

Seismic risk found in San Francisco's waterfront foundation, report shows

Laura Dudnick, The San Francisco Examiner, 4-14-16

A major earthquake could significantly impact the foundation of San Francisco's waterfront more than previously thought, perhaps even rendering The Embarcadero nonfunctional, a new report shows.

Invisible to the thousands of people who enter and leave The City each day via the three-mile stretch of the northern waterfront, the seawall is a critical piece of infrastructure that, at more than a century old, is in dire need of billions of dollars of repairs.

About \$2 billion alone is needed to fix the seawall that stretches between Fisherman's Wharf and AT&T Park, an area that contains some of the most valuable land in the world, according to the "Earthquake Vulnerability Study of the Northern Waterfront" report.

"We can definitely say a large earthquake, [magnitude] 7 or above, on the San Andreas fault will likely cause movement of the seawall," said Steven Reel, a project manager for the Port of San Francisco.

The impact of such a quake could move the seawall several feet, which could lead to cracks in The Embarcadero, possibly impacting transportation, damaging buildings and leaving utilities vulnerable.

"The Embarcadero roadway may or may not be usable after that event," Reel said of a major earthquake.

Commissioned for \$500,000 in 2014, the report is the most extensive study the Port has conducted on seismic safety of The City's waterfront. A team of geotechnical and civil engineers used existing data to create a three-dimensional picture of the subsurface beneath the seawall to examine its durability.

"We're just trying to learn more about how to have good performance of our infrastructure in an earthquake," Elaine Forbes, interim executive director of the Port, told the San Francisco Examiner. "We've known it's an issue we want to look into more carefully to make sure we're resilient in a major event."

San Francisco — home to such notorious temblors as the devastating 1906 and 1989 earthquakes, as well as the more recent magnitude-6.0 quake that rattled Napa County in 2014 — is due for an earthquake of magnitude 6.7 or greater within the next 30 years. U.S. Geological Survey officials have estimated there's a 72 percent chance such an event could occur in that time.

But there's only one earthquake that was centered in San Francisco within the past century that tested The City's waterfront: the 1906 earthquake, which occurred before many of the bulkhead buildings and piers along the northern waterfront were constructed.

"The reality is, it's been 110 years since we saw some serious ground shaking in San Francisco," said Patrick Otellini, The City's chief resiliency officer.

The report found there is more seismic risk than previously thought to the seawall, which was built between 1879 and 1916 by dredging a trench through the mud and filling the trench with rock to create a pyramid-shaped dike that's capped with a bulkhead wall.

Together, the seawall and bulkhead serve as the foundation for wharves and buildings — many of them historic — constructed along The Embarcadero.

The study didn't conclude exactly which areas along the waterfront may be most vulnerable, but Reel noted there are possible "hot spots" near Piers 27, 29 and 31.

City officials hope to repair the seawall within the next decade, though details of the effort have not yet been addressed. Reel said the ideal solution would be to fix the mud foundation under the seawall with what's called a jet-grounding technique, which uses small-diameter drills and high-pressure nozzles that spin to create improved soil in place.

Effectively, that would mean drilling through the seawall to access the weak soil layers, where the jets are activated to erode the soil and inject cement grout at the same time. The method is used in construction projects throughout The City.

In addition to seismic repairs, the Port is also planning for sea level rise. San Francisco was recently selected to help establish a financing strategy over the next 18 months along with Pittsburgh, St. Paul and Washington, D.C. for each city's individual infrastructure plans, an effort that locally will directly impact funding to repair the seawall.

The earthquake vulnerability report is scheduled to be presented to the Port Commission today.