

August 24, 2014, M6.0 South Napa, California Earthquake

OVERVIEW

On Sunday, August 24, 2014, at 3:20 am local time, a magnitude 6.0 earthquake struck Napa, California. This is the largest earthquake in the San Francisco Bay Area since the 1989, M6.9 Loma Prieta Earthquake. The quake's epicenter was just west of the Napa airport, approximately 9 km south of downtown Napa, near the West Napa Fault. USGS analysis of the seismic recordings indicates the earthquake rupture propagated to the NNW, directing the brunt of the earthquake energy towards Napa. This directionality affect, along with weak soils in the downtown area, next to the Napa River, resulted in significant damage to the city. The earthquake cause no deaths, but local hospitals treated over 200 injuries.

Napa is one of the world's great wine growing regions and the earthquake occurred in the middle of the 2014 harvest. Damage to wineries in the region was modest since most are located north of the city and/or on hillsides with firmer soils. Also, with a NNW energy focus, major wine warehouses in American Canyon were spared and suffered little

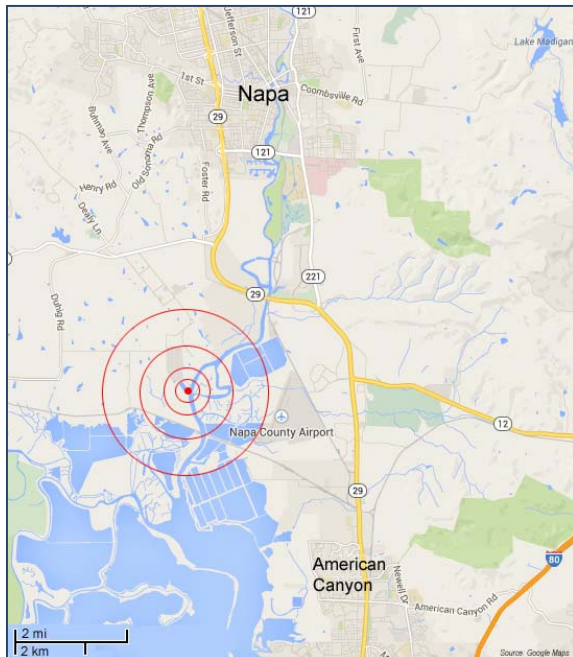


Damaged retrofitted unreinforced masonry building (URM) at 2nd and Brown Streets, downtown Napa.

damage. Wineries near Napa had the highest damage to older buildings and unanchored barrels. Most wineries were back in operation within 1-2 days.



Wine barrel collapse at a Napa winery.



SEISMICITY

Napa is in a high seismic risk region surrounded by very active earthquake fault systems, including the Calaveras-Concord-Greenville, Hayward-Rodgers Creek and San Andreas; which forms the boundary of the North American and Pacific Plates. The last significant earthquake on the West Napa Fault was the M5.0 Yountville Earthquake of 2000.

This M6.0 earthquake reminds us of the importance of preparedness and risk mitigation in the San Francisco Bay Area and the West Coast of the United States and Canada, where many large earthquake faults are overdue and can strike at any time.

According to the USGS and WGCEP, the San Francisco and Los Angeles regions have a 63% and 67% (respectively) probability of a magnitude 6.7 or greater earthquake in the next 30 years. For California as a whole, the probability is 99.7%.

BUILDING PERFORMANCE

Older wood and masonry buildings suffered the most damage. In the downtown area, unanchored houses slid off of their foundations and fell. A couple of dozen homes lost brick chimneys. Unreinforced masonry buildings (URMs) cracked and spalled bricks and stone onto the streets below. Even retrofitted URMs experience significant masonry damage due to their “collapse prevention” (CP) retrofit levels. None collapsed so CP was achieved.



House not bolted to its foundation slid and dropped.

Modern buildings generally had good performance except for unanchored (or poorly anchored) nonstructural items, contents and equipment. A modern (2009) 3-story steel moment frame building was structurally undamaged, but was red tagged because of (steel stud) curtain wall connection failures on one side of the building. Sprinkler breakage resulted in flooding in many office buildings and stores. Fires burnt down several homes due to building movement and tearing of gas lines. Damage observed was expected - good buildings performed well and anchored equipment was undamaged.



Sprinkler lines and heads impacting structural members or other suspended equipment caused pipe breakage and water damage.



Downtown Napa AT&T building was red tagged due to rooftop equipment anchorage failure and knock-out wall panel fallout.

City building inspectors started inspecting and tagging damaged buildings immediately. As of Thursday (4 days after the earthquake), inspectors have tagged 170 buildings Red and 652 Yellow in Napa. Most of these are houses, but many are commercial structures. A red-tag means no entry. A yellow-tag means restricted use and limited entry.

Following any large earthquake, building inspectors don't have much time to study a building's safety, so there is a tendency to be conservative in tagging. For building owners and tenants, it is important to quickly find qualified structural engineers to inspect buildings to make sure they are correctly tagged and design measures to stabilize and repair damaged buildings so business can resume.

LIFELINES AND RECOVERY

Roads were repaired and opened within 1 day, as was power and telecommunications. Water main and distribution line breaks were extensive in areas near the Napa River and along the West Napa fault. As of Thursday night, there were 120 water line breaks and 10 sink holes found across the city. Most breaks were rapidly repaired so only 400 customers are still without water 4 days after the event. Insured losses are expected to be around \$1 billion while total losses (property damage and business interruption) may be 2-4 times that.



Water bubbling up through downtown pavement - one of 120 water line breaks in Napa.