A new way to compete

IN MANY EARTHQUAKE-PRONE COUNTRIES, BASE ISOLATION IS USED WIDELY; BUT IT IS NOT USED SO MUCH IN THE US. NOW A SILICON VALLEY DATA CENTRE HAS COMBINED IT WITH OTHER TECHNIQUES TO OFFER A NEW LEVEL OF PROTECTION. **MELANIE MINGAS** LOOKS AT WHETHER OTHERS COULD FOLLOW THE LEAD

In April, NTT opened the doors on Silicon Valley 1, a facility that claims an engineering first for earthquake-prone Santa Clara: it's the first data centre there to use base isolation technology, and the first to simultaneously combine it with fluid viscus dampers.

SV1 (pictured above) is located at the heart of the US tech industry. But Santa Clara is close to three major fault lines: the Hayward Fault, the Calaveras Fault and, of course, the San Andreas Fault.

"It wasn't necessarily a place we wanted to put a data centre and at the time a lot of companies were moving their data centres outside of the area," says Bruno Berti, VP of product management, NTT Global Data Centers Americas. High-tech clients, however, were not leaving and NTT's established customer base in other locations had noted the trend.

"We started to speak to our clients more and we realised that they really did want to be in Santa Clara. It's the heart of the west, it's close to their offices, there is a lot of research and development happening there, and it is close to a lot of network services and connectivity associated with the West Coast," Berti continues.

Clients didn't just want another data centre built to the same local codes as others in the area – no reflection on the codes, they're designed to prevent collapse, but there's little competitive advantage in following the crowd. NTT already had a data centre in Sacramento, and therefore on a different tectonic plate, but the 16MW SV1 is about a Silicon Valley facility that can withstand a worst-case scenario in the best way possible.

To do that, SV1 is surrounded with a moat, of sorts, part of a sizeable gap between the building and ground, which allows the two to move independently in the event of an earthquake. The gap is large enough to walk underneath, and Berti has accompanied many clients on hard-hat tours.

To isolate the base from the ground, the four-storey building sits on a series of pendulums, which can swing – up to two metres if needed – as the ground does.

"It is two steel plates that are laid out like pancakes with a pendulum bearing system in-between, and that allows the building and ground to move at different paces," explains Berti. "So, the building is floating on those pendulums and that keeps the building and ground separate."

However, the X-factor is in the addition of viscous dampers to connect the isolators and act as a shock absorber, slowing movement. Power and fibre connectivity are installed to move with the building.

Base isolation technology was pioneered in New Zealand in the 1970s by Dr Bill Robinson. Since adapted, developed and applied to buildings of all shapes and sizes, it is now common around the world – it was used in Apple's Cupertino, California HQ, opened in 2019, and features in Digital Realty's 365 Main Street facility in San Francisco, although that was originally built as a military tank assembly plant, not a data centre.

It is widely used in Japan, where it is installed throughout NTT's data centre portfolio. There it protected facilities from damage during the 9.1-magnitude earthquake and tsunami in 2011. That caused approximately US$360 billion of damage across affected areas, but NTT's data centres were able to withstand the force.

In the design and construction of SV1, the US arm of the business frequently called on design firms with Tokyo experience, as well as Japanese colleagues, visiting their base-isolated facilities in the early days of the project.

Surprisingly, overall construction costs were only 5-8% higher, according to Berti. Monitoring capability is the next step to assess for damage and allow quicker access after an event.

But as fascinating as the engineering is, the reason SV1 exists is client demand.

"It was interesting because we opened the doors to the data centre in April, but we have been touring customers since October last year – we had a lot of interest before the building was built," Berti says. NTT is already pre-leasing the capacity that will come online for phase two, next year.

Setting the standard

Three of the world's 20 largest-recorded earthquakes occurred in Chile, including the largest-ever earthquake, in 1960. As the country executes on its digital transformation strategy, it is seeing an ICT infrastructure boom.

"Despite Latin America being an emerging market, and regardless of scale, it's no longer about who gets there first but more about reach. A single campus is no longer enough to provide the level of cyber security that end-users require," says architect Matías Menichetti.

Currently head of the Santiago office for international architecture practice Hyphen, Menichetti has worked directly on a number of the firm's data centre projects,

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including hyperscale facilities in Chile and Brazil and site assessments in Mexico.

"In Chile, industrial buildings have different codes to residential buildings – Chilean regulations, in some cases, for this type of buildings are more restrictive than US or European standards," he says.

"For example, in Europe, depending on the seismic zone, a regular seismic peak ground acceleration is 0.2G/0.3G but in Chile, depending on the seismic zone, that acceleration can reach up to 0.4G. That means that the stability elements and foundation of a data centre will require an increase in size and the architectural design can be affected by that as well."

It's not just the big ones – in Chile, the ground moves frequently. In fact, a quick check of the US Geological Survey database shows just over 40 events (albeit relatively minor ones) in June.

As a result, over the past 60 years the country has developed exemplary building codes. They are credited with preventing many deaths in the major quakes that have occurred in the past 11 years, and they are under constant review.

"Other countries around the world see us as an example of how to seismically protect buildings – critical facilities, residential, or any type of building. Building a data centre in an area where earthquake risk is high requires different construction approaches that will not only keep the building together and the occupants safe, but also allow the facility to remain functional," Menichetti says.

The building can crack, it could need to be demolished afterwards, but people need to get out of it safely.

As in other markets, Chile mandates the minimum standard and those commissioning the build decide how much further they want to take things. In data centres, Menichetti says, most take one of two routes: a complete seismic isolation system and dissipators, or rack-level insulation to protect the most valuable equipment in the simplest way.

It changes from project to project. Those who deploy in an acquired warehouse or other structure have no choice but to focus on the racks. Edge data centres, again, because of their location and size, take "a completely different approach", Menichetti says. The highest standards are most often requested by colocation clients bound by strict SLAs and back-up requirements.

For those building, Menichetti confirms that seismic base isolation provides a competitive edge in Chile's rapidly growing market.

"We have seen, in several cases, with hyperscale colocation companies – because most of them compete for the same cloud providers – once one installs a system like base isolation, the others do it, too. Because basically they cannot be behind the competition when it comes to systems protection," he says.

For power resilience, operators can plug into two substations, thanks to Chile's open access regulations, which state that if a substation has capacity the utility company can't refuse a connection request. That said, Menichetti points out, there currently is a shortage of substations in the Santiago metro area.

However, when competitive edge is key, even this level of systems protection can be improved upon. The next step in disaster resilience, he says, is triangulation.

"We no longer see one deployment in Chile, we see companies that triangulate their deployment and have one hyperscale data centre or even campuses in the north of Santiago, one in the south, and they triangulate for security reasons.

"That same premise can be applied to seismic protection," Menichetti says. "It's a matter of setting the bar higher and higher," he adds.

The quake race

In the world of critical infrastructure, disaster prevention is nothing new and every market has its own risk factors. However, the use of base isolation in the US has long been behind that of more quake-prone nations, which is part of why San Francisco-based Raul Saavedra, senior managing director for JLL, questions whether many will follow in NTT's footsteps.

"This is a seismically active area, and we have a robust data centre market. Users have already calculated the risk. The building standards are already so high and take the seismic issues into account.

"Users probably value the design but will not necessarily pay extra for it. Users are most interested in whether you have what they need when they need it. The base isolation design is what I consider to be belt and suspenders," he adds.

But sometimes caution is the favoured approach.

Joseph Collins, associate principal and structural group leader in Arup's San Francisco and Oakland offices, says: "I think data centre clients will take note of this and will be more likely to consider it when developing new sites in high seismic regions.

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"For highly seismic regions where immediate occupancy after a major earthquake is desired, we would often recommend base isolation. In a lower seismic region, where immediate occupancy is desired, we might recommend designing the building to remain elastic and upgrading the non-structural items to ensure business functions are not interrupted. It is specific to the situation."

As Berti and Menichetti affirm, the secret clearly remains to spread bets with a footprint that covers multiple locations. However, if one of those locations offers a superior level of protection, there will always be a customer willing to pay for it.