SAN FRANCISCO BUSINESS TIMES

From the San Francisco Business Times
:http://www.bizjournals.com/sanfrancisco/print-edition/2014/10/17/making-s-f-safer-for-next-earthquake-loma-prieta.html

Making S.F. safer for next time

Loma Prieta 25 years Later

SUBSCRIBER CONTENT: Oct 17, 2014, 3:00am PDT | **UPDATED:** Oct 20, 2014, 1:03pm PDT

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This is part of a series of Business Times stories looking back at the 1989 Loma Prieta Earthquake, a natural disaster that reshaped the region. Read more of the Times earthquake coverage here .

Spencer A Brown

'What we learned from Loma Prieta was that buildings were too brittle.'

For 9-year-old Ibrahim Almufti, the sight of the collapsed Nimitz Freeway in 1989 was the moment that "shaped my desire to become an earthquake engineer."

"The concrete was just completely crumbled," recalled the Lafayette native, who is currently a senior structural engineer in the downtown office of Ove Arup. When first viewing the double-decker freeway that "pancaked" during Loma Prieta, killing 42 people, "I imagined the cars that had been crushed underneath."

Twenty-five years later, the power of that experience may account for his strong views on earthquake safety — or, as he sees it, the lack of it — in present-day San Francisco. Despite great advances in engineering and computer simulation techniques in the years since Loma Prieta, current building codes, in his view, still set the bar too low. Those codes focus on life safety issues, that is, preventing injury and death, rather than keeping buildings up and running after a major jolt, a concept known as resiliency.

In apparent agreement is a 2009 report from SPUR, the nonprofit urban planning group. Entitled "The Resilient City: Creating a New Framework for Disaster Planning," the report expresses a similar concern about the need to raise earthquake codes to ensure that buildings remain operational after earthquakes.

Even though present-day engineering knowledge can enable buildings to survive even powerful earthquakes without significant harm, current codes "in most cases, ignore the question of building damage and post-earthquake usability," the report says.

Almufti cited the 2010 quake in Christchurch, New Zealand. That city, he said, "has modern building codes just like ours." And while the shock killed only a few, 70 percent of the downtown area was torn down.

Not all developers are looking for the easy way out of earthquake safety, however. "We believe in performance-based design, rather than the 'prescriptive' design," said Chris Heimburger, senior vice president at **Kilroy**, which is building 350 Mission, a 27-story office building in the financial district.

In contrast to engineering that meets the minimal legal standard only, performance-based design proposes an alternative engineering solution. The goal of performance-based design is to meet the safety standards of the code, while adding more resilience to keep buildings operational after a quake. "Our downtown buildings exceed code requirements by 20 percent," he said.

"What we learned from Loma Prieta was that buildings were too brittle," Heimburger added. In the distant past, major buildings relied mostly on steel structures known as moment frames. Unfortunately, these tended to crack at their joints when hit by strong earthquake forces.

Structurally, 350 Mission is designed for three levels of earthquake shaking, the largest of which is a magnitude 8 event on the San Andreas fault, which scientists believe occurs once in 2,475 years, according to SOM Associate Director Eric Long.

Safety features in the design include reinforced concrete shear walls that surround the elevator core on each floor. Essentially a single structure, the concrete core extends from the roof of the office tower to the foundation, 50 feet below the surface.

The massive core walls, 33 inches thick in some places, carry seismic forces down to the foundation, which is 10 feet of solid concrete.

On the exterior is a high-performance glass curtain wall, engineered to remain intact and protect the building from the weather after an earthquake.

Seismic engineering is often most effective when technologies allow buildings to "roll with the punches," and protect structures by absorbing some of the earthquake energy.

Base isolation is one technology that allows structural columns to move slightly under earthquake pressure. (Both San Francisco City Hall and the Ferry Building currently used base isolation.) Another technology is the seismic viscous dampener, which looks like an automobile shock absorber for cars, and works on a similar principle.

If developers of some new buildings appear willing to exceed code requirements, other building owners are lagging behind in basic earthquake safety, according to SPUR director, Gabriel Metcalf. Although the nonprofit group has successfully lobbied for several retrofitting laws since Loma Prieta, the city still needs to enact a law to reinforce structures made of non-ductile (i.e. unreinforced) concrete, according to Metcalf.

Such buildings "tend to be larger and are harder to reinforce," he said.

What is uncontroversial, however, is that San Francisco needs to prepare for a 500-year earthquake. "That's hard for people to understand, so I like to say there's a one in 10 chance of a major shaking in the next 50 years," said Almufti.