and other mitigation efforts that will benefit both policyholders and California homeowners.

Jenn Hogan is the CRMP's Managing Director. Previously, she was the Assistant Director for Hazard Mitigation at Cal OES. Earlier in her career, she worked with the California Air Resources Board and the Department of State Hospitals in Human Resources and Risk Management. Before beginning State Service in 2008, Jenn was a 911 Dispatch Supervisor for the Ak-Chin Indian Community in Arizona.



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OF EMERGENCY SERVICES



**ALFRED E. ALQUIST
SEISMIC SAFETY COMMISSION MEETING**

Memorandum

To: Seismic Safety Commissioners
From: Annde Ewertsen, Executive Director
Date: October 10, 2024
Subject: Fire Following Earthquake – Reducing Post-Earthquake Ignitions

Recommendation:

Staff recommends Commissioners review the background information, be prepared to provide comments/questions on the presentation and provide further directions by voting on the project.

Background:

Dr. Scawthorn, a structural engineer, visiting researcher at the University of California, Berkeley, and a retired Professor at Kyoto University, is recognized as a leading expert on fire-following earthquakes. He advises Global 1000 corporations, government agencies, and the World Bank on natural hazards risk management. At the July SSC meeting, he presented an overview of recent fire-following earthquake research and risk assessment developments.

Dr. Scawthorn will provide a follow-up presentation to further the discussion from the July 18, 2024, SSC Meeting, discussing the potential feasibility of reducing fire-following ignitions during earthquakes via improved gas seismic shutoff devices. He will request approval for the following project:

- *Reducing Post-Earthquake Ignitions*
 - A study on the critical mass needed for gas shut-off valves to reduce fire-following vulnerability in Southern California
 - Final report to SSC documenting the project and outcomes

Reducing post-earthquake ignitions

Charles Scawthorn, S.E.

Pacific Earthquake Engineering Research Center, Univ. California at Berkeley

Summary: Seismic gas shutoff devices (SGSDs, also known as “earthquake gas valves”) can reliably shut off gas to a building in an earthquake, thereby potentially eliminating gas-fed fires, a significant fraction of all post-earthquake ignitions. However, the pace of SGSD installation is slow, with only some jurisdictions requiring them, and only for new construction or major renovations. We propose research to identify those densely built highly seismic areas where widespread comprehensive installation of SGSDs is cost-beneficial, for a study area in southern California. Our analysis will employ a building-specific building inventory, most recent seismicity data, and modeling of fire following earthquake including fire and water agency response. The result will be a report with maps and GIS data that state and local agencies can use to identify where comprehensive installation of SGSDs is cost beneficial. Results will be disseminated online and documented in a final written report. The research will be performed by PEER at UC Berkeley over a 12-month period, requiring \$90,000.

The Issues: Fire following earthquake is regarded as a low probably high consequence event, although there is little basis that the probability is actually low. Indeed, under current circumstances a large earthquake in the urbanized parts of California there is near certainty that hundreds of ignitions leading to conflagrations will occur. If the earthquake occurs during hot dry windy red flag conditions, the conflagrations are likely to be of catastrophic proportions. Reducing this risk involves reducing the *demand* – that is, the number of ignitions, as well as increasing the *capacity* – that is, the ability to rapidly fight the fires while they are small enough to do so. Here we address how to reduce the demand – that is, the immediate earthquake-caused ignitions.

Background and related work: Gas-related ignitions constitute about one-third of all post-earthquake ignitions. To eliminate some of these fires, “earthquake gas valves” – that is, seismic gas shutoff devices (SGSDs), have been around for a long time and are available from many sources. For residential applications, the installed cost is on the order of \$600. SGSDs typically function very simply – they are often installed inline after the gas meter so that the gas flows through a channel in a small metal box above which a ball sits on a railing. Earthquake shaking dislodges the ball, which falls into the channel, stopping gas flow and any feed to a fire due to leaks in the piping or gas-related appliances.

While SGSD reliability is reasonable, for many years gas companies been concerned about their installation because in an earthquake the gas companies would be burdened and potentially slow to “re-light” customers. This loss of service to many customers needed to be balanced against the potential for post-earthquake conflagration. However, since gas-related ignitions are about one-third of all ignitions, if that one-third of ignitions can be largely prevented, the remaining ignitions are much more likely to be quickly responded to by firefighters (the “tipping point” for large conflagrations will not be reached).

However, SGSDs have a fatal flaw, in that if one homeowner in a block of say 100 homes installs the SGSD, then the probability of a post-earthquake ignition in the block will still be 99% of what it was without the SGSD. If a fire breaks out in one of the 99 other homes in the block and is not responded to quickly by the fire department, the likelihood of the block (including the home with the SGSD) being destroyed by fire after the earthquake, remains virtually the same. In other words, the single

installed SGSD is ineffective. That is, SGSDs are really only effective if virtually all customers in the block install them. The situation is akin to a flu or other epidemic – one person getting a vaccination doesn't prevent the rapid spread within the population – rather, a large percentage of the population needs to be vaccinated in order to stop the spread (“herd immunity”, in medical parlance).

In recognition of this, following the 1995 Kobe earthquake in Japan the government required the changeover of all gas meters to new meters with a built-in very simple solid-state earthquake sensor and shutoff switch. In Japanese earthquakes since then, fires have been significantly less of a problem. This is in contrast to the situation in California, where more recently gas companies switched to new “smart meters” in order to eliminate manual meter reading, but opted not to include the seismic technology Japan had been using for more than a decade.

Still, “something is better than nothing” so that some jurisdictions such as Los Angeles and Berkeley have required installation of SGSDs on new construction or major renovations, so that, very slowly, SGSDs are being installed in those jurisdictions. However, other jurisdictions (e.g., San Francisco) still don't require SGSDs.

It can therefore be seen that it would be very beneficial if the pace of SGSD installations could be significantly stepped up in California. However, this need not be in all of California. Rather, the optimum would be SGSDs, or gas meters with built-in seismic switches, for all customers *only in areas of high seismicity and high building density*, where post-earthquake conflagrations are most probable. Using these criteria local governments may choose to institute a police that will significantly reduce the likelihood of post-earthquake conflagrations while keeping costs manageable.

Proposed research and activities: To address this issue, we propose research to quantitatively identify specifically where the overlay of seismicity and building density warrants comprehensive SGSDs or gas meters with built-in seismic switches. To do this, we will perform the following tasks for the study area of southern California:

1. **Building Inventory:** Develop an up-to-date inventory of all buildings in southern California. To do this, we will adapt the current California *BRAILS* building inventory developed by the University of California Sim Center¹ (which is building-specific for all buildings in California) so as to be usable in estimating post-earthquake ignition and fire spread. *BRAILS* is currently developed primarily for earthquake investigation and lacks some fire-related parameters. We will compile and enhance the *BRAILS* inventory with such data.
2. **Seismicity:** Similarly, we will employ the most recent model of southern California seismicity (UCERF3 or if available more recent work by USGS). Shaking and liquefaction effects will be considered.
3. **Industry input:** we have previously met with Japan Gas Association, Osaka Gas and Tokyo Gas companies, and have a good understanding of the Japanese gas meter seismic technology. We will request meetings with representative larger California gas companies, meter manufacturers and other knowledgeable parties, to understand the issues and costs associated with SGSD-equipped gas meters in California.
4. **Analysis:** Using the seismicity model and working with the Sim Center, we will generate a stochastic set of events. For each event, we will model the number and distribution of earthquake-caused ignitions and subsequent firespread, with and without universal SGSDs.

¹ Barbaros Cetiner, Charles Wang, Frank McKenna, Sascha Hornauer, Jinyan Zhao, Yunhui Guo, Stella X. Yu, Ertugrul Taciroglu & Kincho H. Law. (2024). NHERI-SimCenter/BRAILS: Version v3.1.1. Zenodo.

This modeling will consider fire department and water system response. Based on this, we will identify those combinations and regions of seismicity and building density where universal SGSDs are cost-beneficial in reducing the likelihood of post-earthquake ignitions. Maps and a GIS database will be created (at Zip Code or census tract resolution) presenting this data, for use by state and local jurisdictions.

5. **Deliverables and Final Report:** the main deliverables will be a report documenting the data, analysis and findings. The report will include maps and GIS data defining (at Zip Code or census tract resolution) cost-effectiveness of comprehensive deployment of SGSDs in southern California.

Project Advisory Panel: Panelists to be identified and confirmed

Schedule / Budget: The research will be performed over a 12-month period, requiring \$90,000.

Funding mechanism: Seismic Safety Commission grant to the Pacific Earthquake Engineering Research Center, Univ. California at Berkeley

Reducing post-earthquake ignitions

*Presentation to Seismic Safety Commission
10 October 2024*

Charles Scawthorn, S.E., D.Eng.

SPA Risk LLC

Pacific Earthquake Engineering Center, Univ. California at Berkeley

Fire and earthquake
were a problem in
1906

And remain a
problem today



California needs a state-wide approach to reducing fire following earthquake risk

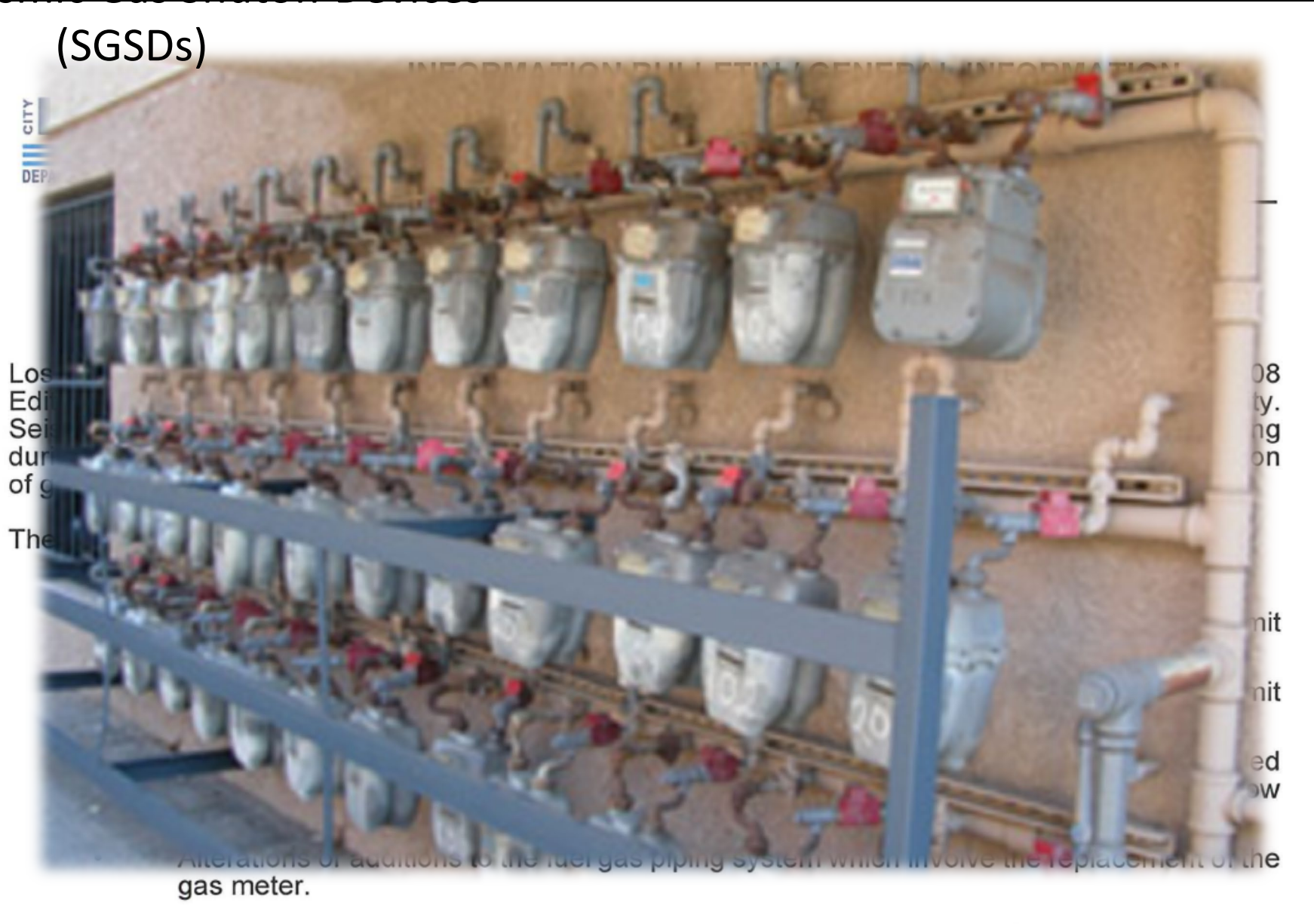
California Seismic Safety Commission, (SSC 2002):

“the number of post-earthquake fire ignitions related to natural gas can be expected to be 20% to 50% of the total post-earthquake fire ignitions.”

→ Reducing gas ignitions significantly reduces earthquake fires

But, is this needed everywhere in California?

Current Seismic Gas Shutoff Devices (SGSDs)



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Alterations or additions to the fuel gas piping system which involve the replacement of the gas meter.

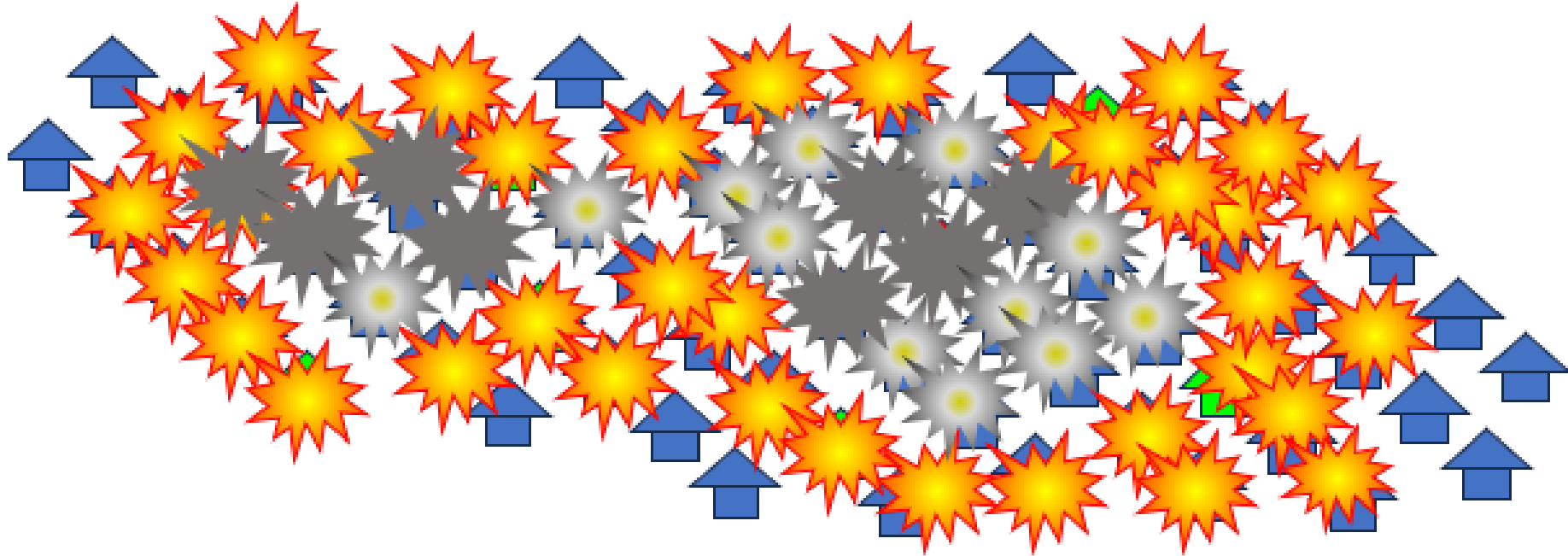


1" NPT GAS VALVE
(VALVE ALSO AVAILABLE)

25-97



**SGSD's are *not* needed state-wide,
but *are* needed in high EQ / population areas**



In lower-density or (lower-seismicity) areas, SGSDs are not needed

Reducing post-earthquake ignitions

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Summary: Seismic gas shutoff devices (SGSDs, also known as “earthquake gas valves”) can reliably shut off gas to a building in an earthquake, thereby potentially eliminating gas-fed fires, a significant fraction of all post-earthquake ignitions. However, the pace of SGSD installation is slow, with only some jurisdictions requiring them, and only for new construction or major renovations. We propose research to identify those densely built highly seismic areas where widespread comprehensive installation of SGSDs is cost-beneficial, for a study area in southern California. Our analysis will employ a building-specific building inventory, most recent seismicity data, and modeling of fire following earthquake including fire and water agency response. The result will be a report with maps and GIS data that state and local agencies can use to identify where comprehensive installation of SGSDs is cost beneficial. Results will be disseminated online and documented in a final written report. The research will be performed by PEER at UC Berkeley over a 12-month period, requiring \$90,000.

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1. **Building Inventory:** Develop an up-to-date inventory of all buildings in southern California. To do this, we will adapt the current California *BRAILS* building inventory developed by the University of California Sim Center¹ (which is building-specific California) so as to be usable in estimating post-earthquake ignitions. The *BRAILS* inventory is currently developed primarily for earthquake investigation parameters. We will compile and enhance the *BRAILS* inventory.
2. **Seismicity:** Similarly, we will employ the most recent model of seismicity (UCERF3 or if available more recent work by USGS effects will be considered).
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4. **Analysis:** Using the seismicity model and working with the Sim stochastic set of events. For each event, we will model the number of earthquake-caused ignitions and subsequent firespread, with and

This modeling will consider fire department and water system response. Based on this, we will identify those combinations and regions of seismicity and building density where universal SGSDs are cost-beneficial in reducing the likelihood of post-earthquake ignitions. Maps and a GIS database will be created (at Zip Code or census tract resolution) presenting this data, for use by state and local jurisdictions.

5. **Deliverables and Final Report:** the main deliverables will be a report documenting the data, analysis and findings. The report will include maps and GIS data defining (at Zip Code or census tract resolution) cost-effectiveness of comprehensive deployment of SGSDs in southern California.

Project Advisory Panel: Panelists to be identified and confirmed

Schedule / Budget: The research will be performed over a 12-month period, requiring \$90,000.

Funding mechanism: Seismic Safety Commission grant to the Pacific Earthquake Engineering Research Center, Univ. California at Berkeley

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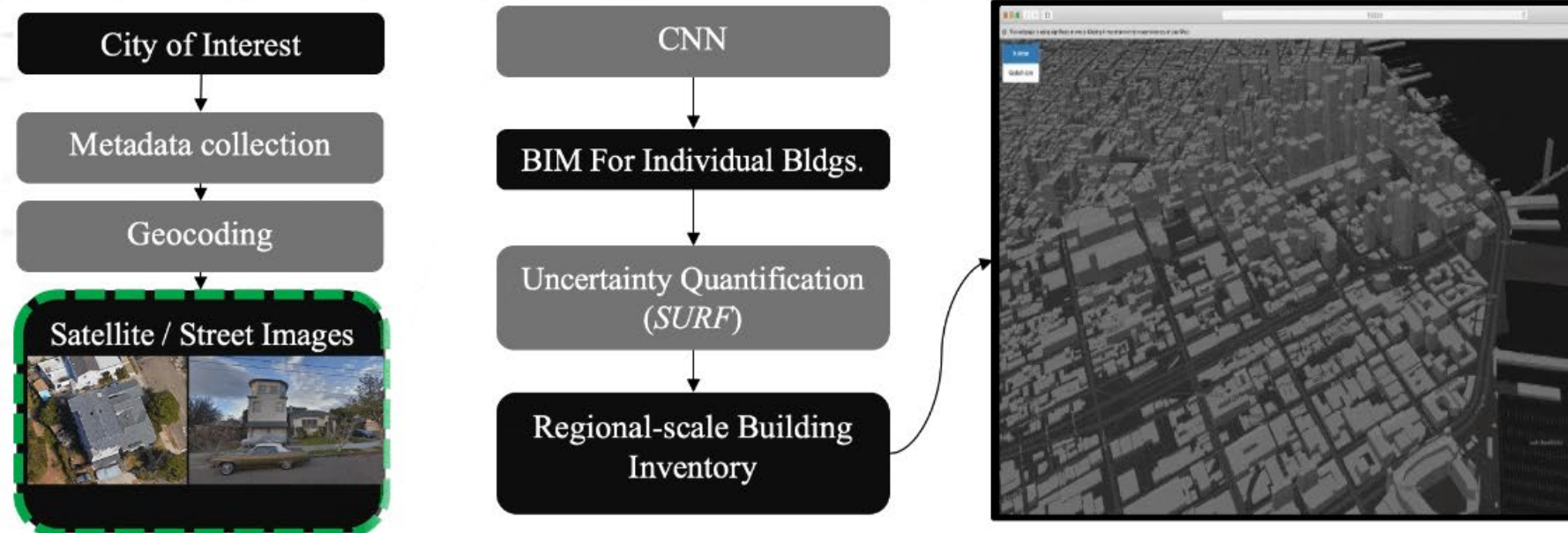
Summary of tasks

1. **Building Inventory:** Adapt the current UC Berkeley California *BRAILS* building inventory.
2. **Seismicity:** Employ most recent model of southern California seismicity (UCERF3 or if available more recent work by USGS). Shaking and liquefaction effects will be considered.
3. **Industry input:**
 - Japan Gas Association, Osaka Gas and Tokyo Gas
 - meet representative larger California gas companies, meter manufacturers and other knowledgeable parties
4. **Analysis:**
 - Overlay seismicity and building inventory for southern California study are to model the number and distribution of earthquake-caused ignitions and subsequent firespread, with and without SGSDs, considering fire department and water system response.
 - Identify regions where SGSDs are cost-beneficial
 - Create maps and GIS database for use by state and local jurisdictions.
5. **Deliverables and Final Report:**
 - Report documenting the data, analysis and findings.
 - Maps and GIS data cost-effectiveness of SGSDs in southern California.

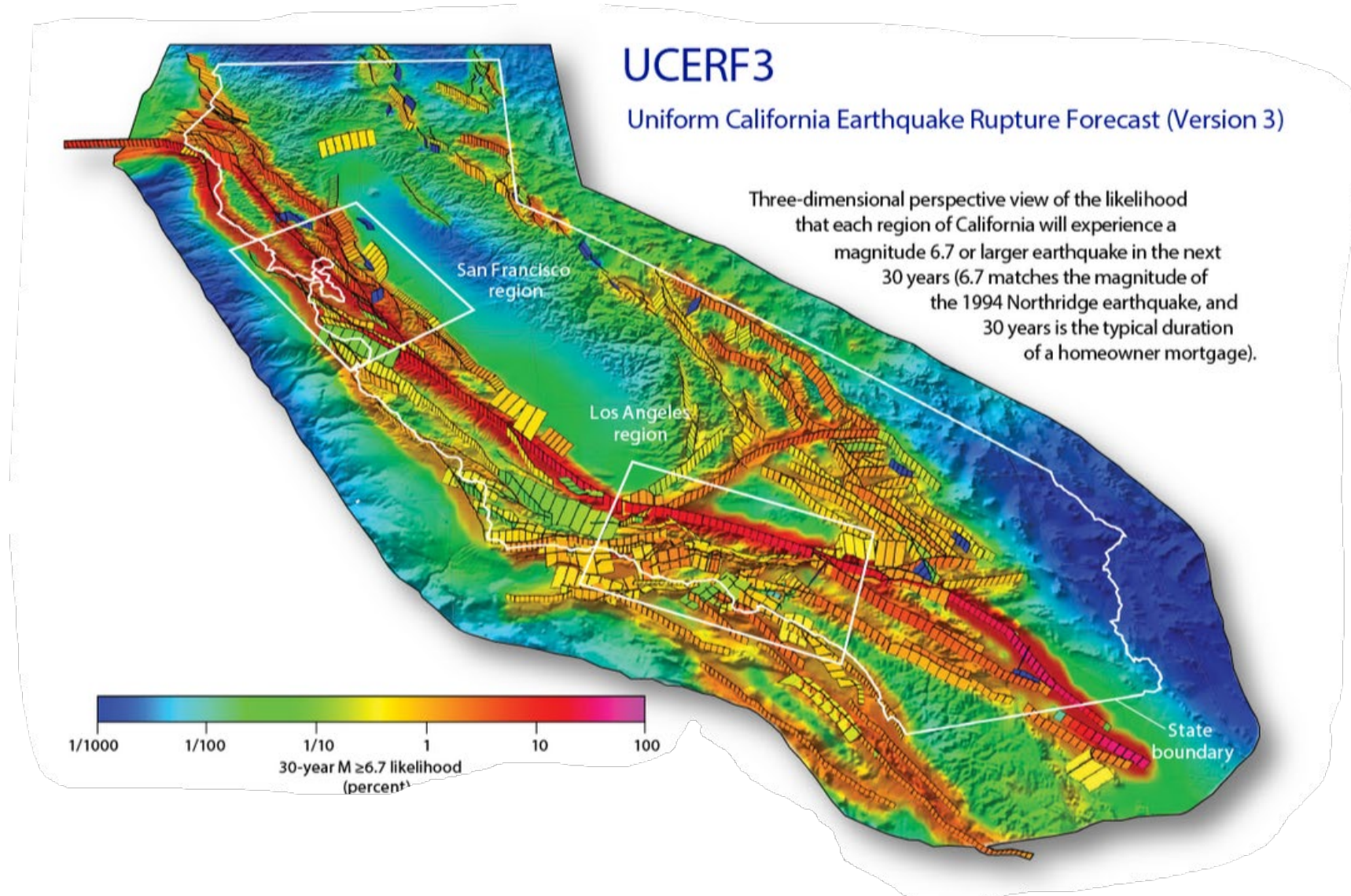
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BRAILS: BUILDING RECOGNITION USING ARTIFICIAL INTELLIGENCE AT LARGE SCALE (LATEST VERSION 3.1.2)

BRAILS is a new AI-enabled tool to assist regional-scale simulations. **BRAILS** utilizes machine learning (ML) and deep learning (DL) to create enhanced building inventory databases of cities. Examples of its capabilities include: (a) The identification of roof shapes to improve the damage and loss calculations for the hurricane workflow. This implementation used data from open street map and images from Google Maps. (b) The identification of soft-story buildings to improve models in earthquake workflows. This implementation used engineering knowledge and a subset of images from Google Street View to train a neural network to automatically classify the remaining images.

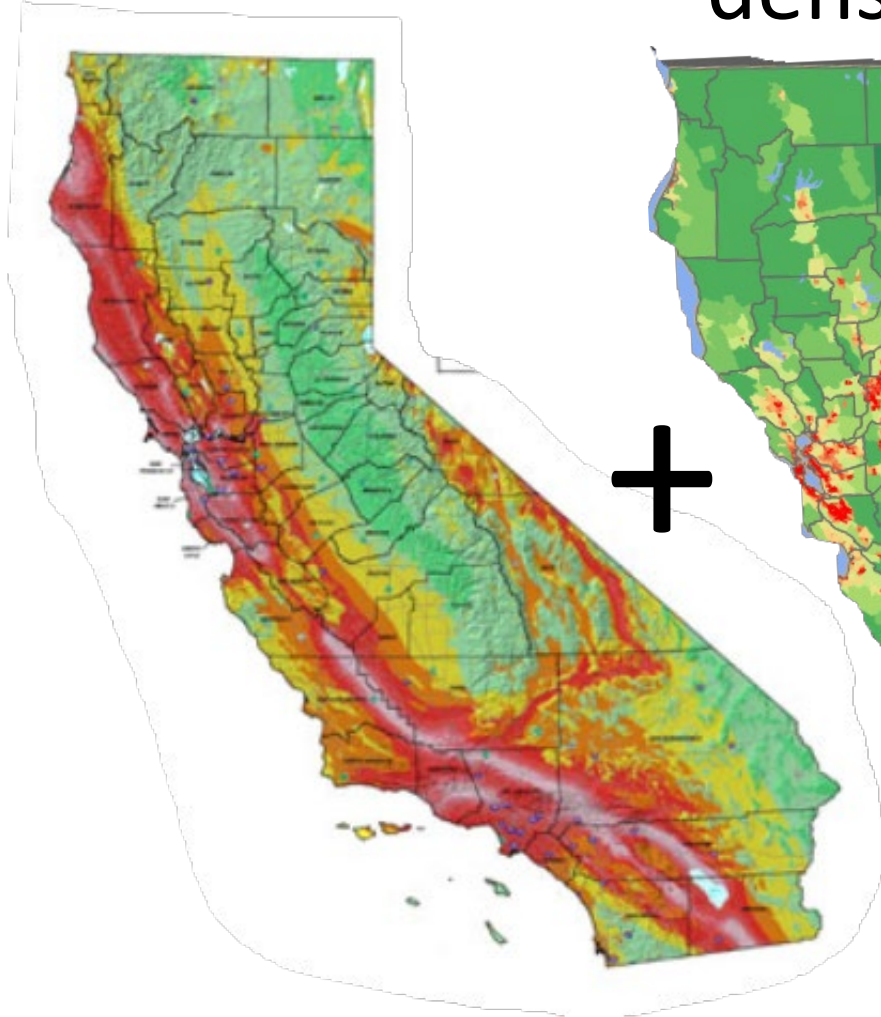


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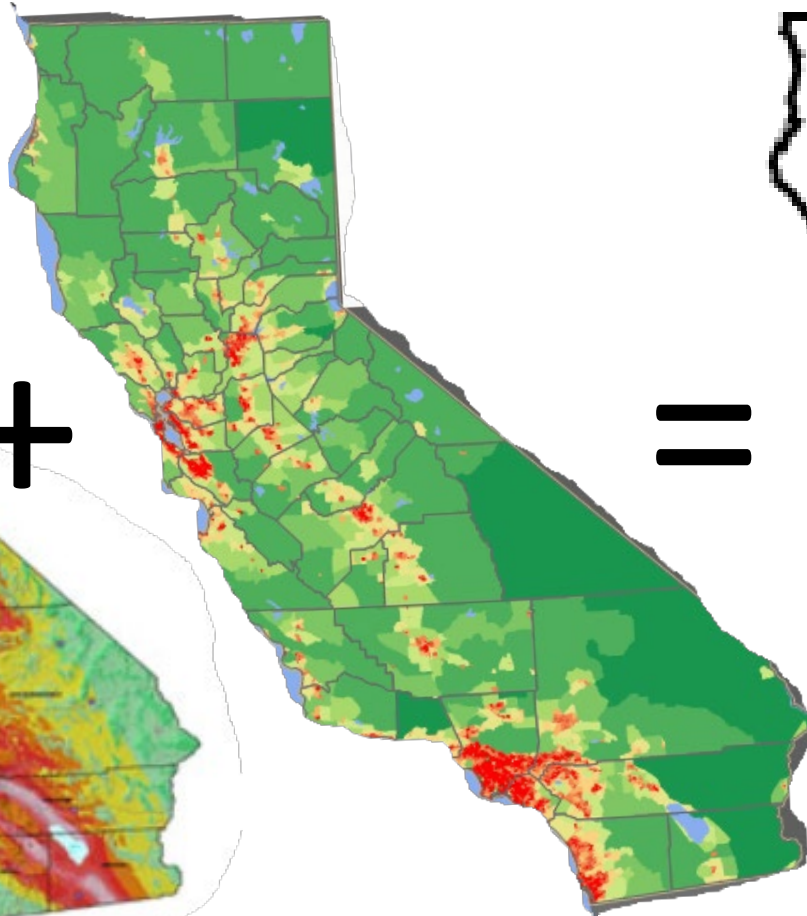


Analysis

Seismicity



Building density



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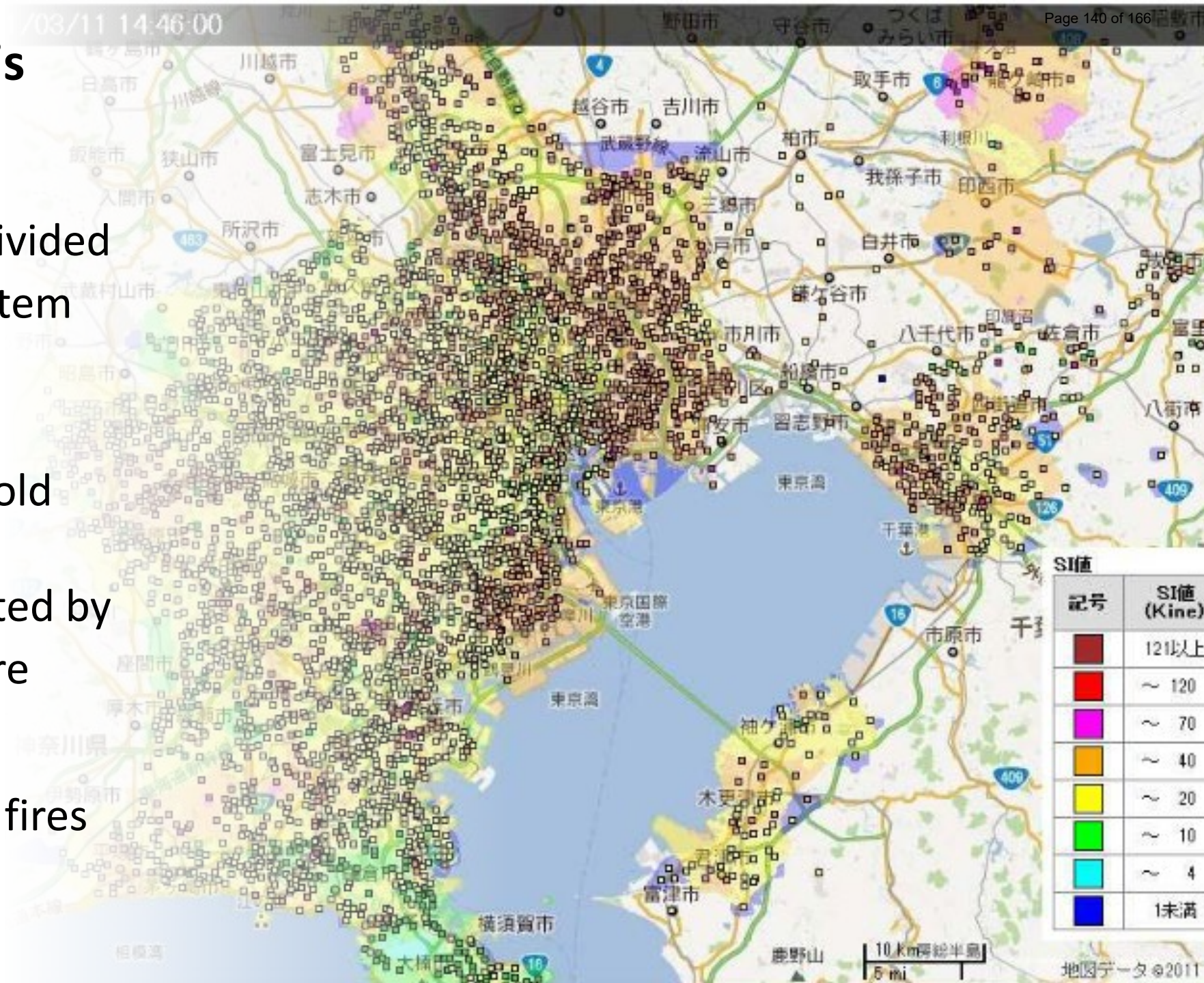
Where are SGSDs
cost effective?



Analysis will estimate and consider existing SGSD installations (currently unknown).

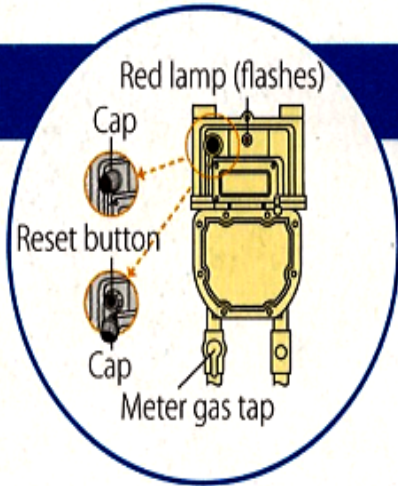
Japan realized this decades ago

- 1980-90s, Tokyo gas divided its gas distribution system into 3800 blocks.
 - If EQ shaking > threshold
 - These blocks are isolated by automatic valve closure
- Gas no longer will fuel fires



At the building level, Japan after the 1995 Kobe earthquake required nation-wide installation of new gas meters with built-in SGSDs:

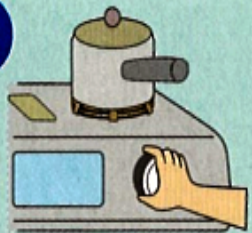
Intelligent gas meter recovery



If a gas leak or an earthquake measuring intensity 5 or greater on the Japanese seismic intensity scale (JMA) is detected, or if a gas device was accidentally left on or there is a high flow of gas, the gas meter automatically shuts off the gas supply. The customer can restore the gas supply by following a simply recovery operation procedure.

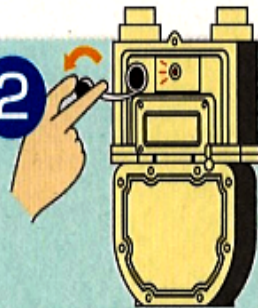
* Refer to the instruction manual provided with the meter for further details.

1



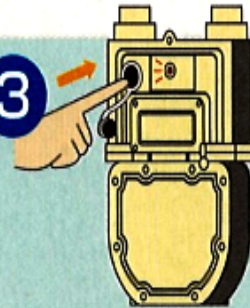
Turn off **all gas devices**. Do not forget to turn off outside devices.
(Meter gas tap is left open.)

2



Remove the reset button **cap**.
(There are also types without caps.)

3



Press the reset button all the way in, and then slowly release it.
(After the red lamp lights up, it starts to flash.)

4

Do not use the gas and wait approximately 3 minutes.

(Gas meter checks the safety during this time.)
When it stops flashing, the gas can be used. If it does not stop flashing, start over from step 1.
(Contact Tokyo Gas if this procedure does not restore the gas.)

Scan the QR code or use the following URL to view the Tokyo Gas website in English.



[Tokyo Gas website]

http://www.tokyo-gas.co.jp/index_e.html

California Seismic Safety Commission, (SSC 2002):

“the number of post-earthquake fire ignitions related to natural gas can be expected to be 20% to 50% of the total post-earthquake fire ignitions.”

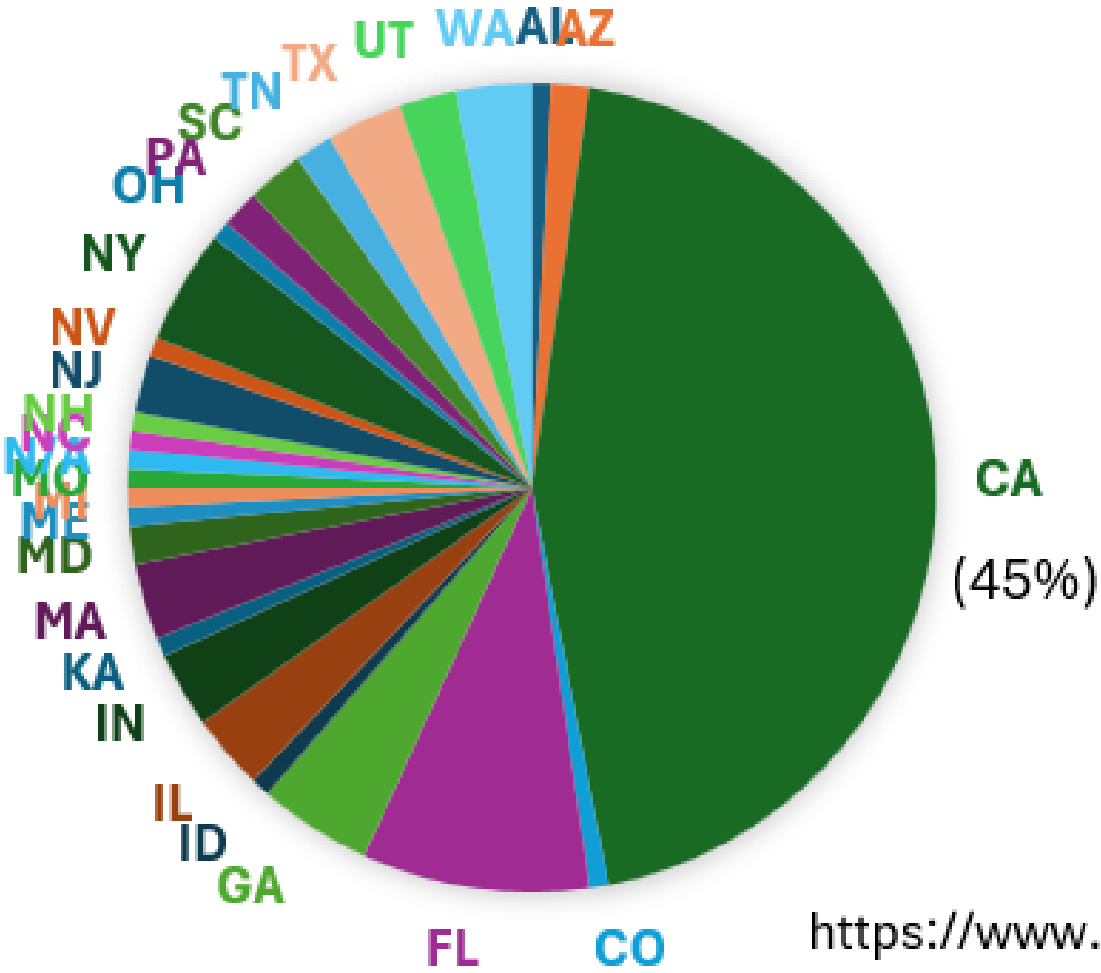
However, another 20% to 50% of ignitions are electrical-related

→ As we ramp down on gas, and ramp up on all-electric homes and businesses, particularly with distributed generation and storage (solar / powerwalls), another issue emerges: ***PV panel and battery fires.***

This issue has not yet been examined

Batteries are a particular issues:

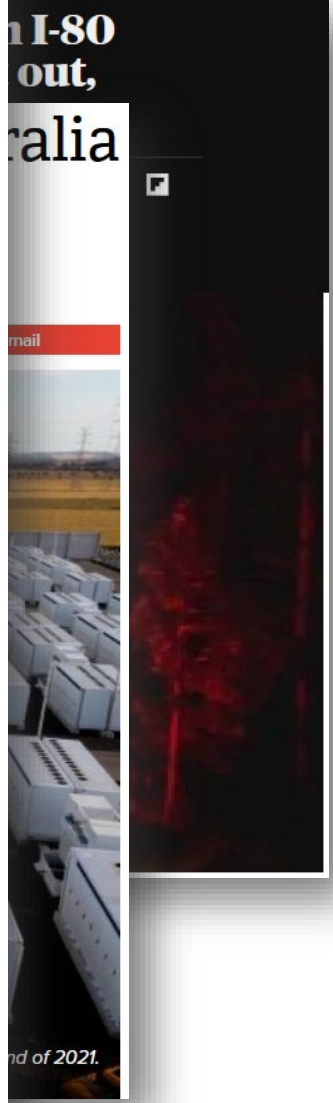
TESLA CAR FIRES BY STATE



<https://www.tesla-fire.com/>



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Project Advisory Panel: representative Fire and Water agencies, industry and academia
Schedule Budget: The research will be carried out over a 12-month period

| | | Months | | | | | | | | | | | |
|---|---|--------|---|---|---|---|---|---|---|---|----|----|----|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | BUILDING INVENTORY | | | | | | | | | | | | |
| | Train BRAILS for FFE inventory | ■ | ■ | | | | | | | | | | |
| | Develop inventory | | | ■ | | | | | | | | | |
| | Estimate current / proj. SGSD installations | | | | ■ | | | | | | | | |
| | Assess results | | | | | ■ | | | | | | | |
| 2 | SEISMICITY | | | | | | | | | | | | |
| | Acquire and integrate UCERF3 | | | ■ | | | | | | | | | |
| 3 | INDUSTRY INPUT | | | | | | | | | | | | |
| | Japan industry | | | | ■ | | | | | | | | |
| | US Distributores | | | | | ■ | | | | | | | |
| | US meter mfgs, others | | | | | | ■ | | | | | | |
| 4 | ANALYSIS | | | | | | | | | | | | |
| | Integrate BI and EQ (R2D or other) | | | | | | ■ | | | | | | |
| | Perform analysis (w/ w/o SGSDs) | | | | | | | ■ | ■ | | | | |
| | Assess results | | | | | | | | ■ | ■ | | | |
| 5 | FINAL REPORT | | | | | | | | | | | | |
| | Project Advisory Panel meetings | | | ■ | | | ■ | | | ■ | | ■ | ■ |

Effort: Approximately 480 professional hours. \$90,000 is requested

Funding: \$75,000 is requested (SSC grant to PEER, Univ. California at Berkeley).





Cal OES
GOVERNOR'S OFFICE
OF EMERGENCY SERVICES



**ALFRED E. ALQUIST
SEISMIC SAFETY COMMISSION MEETING**

Memorandum

To: Seismic Safety Commissioners
From: Annde Ewertsen, Executive Director
Date: October 10, 2024
Subject: Fire Following Earthquake – Improving Post-Earthquake Firefighting Water Supply Capacity Reliability

Recommendation:

Staff recommends Commissioners review the background information, be prepared to provide comments/questions on the presentation and provide further directions by voting on the project.

Background:

Dr. Scawthorn, a structural engineer, visiting researcher at the University of California, Berkeley, and a retired Professor at Kyoto University, is recognized as a leading expert on fire-following earthquakes. He advises Global 1000 corporations, government agencies, and the World Bank on natural hazards risk management. At the July SSC meeting, he presented an overview of recent fire-following earthquake research and risk assessment developments.

Following the recommendation from Dr. Scawthorn's 2012 SSC-funded report ("[Water Supply in regard to Fire Following Earthquake](#)"), he will request approval for the following project:

- *Improving Post-Earthquake Firefighting Water Supply Capacity*
 - A survey of water and fire agencies to understand the current situation
 - An invitational workshop for water agencies and fire departments to inform and discuss issues and mitigation options, recorded and findings provided
 - Follow up support meetings within 6 months following the workshops
 - Final report to SSC documenting the project and outcomes

Improving Post-earthquake Firefighting Water Supply Capacity / Reliability

Charles Scawthorn, S.E.

Pacific Earthquake Engineering Research Center, Univ. California at Berkeley

Summary: The current capacity and reliability of post-earthquake firefighting water in large parts of California is poor, as found over a decade ago in a project funded by the Seismic Safety Commission. We propose to examine the current capacity of fire and water agencies for reliable post-earthquake firefighting water supply, identify options for improving capacity, and evaluate the long-term damage earthquakes cause to water distribution networks. This will be accomplished by analyses and surveys and interviews with key larger water and fire agencies in California. Based on findings, a series of mitigation measures such as secondary water sources, portable water supply systems and pre-earthquake preparedness will be examined and prioritized for cost-effectiveness. Analyses will also be conducted to examine how longer-term losses can be reasonably assessed in order to support more accurate and complete damage assessments and claims. These findings will be shared with the fire and water agencies in a workshop, followed by presentations to selected agencies' senior management/directors. Results will be disseminated online and documented in a final written report. The research will be performed by PEER at UC Berkeley over a 12-month period, requiring \$75,000.

The Issues: Water is of course vital for life, fire safety and the well-being of communities in California. Earthquakes cause great damage to water distribution networks to the extent that large areas of California's largest cities can lose all water pressure, can take days to weeks to restore this pressure, and take months to years to completely repair and restore the network. The immediate loss of pressure deprives fire departments of firefighting water and is a major factor in large urban conflagrations. This risk involves both fire and water agencies and is being exacerbated by climate change and has the potential for truly holocaust dimensions given foehn wind conditions (i.e., Santa Ana or Diablo winds). Moreover, research has recently shown that water agency distribution networks sustain much greater long-term damage requiring accelerated pipe replacement, than if the earthquake had not occurred¹. Thus, earthquakes create two significant water system-related issues: (1) for fire and water agencies, will they be able to supply adequate firefighting water following a major earthquake? If not, how can this situation be improved? (2) for water agencies, how great is long-term earthquake damage, how can it be quantified, and to what extent can appropriate data can be provided to FEMA and the State when assessing damage and potential aid?

Background and related work: In 2011 the Seismic Safety Commission (SSC) funded a study on firefighting water supply², which found based on a survey of over 100 fire and water agencies in California, that the crucial need for post-earthquake firefighting water supply is falling through a gap, and recommended dissemination of these findings to fire and water agencies, development of state-

¹ Scawthorn, Charles, and Keith Porter. 2022. *Effect of Major Stress Events on Buried Pipe Service Life*. Denver: SPA Risk LLC, research supported by the Water Research Foundation

² Scawthorn, C. 2011. *Water Supply In Regards To Fire Following Earthquakes*. PEER Report 2011/08. Berkeley: Pacific Earthquake Engineering Research Center, College of Engineering, University of California, sponsored by the California Seismic Safety Commission, available at https://ssc.ca.gov/wp-content/uploads/sites/9/2020/08/cssc_2011-02_watersupply_peer.pdf with four page summary at http://peer.berkeley.edu/publications/peer_reports/reports_2011/Fire%20Following%20Earthquake-online-view-layout-sm.pdf.

wide goals for post-earthquake firefighting water, and development of a standardized California portable water supply system (PWSS), that would be deployed in major urban areas. More than a decade has elapsed since then, and whether and how these recommendations have been implemented is unknown. More recently, research funded by the Water Research Foundation (WRF) has shown that earthquakes cause much greater long-term damage than previously understood³. This finding and its implications are not widely known by California water agencies.

Proposed research and activities: To address these issues, we propose the following activities:

1. **Survey of water and fire agencies:** to understand the current situation, a survey similar to the 2011 survey of over 100 major urban California fire and water agencies will be designed, tested and deployed. The survey will be updated to reflect the findings of the 2011 SSC and 2022 WRF projects as well as the current situation. The results of this survey will inform next steps.
2. **Mitigation measures:** Based on the survey and consultation with selected fire and water agencies and a Project Advisory Panel, a spectrum of mitigations such as resilient water grids, portable water supply systems, earthquake early warning and other approaches will be investigated to identify cost-effective measures for medium and large population jurisdictions in high seismicity areas of California. These investigations will draw on and extend work previously done for San Francisco⁴, Los Angeles⁵ and other jurisdictions⁶. The result of this task will be a spectrum of mitigation measures with documentation and materials for presentation to water and fire agencies, presented in a prioritized risk or ranked matrix to allow individual agencies to determine a mix of mitigation measures suited to their own system.
3. **Total damage cost:** A key issue for water agencies is assessing the total cost of water system damage following an earthquake. Restoration of service is urgent and often leads to incomplete assessment of damage and only temporary repairs. Recent work has shown that disaster aid claims to FEMA often account for only these initial costs and omit longer-term losses¹. Based on this recent work, analyses will be conducted to examine how longer-term losses can be reasonably assessed in order to support more accurate and complete damage assessments and disaster aid claims.
4. **Workshop:** An invitational workshop will be organized for California water and fire agencies, sponsored by SSC and other relevant organizations to be determined. The purpose of the workshop will be to inform water and fire agencies of the two issues (fire following earthquake risk, and long-term distribution network damage), and the spectrum of mitigation measures available for reducing these risks. The workshop will include a plenary session with keynote presentations, and parallel sessions, the latter organized in two ways: (1) separate sessions for fire and water agencies, for exchange within their specific domains, and (2) sessions combining fire and water agencies, to promote exchange between the two domains and explore cross-

³ Scawthorn, Charles, and Keith Porter. 2022. *Effect of Major Stress Events on Buried Pipe Service Life*. Denver: SPA Risk LLC, research supported by the Water Research Foundation.

⁴ Scawthorn, C. 2017. *Study of Options to Reduce Post-Earthquake Fires in San Francisco*. ATC-119. Redwood City: Applied Technology Council.

⁵ Scawthorn, C., K. Porter, and C. A. Davis, “Benefit-Cost Optimization of Resilient Lifeline Networks,” presented at the San Fernando Earthquake Conference - 50 years of Lifeline Engineering, University of California, Los Angeles, California USA: American Society of Civil Engineers, Feb. 2022, p. 12.

⁶ Multi-Hazard Mitigation Council. 2019. *Natural Hazard Mitigation Saves: 2019 Report*. Principal Investigator Porter, K.; Co-Principal Investigators Dash, N., Huyck, C., Santos, J., Scawthorn, C. . Washington D.C: Multihazard Mitigation Council, National Institute of Building Sciences. Prepared for FEMA, see https://www.nibs.org/files/pdfs/NIBS_MMC_MitigationSaves_2019.pdf

domain solutions and synergies. Proceedings of the workshop will be published and distributed to all attendees, as well as being a joint SSC-PEER publication. Based on the workshop, material will be produced summarizing the two issues and available solutions for online dissemination.

5. **Follow-up:** An anticipated outcome of the workshop will be requests from individual water and fire agencies for more detailed discussions and in-house presentations to directors, senior management and staff. The project will budget for such follow-up agency support activities within the 6 months following the workshop. These activities may be specific to one (larger) agency, or involve several neighboring agencies.
6. **Deliverables and Final Report:** the main deliverables will be (1) the survey and findings; (2) identification and analysis of a ranked matrix of mitigation measures to reduce risk due to fire following earthquake, (3) guidelines on how longer-term losses can be reasonably assessed to arrive at total damage cost in order to support more accurate and complete damage assessments and claims; (3) a worksheet or toolkit to assist individual agencies in ranking mitigation measures appropriate to their own system, (4) a Workshop for fire and water agencies; (5) follow-up support meetings, and (6) a final report to SSC documenting the project and its outcomes, with materials for online dissemination.

Project Advisory Panel: Panelists to be identified and confirmed

Schedule / Budget: The research will be carried out over a 12-month period, requiring \$75,000.

Funding mechanism: Seismic Safety Commission grant to the Pacific Earthquake Engineering Research Center, Univ. California at Berkeley.

Improving Post-earthquake Firefighting Water Supply Capacity / Reliability

*Presentation to Seismic Safety Commission
10 October 2024*

Charles Scawthorn, S.E., D.Eng.

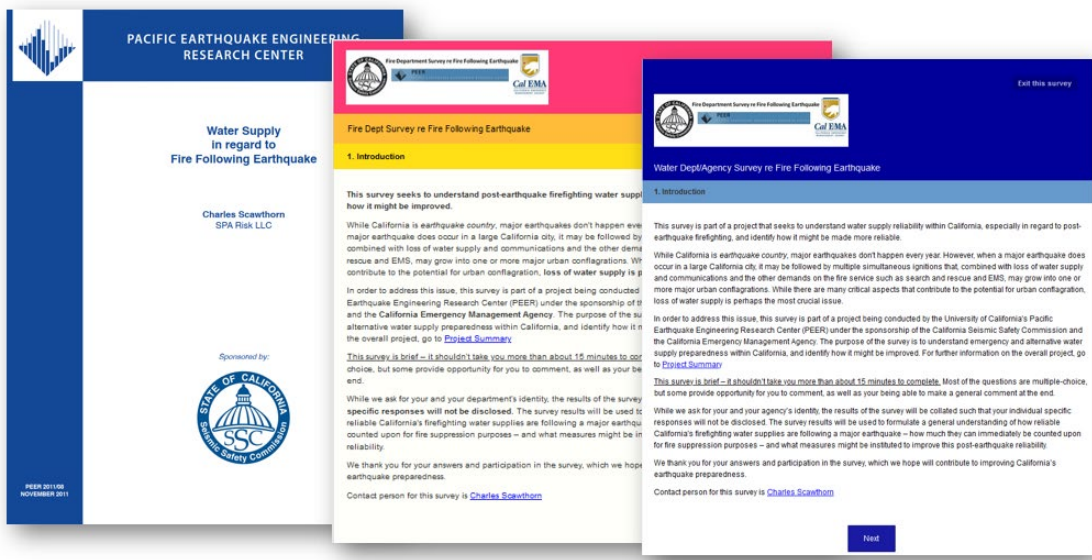
SPA Risk LLC

Pacific Earthquake Engineering Center, Univ. California at Berkeley

Fire and earthquake
were a problem in
1906

And remain a
problem today





California-wide approach to reducing fire following earthquake risk

Enhance
post-EQ
Capacity
(water)

- Develop policies to maximize post-EQ disaster aid
 - Uniform assessment of FFE, water requirements
 - Water/Fire agency PWSS task forces
 - Assist water utilities to develop resilient grids
- First step: Workshop of water agencies (PEER)**

Improving Post-earthquake Firefighting Water Supply Capacity / Reliability

Charles Scawthorn, S.E.

Pacific Earthquake Engineering Research Center, Univ. California at Berkeley

Summary: The current capacity and reliability of post-earthquake firefighting water in large parts of California is poor, as found over a decade ago in a project funded by the Seismic Safety Commission. We propose to examine the current capacity of fire and water agencies for reliable post-earthquake firefighting water supply, identify options for improving capacity, and evaluate the long-term damage earthquakes cause to water distribution networks. This will be accomplished by analyses and surveys and interviews with key larger water and fire agencies in California. Based on findings, a series of mitigation measures such as secondary water sources, portable water supply systems and pre-earthquake preparedness will be examined and prioritized for cost-effectiveness. Analyses will also be conducted to examine how longer-term losses can be reasonably assessed in order to support more accurate and complete damage assessments and claims. These findings will be shared with the fire and water agencies in a workshop, followed by presentations to selected agencies' senior management/directors. Results will be disseminated online and documented in a final written report. The research will be performed by PEER at UC Berkeley over a 12-month period, requiring \$75,000.

The Issues: Water is of course vital for life, fire safety and the well-being of communities in California. Earthquakes cause great damage to water distribution networks to the extent that large areas of California's largest cities can lose all water pressure, can take days to weeks to restore this pressure, and take months to years to completely repair and restore the network. The immediate loss of pressure deprives fire departments of firefighting water and is a major factor in large urban conflagrations. This risk involves both fire and water agencies and is being exacerbated by climate change and has the potential for truly holocaust dimensions given foehn wind conditions (i.e., Santa Ana or Diablo winds). Moreover, research has recently shown that water agency distribution networks sustain much greater long-term damage requiring accelerated pipe replacement, than if the earthquake had not occurred¹. Thus, earthquakes create two significant water system-related issues: (1) for fire and water agencies, will they be able to supply adequate firefighting water following a major earthquake? If not, how can this situation be improved? (2) for water agencies, how great is long-term earthquake damage, how can it be quantified, and to what extent can appropriate data can be provided to FEMA and the State when assessing damage and potential aid?

Background and related work: In 2011 the Seismic Safety Commission (SSC) funded a study on firefighting water supply², which found based on a survey of over 100 fire and water agencies in California, that the crucial need for post-earthquake firefighting water supply is falling through a gap, and recommended dissemination of these findings to fire and water agencies, development of state-

wide goals for post-earthquake firefighting water, and development of a standardized California portable water supply system (PWSS), that would be deployed in major urban areas. More than a decade has elapsed since then, and whether and how these recommendations have been implemented is unknown. More recently, research funded by the Water Research Foundation (WRF) has shown that earthquakes cause much greater long-term damage than previously understood³. This finding and its implications are not widely known by California water agencies.

Proposed research and activities: To address these issues, we propose the following activities:

1. **Survey of water and fire agencies:** to understand the current situation, a survey similar to the 2011 survey of over 100 major urban California fire and water agencies will be designed, tested and deployed. The survey will be updated to reflect the findings of the 2011 SSC and 2022 WRF projects as well as the current situation. The results of this survey will inform next steps.
2. **Mitigation measures:** Based on the survey and consultation with selected fire and water agencies and a Project Advisory Panel, a spectrum of mitigations such as resilient water grids, portable water supply systems, earthquake early warning and other approaches will be investigated to identify cost-effective measures for medium and large population jurisdictions in high seismicity areas of California. These investigations will draw on and extend work previously done for San Francisco⁴, Los Angeles⁵ and task will be a spectrum of mitigation measures presentation to water and fire agencies, presented in individual agencies to determine a mix of mitigation
3. **Total damage cost:** A key issue for water agencies is damage following an earthquake. Restoration of service assessment of damage and only temporary repairs. FEMA claims to FEMA often account for only these initial costs on this recent work, analyses will be conducted to be reasonably assessed in order to support more accurate disaster aid claims.
4. **Workshop:** An invitational workshop will be organized sponsored by SSC and other relevant organizations. The workshop will be to inform water and fire agencies of risk, and long-term distribution network damage), are available for reducing these risks. The workshop will include presentations, and parallel sessions, the latter organized by fire and water agencies, for exchange within their specific fire and water agencies, to promote exchange between

domain solutions and synergies. Proceedings of the workshop will be published and distributed to all attendees, as well as being a joint SSC-PEER publication. Based on the workshop, material will be produced summarizing the two issues and available solutions for online dissemination.

5. **Follow-up:** An anticipated outcome of the workshop will be requests from individual water and fire agencies for more detailed discussions and in-house presentations to directors, senior management and staff. The project will budget for such follow-up agency support activities within the 6 months following the workshop. These activities may be specific to one (larger) agency, or involve several neighboring agencies.
6. **Deliverables and Final Report:** the main deliverables will be (1) the survey and findings; (2) identification and analysis of a ranked matrix of mitigation measures to reduce risk due to fire following earthquake, (3) guidelines on how longer-term losses can be reasonably assessed to arrive at total damage cost in order to support more accurate and complete damage assessments and claims; (3) a worksheet or toolkit to assist individual agencies in ranking mitigation measures appropriate to their own system, (4) a Workshop for fire and water agencies; (5) follow-up support meetings, and (6) a final report to SSC documenting the project and its outcomes, with materials for online dissemination.

Project Advisory Panel: Panelists to be identified and confirmed

Schedule / Budget: The research will be carried out over a 12-month period, requiring \$75,000.

Funding mechanism: Seismic Safety Commission grant to the Pacific Earthquake Engineering Research Center, Univ. California at Berkeley.

¹ Scawthorn, Charles, and Keith Porter. 2022. *Effect of Major Stress Events on Buried Pipe Service Life*. Denver: SPA Risk LLC, research supported by the Water Research Foundation

² Scawthorn, C. 2011. *Water Supply In Regards To Fire Following Earthquakes*. PEER Report 2011/08. Berkeley: Pacific Earthquake Engineering Research Center, College of Engineering, University of California, sponsored by the California Seismic Safety Commission, available at www.seismic.ca.gov/pub/CSSC_2011-02_WaterSupply_PEER.pdf with four page summary at http://peer.berkeley.edu/publications/peer_reports/reports_2011/Fire%20Following%20Earthquake-online-view-layout-sm.pdf.

³ Scawthorn, Charles, and Keith Porter. 2022. *Effect of Major Stress Events on Buried Pipe Service Life*. Denver: SPA Risk LLC, research supported by the Water Research Foundation, <https://drive.google.com/file/d/1L0G12pFxFxZaShRmAzgn1AZhsgdG/view>

⁴ Scawthorn, C. 2017. *Study of Options to Reduce Post-Earthquake Fire Risk*. City: Applied Technology Council.

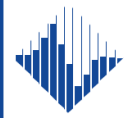
⁵ Scawthorn, C., K. Porter, and C. A. Davis, "Benefit-Cost Optimization of Earthquake Resilient Water Distribution Systems," Proceedings of the San Fernando Earthquake Conference - 50 years of Lifeline Engineering, California USA: American Society of Civil Engineers, Feb. 2022, p. 11-14.

⁶ Multi-Hazard Mitigation Council. 2019. *Natural Hazard Mitigation Strategy*. Washington, DC: National Institute of Building Sciences. Prepared by Porter, K.; Co-Principal Investigators Dash, N., Huyck, C., Santos, J., et al. https://www.nibs.org/files/pdfs/NIBS_MMC_MitigationSaves_2019.pdf

Summary of tasks

1. **Survey of water and fire agencies:** update / enhance 2011 survey of over 100 major urban California fire and water agencies
2. **Mitigation measures:** Tool for fire/water agencies to select from mix of mitigation measures ((resilient water grids, portable water supply systems, earthquake early warning)
3. **Total damage cost:** Provide guidance to water agencies to assess full cost of earthquake damage, not just initial emergency repairs
4. **Workshop:** present findings to California water and fire agencies
5. **Follow-up:**, Budget includes follow-up agency support / Details to senior management for 6 months
6. **Final Report:**

1. Survey of water and fire agencies



PACIFIC EARTHQUAKE ENGINEERING
RESEARCH CENTER

Water Supply
in regard to



Exit

- Many things have changed in last 14 years (Better? Worse? Different? Where? How?)
- No major earthquakes – have agencies slipped?
- Wildland fires – a shift in attention?
- New approaches have been developed – pros' and cons'?
- New understanding of long-term earthquake water system damage has emerged

for fire suppression purposes – and what measures might be instituted to improve this post-earthquake reliability.

We thank you for your answers and participation in the survey, which we hope will contribute to improving California's earthquake preparedness.

Contact person for this survey is [Charles Scawthorn](#)

Next

will water be there for firefighters?

Fire following earthquake (FEE) is a significant problem in California. Fire services in California have not been tested by a major earthquake since 1906. This study shows that a major earthquake in major metropolitan cities in California will result in simultaneous ignitions and water distribution breaks.



PEER



EARTHQUAKE WARNING CALIFORNIA

LA
DWP Los Angeles
Department of
Water & Power

on measures



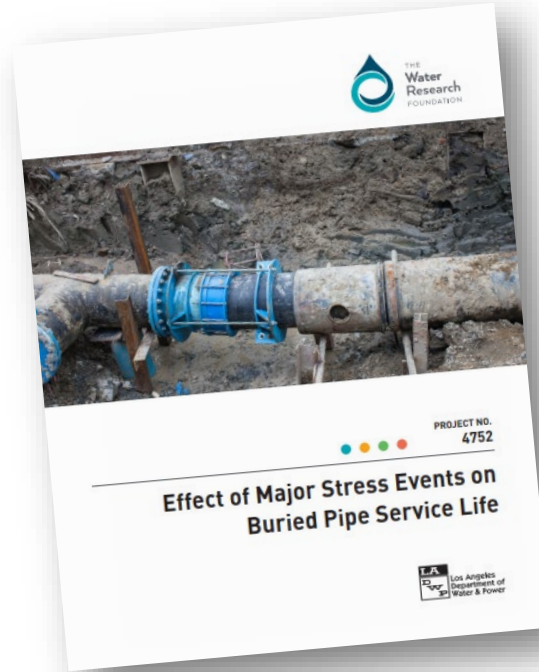
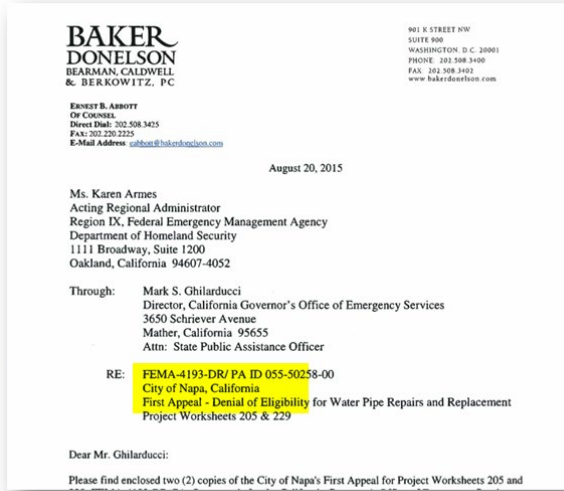
Table 3-1 List of Attendees at June 8, 2015 Workshop

| Attendee | Organization |
|--------------------|------------------------------|
| Benjamin Aymes | Human Services Agency |
| Brian Barry | SFPUC |
| Sherlyn Bura | SFUSD |
| Kevin Connolly | SFUSD |
| Dan Decossio | SFFD |
| Jason Elliot | Mayor's Office |
| Joanne Hayes White | SFFD |
| Carla Johnson | Mayor's Office on Disability |
| Jennifer Johnston | Chief Administrator's Office |
| Nick Majeski | Chief Administrator's Office |
| Katie Miller | SFPUC |
| David Myerson | SFPUC |
| Rafael Picazo | SFUSD |
| Corey Reynolds | Hagerty Consulting |
| Ryan Rusler | Har-Bro/BOMA SF |
| Brian Strong | Office of Capital Planning |



| No. | Option |
|-----|---|
| 1 | Earthquake Early Warning (EEW) |
| 2 | Gas seismic shutoff devices |
| 3 | Mandatory gas valvewrenches |
| 4 | Finer gas blocking and valving |
| 5 | Gas appliance bracing |
| 6 | Electric shut off panels, meters, or plugs |
| 7 | Improved high school chem lab housekeeping |
| 8 | Improved comm./indust. chemical housekeeping |
| 9 | Seismic retrofit of additional buildings |
| 10 | Household required fire extinguishers |
| 11 | Remote sensing/drones |
| 12 | Smartphone 911 capability |
| 13 | Protection of openings |
| 14 | Intumescent paint |
| 15 | More sprinklers |
| 16 | More SFFD staffing |
| 17 | Expanded NERT |
| 18 | Increased foam capacity |
| 19 | Additional AWSS pipe network |
| 20 | Flexible water supply system |
| 21 | Third AWSS pump station |
| 22 | More cisterns |
| 23 | More robust potable water supply distribution network |
| 24 | AWSS dedicated engineer |
| 25 | Third fireboat |
| 26 | Buddy system for vulnerable populations |

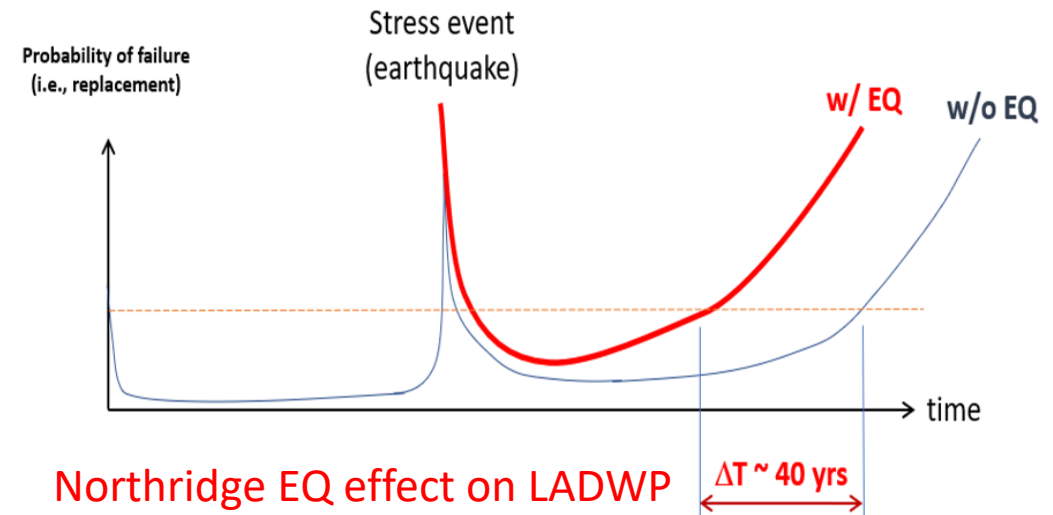
3. Total damage cost (Effect of stress events on buried pipe service life)



Research sponsored by The Water Research Foundation and Los Angeles Department of Water and Power (2023) With participation of San Francisco PUC, East Bay Municipal Utilities District, Seattle Public Utilities and Portland Water Bureau

Findings

- Earthquakes decrease service life
- For the LADWP, decrease ~ 40 years
- \$ loss ~31% of replacement value.



4. Workshop



Pacific Earthquake Engineering
Research Center,
UC Berkeley

2014 Workshop →
(> 40 FDs attended)

This project's Workshop:

- Fire Agencies
- Water Agencies
- Emergency Managers



Agenda:

- Impacts fire following earthquake
- Mitigation opportunities / Toolkit
- Total damage cost (water agencies)
- Sum of water/fire efforts >> parts



5: Follow-up:

Anticipated outcome of the workshop:

- Requests from individual water and fire agencies:
 - more detailed discussions
 - In-house presentations to directors, senior management and staff.
- The project budgets for such follow-up agency support activities within the 6 months following the workshop.
- These activities may be specific to one (larger) agency, or involve several neighboring agencies.

6. Deliverables and Final Report:

- 1) The survey and findings;
- 2) Identification and analysis of a ranked matrix of mitigation measures to reduce risk due to fire following earthquake,
- 3) Guidelines on how longer-term losses can be reasonably assessed to arrive at total damage cost in order to support more accurate and complete damage assessments and claims;
- 4) A worksheet or toolkit to assist individual agencies in ranking mitigation measures appropriate to their own system,
- 5) Workshop for fire and water agencies;
- 6) Follow-up support meetings, and
- 7) Final report to SSC documenting the project and its outcomes, with materials for online dissemination.

Project Advisory Panel: representative Fire and Water agencies, industry and academia
Schedule Budget: The research will be carried out over a 12-month period

| | | Months | | | | | | | | | | | |
|---|---------------------------------------|--------|---|---|---|---|---|---|---|---|----|----|----|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | SURVEY | | | | | | | | | | | | |
| | Design and test Survey instrument | ■ | | | | | | | | | | | |
| | Deploy instrument | | ■ | | | | | | | | | | |
| | Analyse results | | | ■ | ■ | ■ | | | | | | | |
| 2 | MITIGATION MEASURES | | | | | | | | | | | | |
| | Compile mitigation measures | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | Rank mitigation measure effectiveness | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | Develop tool for users | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 3 | TOTAL DAMAGE COST | | | | | | | | | | | | |
| | Assess damage as function of time | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | Develop materials for water agencies | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 4 | WORKSHOP | | | | | | | | | | | | |
| | preparation | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ |
| | convene Workshop | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ |
| 5 | FOLLOW-UP | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ |
| 6 | FINAL REPORT | | | | | | | | | | ■ | ■ | ■ |
| | Project Advisory Panel meetings | | ■ | | | ■ | | ■ | | | | ■ | ■ |

Effort: Approximately 400 professional hours. \$75,000 is requested

Funding: \$75,000 is requested (SSC grant to PEER, Univ. California at Berkeley).





Cal OES
GOVERNOR'S OFFICE
OF EMERGENCY SERVICES



ALFRED E. ALQUIST
SEISMIC SAFETY COMMISSION MEETING

Memorandum

To: Seismic Safety Commissioners
From: Annde Ewertsen, Executive Director
Date: October 10, 2024
Subject: SSC Project Updates

Recommendation:

Staff recommends Commissioners review the background information and be prepared to provide comments/questions on the presentation.

Background:

SSC Executive Director Annde Ewertsen will update Commissioners on the status of the following projects:

- **Ferndale and Türkiye**—A three-part project encompassing: (1) a report on the impediments to recovery for Rio Dell; (2) data on tectonics/triggered events, similar to Türkiye, with Pacific Earthquake Engineering Research (PEER), modeling locations in Northern and Southern California; and (3) recovery simulations provided by the Interdependent Networked-Community Resilience Modeling Environment (IN-CORE).
 - (1) The report has been approved and published on the SSC website.
 - (2) PEER has provided the first draft of Volume 1 of the report: Lessons from Historical Earthquakes. The draft is being reviewed by SSC staff and will then be submitted for internal review before being peer-reviewed. Volume 2 of the report will be the regional scale assessments (NorCal—M7.21 Hayward/M7.23 Calaveras; SoCal—M7.25 Newport-Inglewood/M7.05 Palos Verdes). The reports have been delayed and will be provided to the commission at the January meeting.
 - (3) The IN-CORE contract has been recently approved, and the kickoff meeting has been completed. A draft will be provided in October with the expectation of presenting it to the commission at the January meeting.
- **CA Fire Station Seismic Vulnerabilities Survey and Risk Assessment Project**—This project includes a statewide survey of CA Fire Stations to determine seismic vulnerabilities to help inform mitigation strategies and learn about

potential funding sources and related barriers. In addition, an analysis of risk assessment was conducted utilizing HAZUS data inputs and the potential of incorporating social benefits in FEMA BCA. The survey has collected approximately 454 responses. The collection is being extended to maximize the number of fire stations available for analysis and has recently been sent to California tribes. Also, an initial run of HAZUS 6.1 Advanced Engineering Building Module (AEBM) has been conducted and reviewed in conjunction with the BCA Toolkit EQ Structural Model to develop an initial assessment and understanding using FEMA's current HAZUS database of all CA fire stations. The survey submissions will be used to update this database and additional risk assessment will be conducted in the project's next phase. This project is behind schedule due to the lack of survey submissions and the SSC AGPA vacancies staffing the project.

- **Shake Table Project**—Construction of the test specimen on the shake table is scheduled to start in late September. It is behind schedule due to a short commercial project that followed the mass timber program. The schedule was adjusted, material was delivered onsite, and construction will begin in early October. Construction will continue through early 2025, followed by three months of instrumentation. Earthquake testing should begin in late April-May 2025, followed by live fire tests in Summer 2025.
- **Mobile Home Building Code Project**—The BRIC Building Code Plus Up grant was approved in Round 1. SSC is awaiting verification of Round 2 approval before proceeding with the project. No information on FEMA's timing is available.
- **Earthquakes and Climate Change Workshop**—At the April 11, 2024, meeting, the SSC approved moving forward in collaboration with the USGS and California Geological Survey (CGS) to organize a workshop to facilitate knowledge exchange among earthquake and climate scientists/researchers to include exploring collaborative opportunities for the improvement of the multi-hazard resilience of our communities. On May 2, 2024, SSC and all stakeholders met for a check-in meeting to discuss workshop topics and potential timelines. The group met again in July, August, and September to refine the agenda and speakers further. SSC staff continue to work with external and internal partners and anticipate the workshop to be held in early 2025.
- **SSC Website & Design Contract**—The commission approved SSC staff to contract for an update and creation of an interactive "100 Years of Seismic Safety" page/infographic, overall Content review/update, and technical assistance updating the current website to utilize the Cal OES template. At the July 2024 SSC Meeting, the Commission approved an Ad-Hoc Committee. SSC staff are now in the vendor selection stage.



Cal OES
GOVERNOR'S OFFICE
OF EMERGENCY SERVICES



**ALFRED E. ALQUIST
SEISMIC SAFETY COMMISSION MEETING**

Memorandum

To: Seismic Safety Commissioners
From: Annde Ewertsen, Executive Director
Date: October 10, 2024
Subject: Executive Director Hiring Process

Recommendation:

Staff recommends Commissioners review the background information and be prepared to provide comments/questions on the presentation.

Background:

Cal OES Chief Counsel David Neill will provide Commissioners information on the hiring process for the executive director.