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OP-ED CONTRIBUTOR

Shake, Rattle, Seattle

By PETER YANEV

AS an engineer who advises companies on how to make their buildings survive earthquakes, I have visited the aftermath of nearly every key quake since 1970, observing how new and old buildings have performed when the ground shook beneath them. I try to learn from each new disaster how to change our design techniques, construction practices and building codes to reduce future losses of life and damage. From my perspective, the shock that hit Chile in February was the most important earthquake of the last 100 years.

It was the first mega-quake, its magnitude near 9, to strike a developed country with rigorous building codes. Modern cities full of state-of-the-art buildings were tested by intense ground-shaking that lasted about 120 seconds — compared to about 40 seconds for the 1906 and 20 seconds for the 1989 San Francisco earthquakes, which had magnitudes of 7.9 and 6.9, respectively. Despite Chile's exacting construction codes, which often exceed those of California and Japan, the performance of numerous high-rise buildings was worryingly poor.

We engineers and seismologists need to gather and study as much data as we can from Chile's quake. But one thing is already clear: based on the kind of damage that buildings suffered in Chile, tall structures in the earthquake zones of the United States appear to be at much higher risk than we thought. This lesson should be of obvious concern to San Francisco and Los Angeles. But it is actually the Pacific Northwest that is most vulnerable to a mega-quake like Chile's.

Just off Northern California, Oregon, Washington and British Columbia sits the 600-mile-long Cascadia fault. Like the Nazca tectonic plate that caused the quake and tsunami in Chile, Cascadia can produce temblors with magnitudes of 9 or greater, more powerful than anything we've experienced or expect from California's famous San Andreas fault.

Cascadia's last mega-quake, in January 1700, was approximately as large as Chile's; it caused a tsunami that pummeled Japan. Many seismologists believe the Pacific Northwest is overdue for another mega-quake. Yet in cities like Seattle, Vancouver and Portland, Ore., hardly any building is designed to withstand such a huge jolt.

That is precisely why it is so important to understand what happened in Chile, which has a history of huge earthquakes. The previous one, in 1960, had a magnitude of 9.5 and caused widespread destruction. Chileans responded with better construction codes, better structural and earthquake engineering; buildings were made with massive reinforced concrete frames and backed by numerous reinforced concrete walls, called shear walls. However, over the last decade, more fanciful architecture and financial pressure to reduce costs have resulted in new buildings with fewer and more slender shear walls.

In Concepción, an industrial city closer to the epicenter, those terrifying two minutes left 20 percent of buildings 15 or more stories tall damaged beyond repair. Most of the failed buildings were new; several were still for sale. These buildings had fewer shear walls than older Chilean structures, but they were still stiffer and stronger than many buildings in California.

Another major lesson comes out of Santiago, an area of relatively weak shaking. There, a large, high-end office development called Ciudad Empresarial was still under construction when the quake hit. Again, the buildings of Ciudad Empresarial were a lot like trendy offices in Silicon Valley, cheaper and more flexible than the structural designs usually

found in Chile.

The buildings themselves were largely undamaged, or suffered only moderate damage. But many of the interior architectural features — suspended ceilings, expensive finishes, interior partitions, heating and ventilating equipment, air-conditioning ducts and some of the water piping — were utterly destroyed. If the earthquake had occurred during the workday, the damage would have caused many casualties.

Construction codes are based on the probability of earthquakes striking a region. That means Seattle's buildings, for example, are designed for roughly half of the earthquake loads of buildings in San Francisco or Los Angeles, because earthquakes occur roughly half as often in Seattle as in California's cities. But the result is that Pacific Northwest cities are full of buildings with slender structural frames and fewer and smaller shear walls. In a mega-quake, many of the region's iconic tall buildings would probably collapse. The loss of life and property from such a disaster would be far worse than the damage and death suffered in Chile.

It is only a matter of time before a quake like the one in 1700 happens again in the Pacific Northwest — perhaps tomorrow, or not for 20, 50, 100 years. We do not know that precisely. But we do know that the earthquake will happen. Are we ready? No, we are not. Not in California, and definitely not in the Pacific Northwest.

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