California
Department of
Conservation
California Geological Survey

Updates on California Strong Motion Instrumentation Program (CSMIP)

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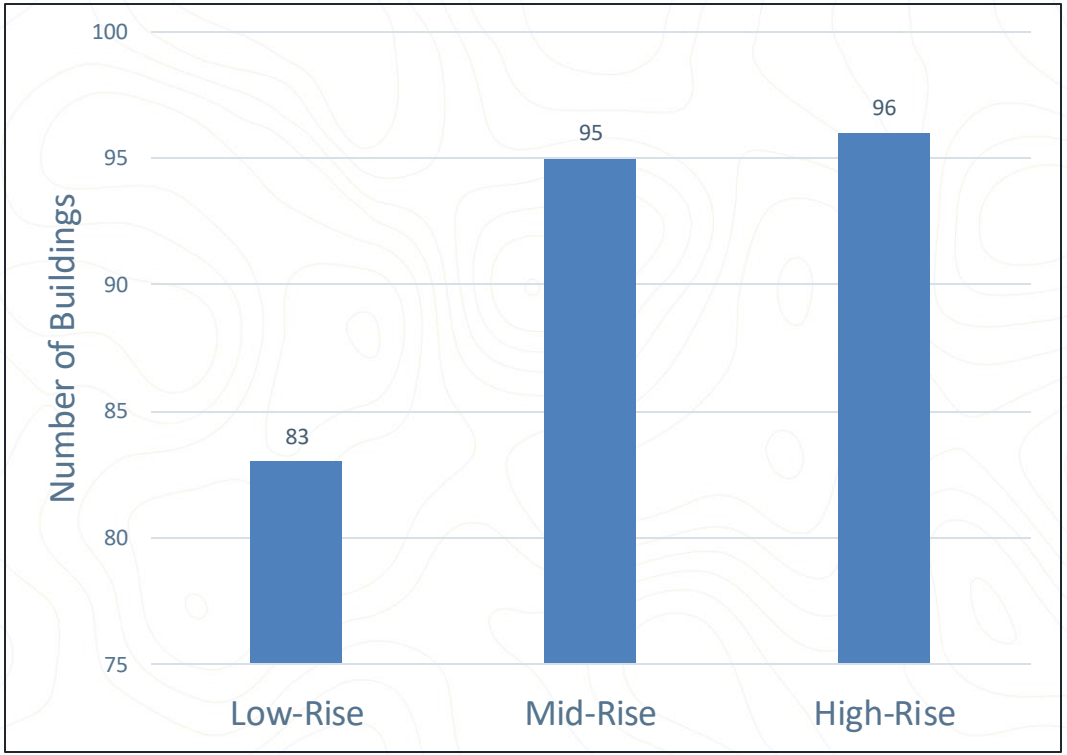
PEER Researchers' Workshop August 16, 2024

CSMIP Active Stations

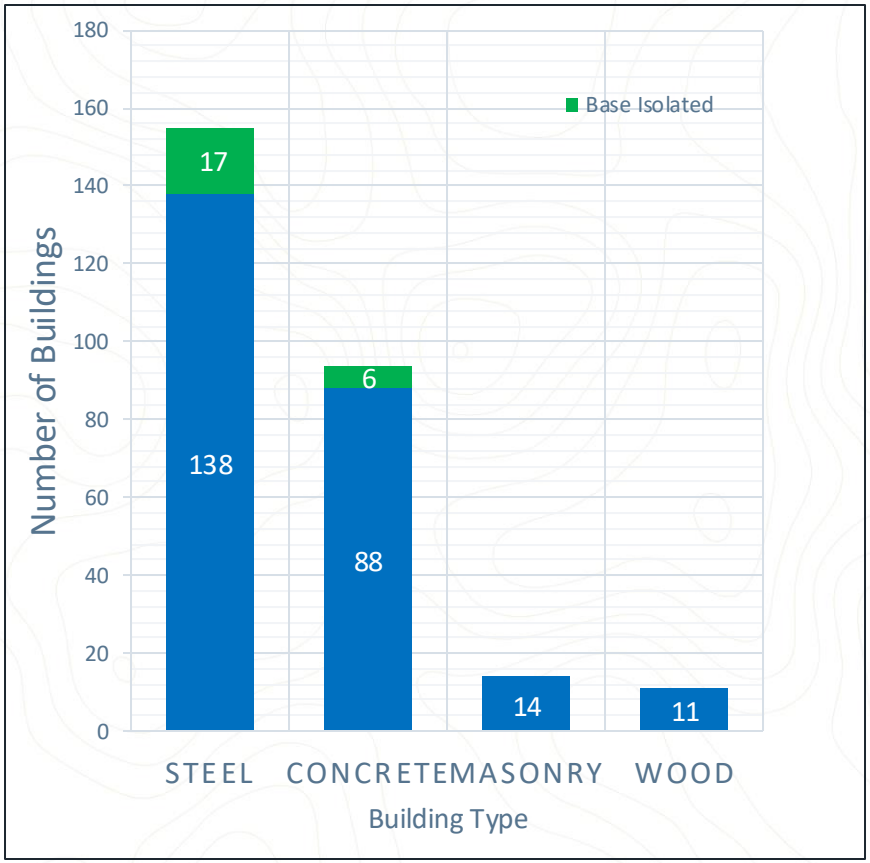
1384 active stations (>10,000 sensors) including:

- 940 Ground Response Stations
- 274 Buildings
- 128 Lifelines
- 42 Geotechnical Arrays

CSMIP Instrumented Buildings by Height (274 Buildings)



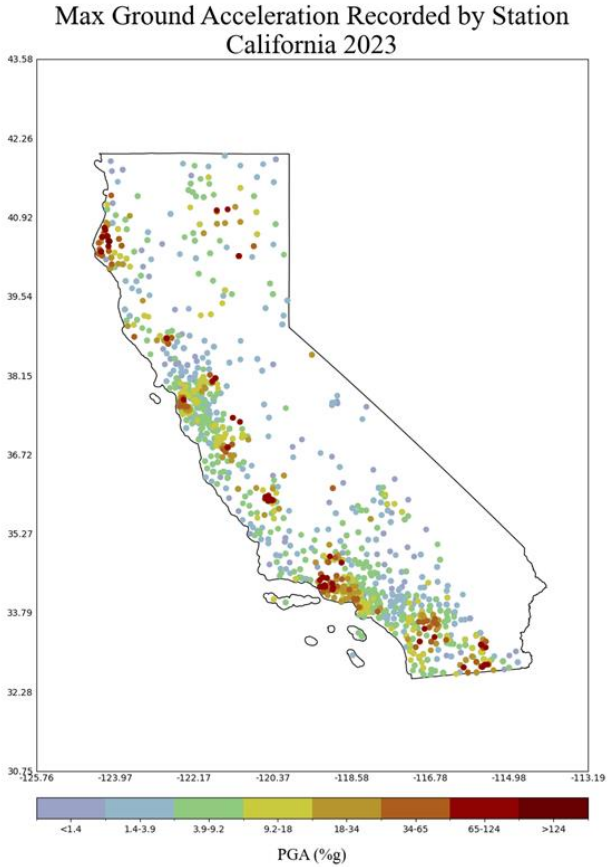
CSMIP Instrumented Buildings by Types



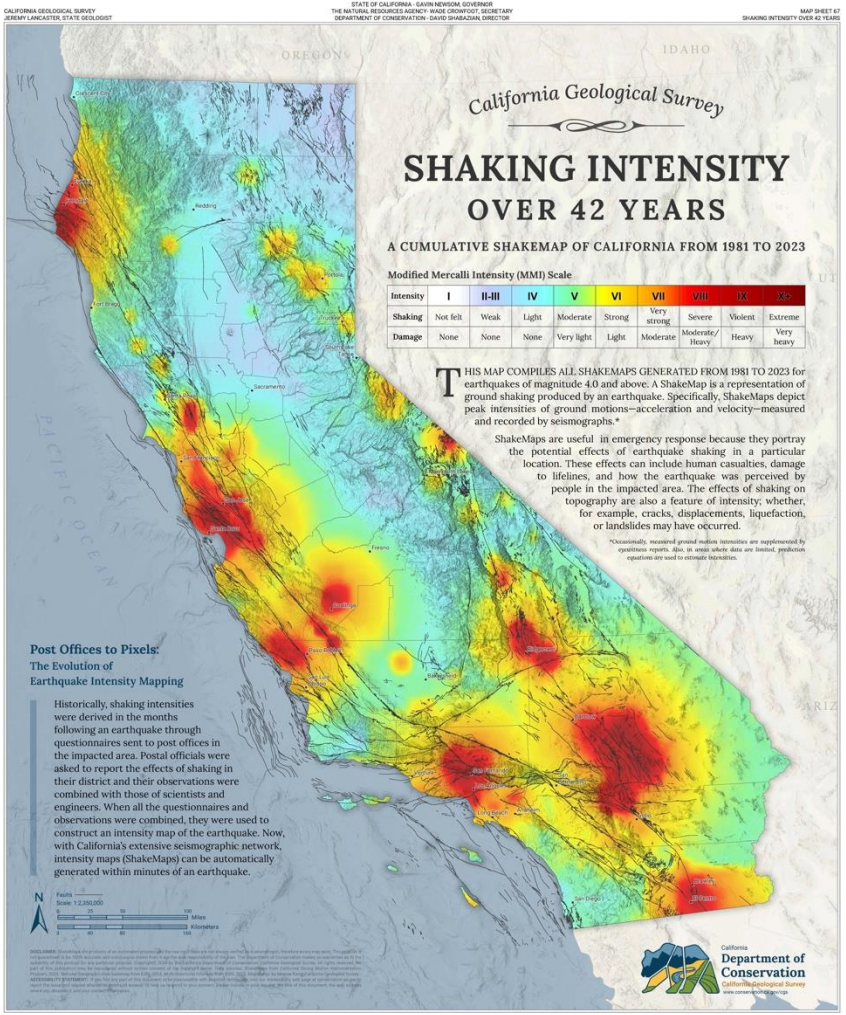
Strong-Motion Data at CESMD

Maximum ground shaking recorded at strong-motion station during 2023 from 377 California earthquakes.

Data are posted at the CESMD

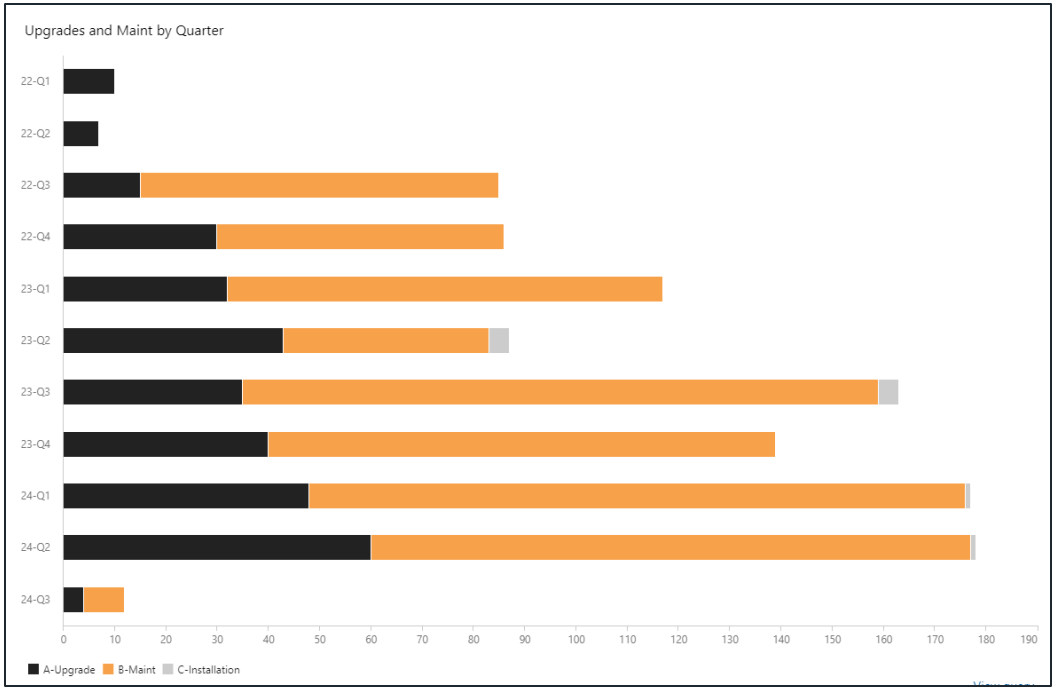


Shaking Intensity Over 42 Years in California



Statewide Strong-Motion Instrument Upgrades Project

Instruments Upgrade, Maintenance, and New Installation (since Jan 2022)



Upgrades and Maint by Quarter

	Installation	Maintenance	Upgrade	Total
22-Q1	0	0	10	10
22-Q2	0	0	7	7
22-Q3	0	70	15	85
22-Q4	0	56	30	86
23-Q1	0	85	32	117
23-Q2	4	40	43	87
23-Q3	4	124	35	163
23-Q4	0	99	40	139
24-Q1	1	128	48	177
24-Q2	1	117	60	178
24-Q3	0	8	4	12
Total	10	727	324	1.1K

Buildings Re-instrumentation

72 buildings were planned to get re-instrumented

Phase 1: More extensive instrumentation of 49 buildings: 5 completed

Phase 2: Instrumentation of the remaining 23 buildings

Lancaster Airport Control Tower
CSMIP Station #24474

Palm Desert – Kiewit Building
CSMIP Station #12284

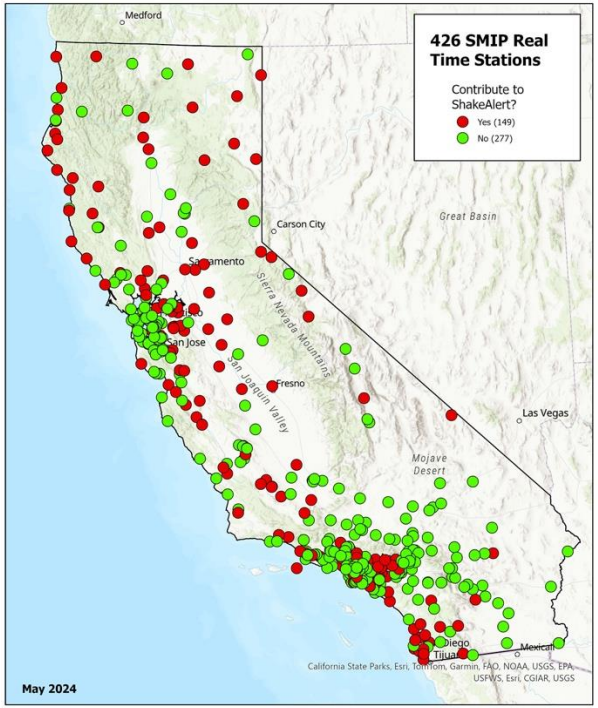
Lancaster – Medical Office Building
CSMIP Station #24517

Los Angeles – 311 S. Spring Street
CSMIP Station #24567

Pasadena – Mutual Savings Bldg.
CSMIP Station #24571

CSMIP Stations Operating in Real Time

- Currently 426 CSMIP stations operate in real time.
- 277 stations supported by CEEWS
- 149 out of 277 stations contribute to ShakeAlert
- Realtime Shaking Map



BRACE2

Hayward - Hwy 580/238 Interchange Bridge

Caltrans Bridge No.33-214-I (04-ALA-580-30.80)

CSMIP Station No. 58658

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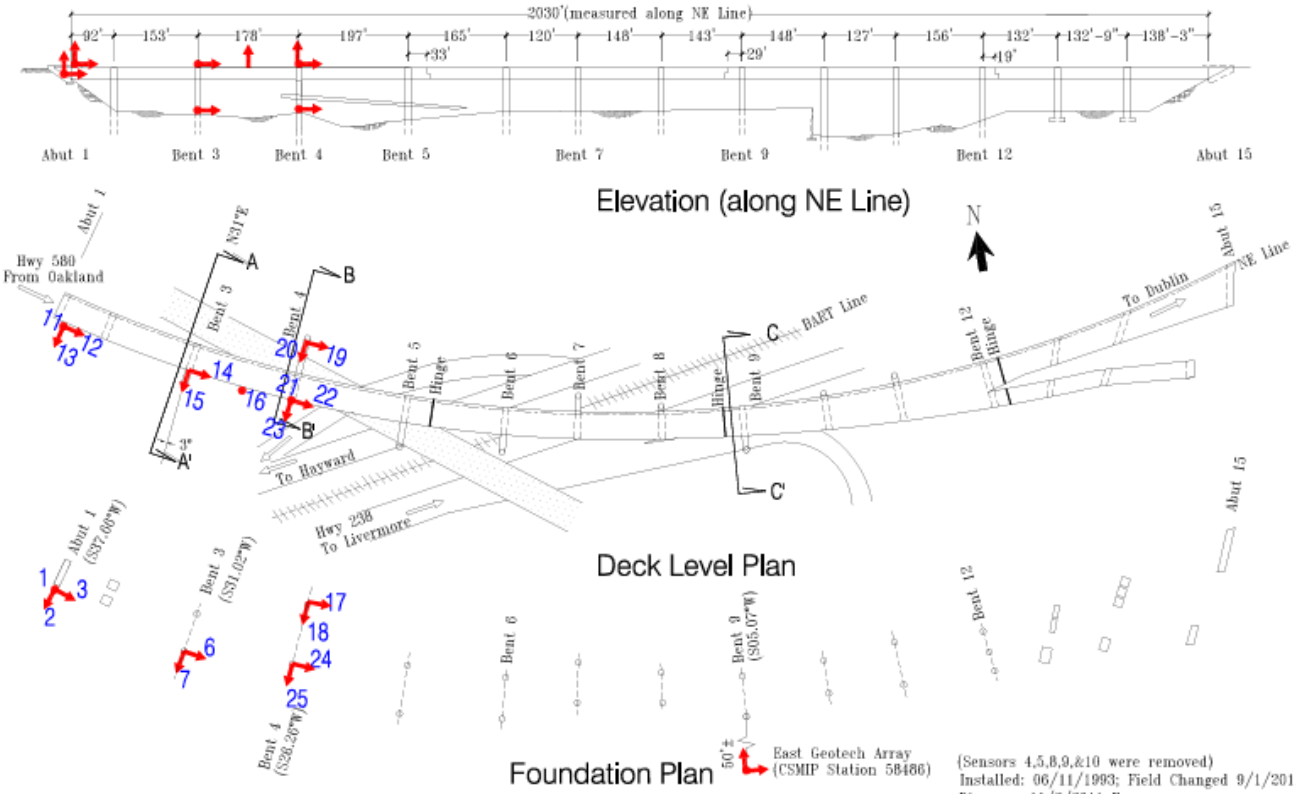
SENSOR LOCATIONS

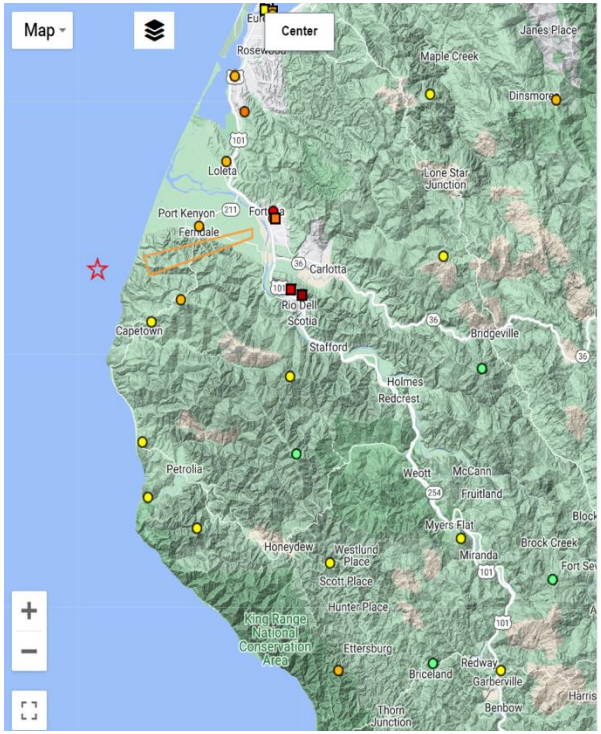


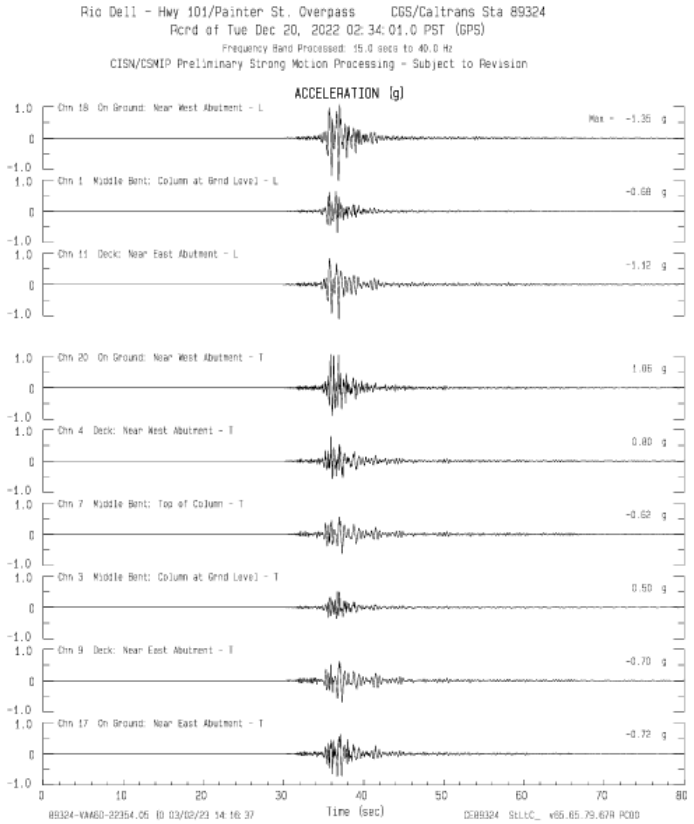
(Sensors 4,5,8,9,&10 were removed)
Installed: 06/11/1993; Field Changed 9/1/2011
Diagram: 11/2/2011 Rev.

Hayward –Hwy 580/238 Records in CESMD

StaNo ▼	Station	Network	Epicentral Distance (km)	Fault Distance (km)	Ground pga (g)	Struct pga (g)	Earthquake Name	Magnitude	Earthquake Origin Time(UTC)	Event ID	View	Download
58658	Hayward - Hwy 580/238 Interchange Bridge	CGS	91.7	--	0.014	0.015	Gilroy	4.9MI	2002-05-14 05:00:29	nc40133364	○	☐
58658	Hayward - Hwy 580/238 Interchange Bridge	CGS	23.3	--	--	0.055	Lafayette	4.2ML	2007-03-02 04:40:00	nc40194055	○	☐
58658	Hayward - Hwy 580/238 Interchange Bridge	CGS	21.5	--	--	0.027	Alamo	4.0Mw	2008-09-06 04:00:15	nc51207740	○	☐
58658	Hayward - Hwy 580/238 Interchange Bridge	CGS	22.7	--	0.039	0.040	berkeley	4.4MW	2018-01-04 10:39:37	nc72948801	○	☐
58658	Hayward - Hwy 580/238 Interchange Bridge	CGS	2.7	--	0.074	0.142	SanLorenzo	3.9MW	2021-06-29 01:29:48	nc73580646	○	☐
58658	Hayward - Hwy 580/238 Interchange Bridge	CGS	15.9	--	0.034	0.028	SanRamon	3.9MW	2021-11-17 19:43:43	nc73654060	○	☐
58658	Hayward - Hwy 580/238 Interchange Bridge	CGS	5.2	--	0.020	0.020	SanLeandro	3.1ML	2022-02-07 00:01:53	nc73689506	○	☐
58658	Hayward - Hwy 580/238 Interchange Bridge	CGS	6.9	--	0.007	0.016	SanLeandro	3.2MW	2022-02-12 03:13:42	nc73691736	○	☐
58658	Hayward - Hwy 580/238 Interchange Bridge	CGS	7.6	--	0.008	0.021	SanLeandro	3.0ML	2023-04-01 16:43:48	nc73865505	--	☐

M6.4 Ferndale Earthquake of Dec 20, 2022
Rio Dell – Hwy 101/Painter St.





Fernbridge Seismic Gate

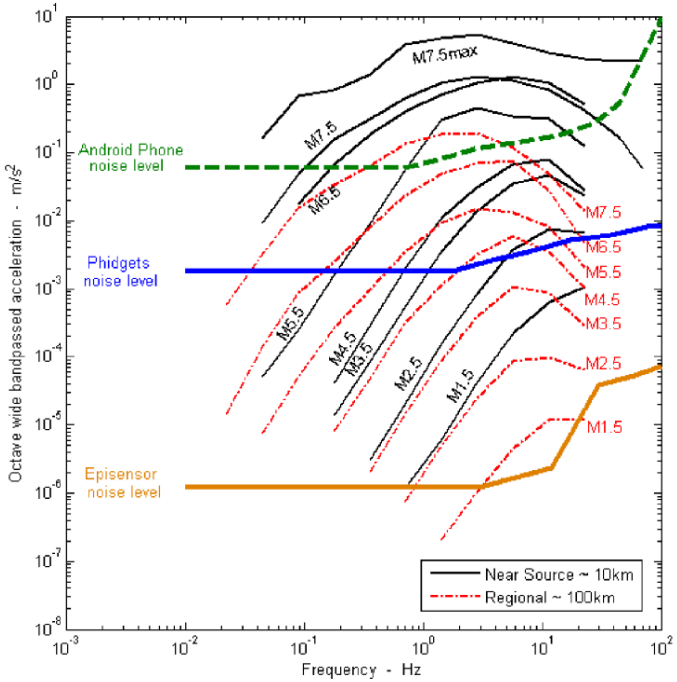
Constructed in 1911

Connects Fernbridge community to Ferndale

In 1976, the American Society of Civil Engineers designated Fernbridge as an historic civil engineering landmark

Fernbridge Seismic Gate

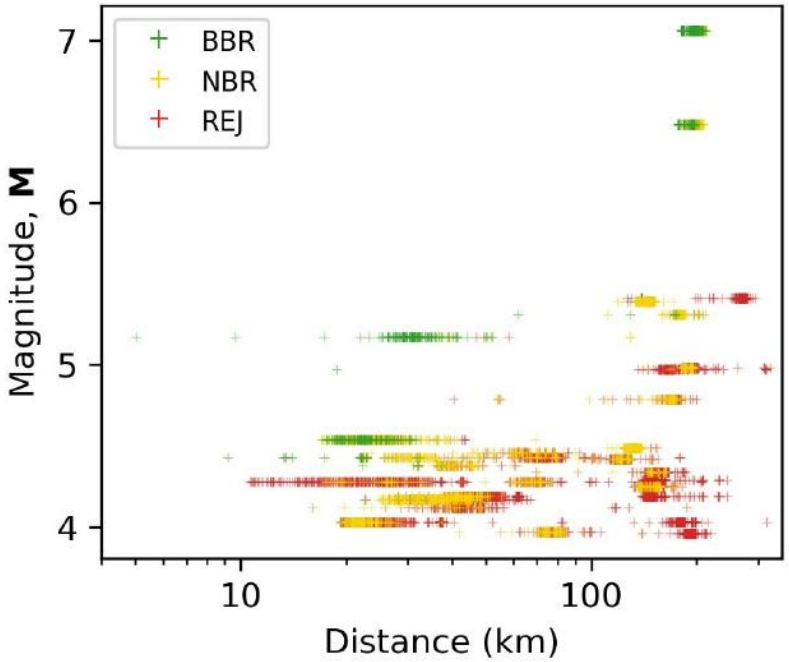
Application of High vs Low Resolution Accelerometers



Clayton et al. (2011)

Noise level of MEMS accelerometers (Phidgets) as compared to cell phone and episensor accelerometers

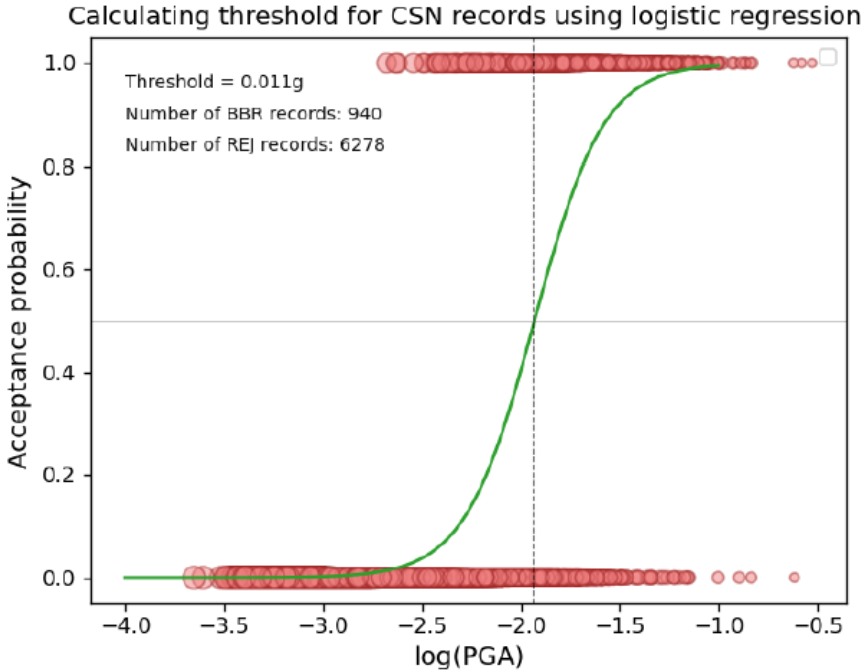
Useability of CSN Data



Record classification of Phidgets as function of distance and magnitude

CSMIP Data Utilization Project, Stewart et al. (2023)

Useability of CSN Data



Data and binary logistic regression fit for acceptance (BBR) and rejection (REJ) of CSN data as function of log(PGA)

CSMIP Data Utilization Project, Stewart et al. (2023)

Evaluate Usability of Lower Cost/Resolution Instruments
A project of CGS and CalOES with Caltech/UCLA

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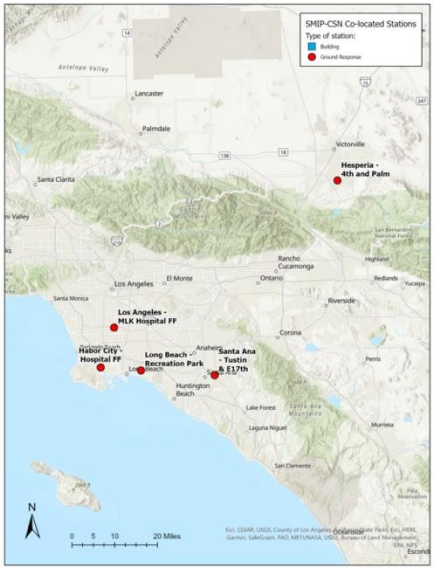
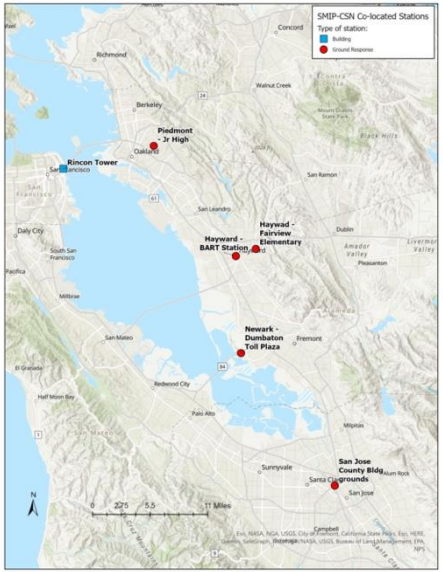
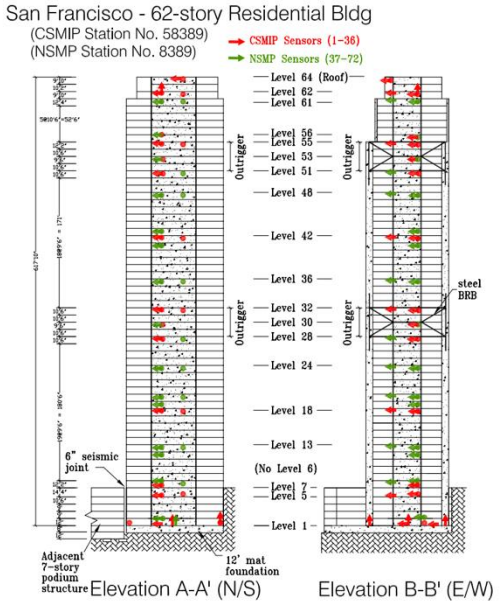
Collocated CSN at 10 Ground Response Stations and one High-Rise Building



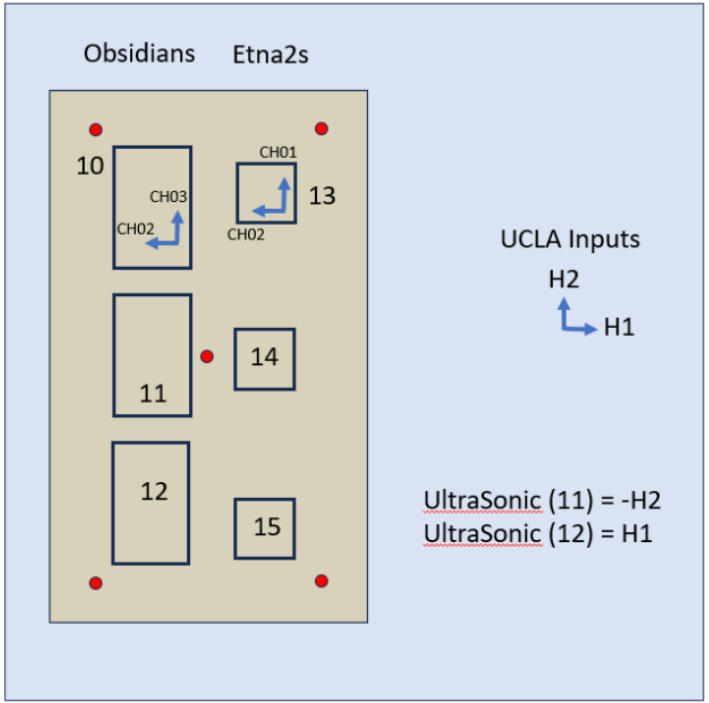




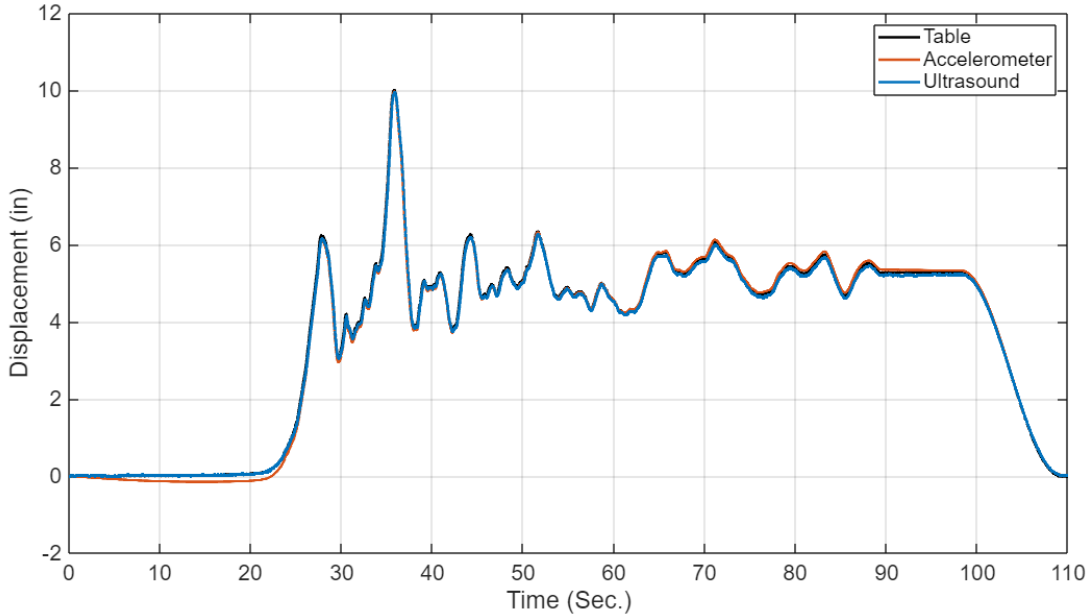
Evaluate Usability of Lower Cost/Resolution Instruments
A project of CGS and CalOES with Caltech/UCLA

- Shake Table test at UNR: July 2024
- Shake Table test in Spring 2025 at UC San Diego
- HCAI wood-frame hospital instrumentations: collocate high- and low-resolution instruments

Evaluate Usability of Lower Cost/Resolution Instruments
Shake Table Test



Residual Displacement Measurement - Shake Table Test



CSMIP Data Utilization Projects

Year	PI	Institution	Project Title	Remarks
Ground Response				
2022	Kim Olsen	California State University, San Diego	Calibration of the Near-surface Seismic Structure in the SCEC Community Velocity Model Version S	Contract executed in December 2022
2023	Norm Abrahamson	University of California, Berkeley	Development of a Period-Dependent Duration Model for California	Contract executed in May 2024
2023	Eduardo Miranda	Stanford University	Effect of focal mechanism on the directionality of horizontal ground motion intensity	Contract executed in March 2024
2023	Jonathan Stewart	University of California, Los Angeles	Application of HVSR for Ergodic Site Response Modeling in California	Contract executed in April 2024
Building Response				
2022	Khalid Mosalam	University of California, Berkeley	Structural Response Prediction Using Deep Neural Networks	Contract executed in December 2022
2022	Dennis Bernal	Northeastern University	Inherent Damping During Nonlinear Seismic Response	Contract executed in January 2023
Lifeline Response				
2023	Tracy Becker	University of California, Berkeley	Seismic performance of bridges with pier walls	Contract executed in November 2023

Join CSMIP 2024 Seminar on October 17th

THANK YOU