WHAT CHRISTCHURCH DID NEXT

Reinventing our city.
Redefining our future.
Sharing lessons in resilience.
A narrative.

CHRISTCHURCH

aurecon
Bringing ideas to life
**Chapters**

01 A city thrown into crisis

02 Protecting our community

03 Formulating a vision for the future

04 Confidence after crisis

05 The community connection

06 An accessible city

07 Our future is strong: the lessons learnt from a remarkably resilient community

**Recovery and rebuild - the key players**

**Recovery:**
- Civil Defence
- Urban Search and Rescue (USAR)

**Rebuild:**
- Christchurch City Council
- Canterbury Earthquake Recovery Authority (CERA)*
- Christchurch Central Development Unit (CCDU)
- Stronger Christchurch Infrastructure Rebuild Team (SCIRT)
- CERA’s Significant Buildings Unit (SBU)

*CERA completed their recovery work in early 2016, handing over to Regenerate Christchurch. Jointly owned and funded by the Crown and the Christchurch City Council, their focus is on development in Christchurch’s central city, residential red zones and New Brighton. Regenerate Christchurch will be in existence until June 2021 and then transition into a solely council-owned organisation.
THE CITY THAT REFUSED TO BE FLATTENED BY DISASTER

Reflections from those who were there and those who are taking Christchurch into the future
What Christchurch did next

Beneath the Pacific Ocean, rocks on opposing sides of a ‘strike-slip’ fault had slid past one another with insidious force – quite literally causing a ‘tear’ in the earth’s surface. The tear was so cataclysmic, and so close in succession to a previously damaging major earthquake event in 2010, that it rendered hundreds of commercial buildings and around 10,000 residential homes unsalvageable. Even more tragic was the loss of life. Wives, husbands, sons and daughters. 185 lives. 185 stories.

Five years on from 2011, Aurecon has curated some of these collective stories into a unique reflection. Although each has been born out of disaster, they are also incredible tales of resilience, renewed strength and hope for a brighter future. These stories now form part of the story of Christchurch as it reclaims its destiny.

Christchurch and its people, community, and businesses refused to be flattened.

Rebuilding central Christchurch is one of the most ambitious projects in New Zealand’s history and is about recreating and planning for a new, resilient community. It is not an engineering project. It is a rebuild that focuses on the creation of infrastructure and places for Christchurch’s people and the stories that bind them together.

Aurecon is proud to be playing its part in this rebuild.

By sharing these stories and engaging with global communities about lessons learned, we hope to contribute to global conversations about disaster resilience.

This is what Christchurch did next...

"Reflections from those who were there and those who are taking Christchurch into the future."
A CITY THROWN INTO CRISIS:

recovery operations in the immediate aftermath of devastation
Ultimately it was a community response. Many Urban Search & Rescue members also lost homes and it was that human insight that resonated. It was our community involvement that really helped people understand that everyone was trying their best during the perils of reality."

Dr Jan Kupec,
Technical Director - Ground Engineering, Aurecon

The series of tremors that rocked the Canterbury region began with a 7.1 magnitude earthquake striking on 4 September 2010. Despite the widespread damage, the community committed to carry on with their lives with as much ‘normality’ as possible throughout the aftermath, which was marred by thousands of aftershocks. But when a magnitude 6.3 quake struck less than six months later on 22 February 2011 near the heart of Christchurch, with one of the greatest-ever ground accelerations recorded in the world, already weakened buildings and roads were either severely damaged or completely destroyed.

Christchurch was a city thrown into crisis. Hospitals faced mounting admissions for serious injuries; hundreds of residents had lost their homes; shaking had caused the soil in many areas to behave like a liquid (‘liquefaction’), producing around 400 000 tons of silt in the eastern suburbs. These almighty

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challenges forced New Zealand’s Central Government to declare a State of Emergency. Due to significant building damage, the central business district (CBD) was immediately evacuated.

Those two earthquakes required very different responses. Post-disaster response following the September 2010 quake focused on restoring building stability in order to reopen the city and allow people to return to their homes. The February 2011 event centred around live rescues, requiring engineers at major collapse sites to advise on search locations, building stability, fall hazards, shoring and debris removal. Work then extended to victim recovery, property protection, retrieval of essential items, including medical records, and accessing infrastructure, including critical transport routes and generators powering essential services.

**Christchurch’s heroes**

Both of these responses were underpinned by an incredibly practical approach to post-disaster enablement as first responders and stakeholders banded together to gird Christchurch’s loins as it, still shuddering from shock, prepared to lift its head. It was these first-responders who led by example, instilling confidence and giving hope to locals that their city could rise above adversity.

“First-responders led by example, instilling confidence and giving hope to locals that their city could rise again.”
For Margot Christeller, the appeal of pre-earthquake Christchurch was that it was “a small, nimble city, easy to get around with plenty of opportunities and options,” and it became a community that Margot was at the very heart of on that day in February.

“I was in the car park next door to the CTV building when it happened. I crawled out of my car and saw the building collapse. It didn’t really compute and I was covered in dust and simply followed a friend who said ‘There must be people in here’.

“By this stage there were around five of us lifting material and we saw people just sitting there so we took them down from the rubble. Then there was a baby and it was when the baby started to scream that I realised I was part of something beyond comprehension and that was when I felt overwhelmingly afraid.

“But seeing significantly damaged people and then the aftershock, which felt like standing in jelly, is when I just stopped being afraid. I think the level of violent shock moved me to a calm place, focused on survival and helping others.

“At the same time I was trying to reach my family, remote texting via my sister in Queenstown as communications systems were all down. When the first big fire engine arrived, I then realised that there is someone here that knows what to do and so I passed the baton and made a decision to leave the CTV building to find our daughter. I remember the noise of the sirens the most, but not the people.”
Peter Townsend, CEO, Canterbury Employers’ Chamber of Commerce, recalls: “The story of the Christchurch business community’s refusal to lie down in what was a cataclysmic event is one that needs to be remembered. The lessons learned will be applied in future national and international disasters. It wasn’t about having water and bandages or civil defence gear in your building, it was about having backup systems and being able to locate your staff and having a Plan B for accommodation. It was about looking at your business support systems, checking they were resilient and, most importantly, it was about understanding what you were insured for.”

“Our citizens really proved their ‘can do’ attitude by picking up each other’s books and bricks. We saw incredible community strength with all who are assisting us with the rebuild and just a determination to get onto it.”

Peter Townsend talks to Aurecon about the effects on local business, its economy and attracting investment back into the city.
Aurecon’s first responders

As a local business, Aurecon lost its office and, as residents, many of our people lost their homes. Our people and our clients were all affected and because we are all intrinsically part of the Christchurch community, we were determined to give back to Christchurch. We wanted to show our commitment to its future. From the very first tremor in 2010, Aurecon has put Christchurch at the forefront. The scale of the destruction required all available Aurecon engineers to deploy to Christchurch immediately, with some 20 engineering specialists activated to assist the rescue effort.

The USAR effect

The role of Urban Search and Rescue (USAR) teams is critical in locating, rescuing and medically stabilising victims trapped in confined spaces following a structural collapse.

Aurecon’s first responders to the February 2011 disaster included three specialist New Zealand USAR engineers. Christchurch-based Dr Jan Kupec, a Technical Director and Ground Engineer, was joined by Technical Directors Carl Devereux and Craig Stevenson, both Structural Engineers. Carl and Craig immediately boarded New Zealand Airforce aeroplanes bound for Christchurch to support the New Zealand Fire Service USAR team’s live rescue of 69 people.

Carl, Craig and Jan had previously undertaken intensive USAR training with the New Zealand Fire Service but, as Carl recalls, they still found that “the initial recovery was a daunting process as we didn’t have a blueprint of what to do.”

During those early days, Carl, Craig and Jan, together with volunteers from the New Zealand Fire Service, were all instrumental in live rescue, victim recovery, emergency shoring and building stabilisation works. This saw them crawling through collapsed building voids and over rubble piles.

Paul Burns, a Task Force Leader from the New Zealand Fire Service USAR division, says it was one of the largest USAR mobilisation and deployments in New Zealand. “A standout was the role of USAR engineers in the rescue phase to ensure the safety of emergency workers and civilians. Their enthusiasm, professional approach and total commitment were critical to such a successful deployment.”

Mobilising crucial support

At the same time, Aurecon’s Alistair Greig, a Technical Director and Head of Survey, immediately mobilised 16 Aurecon surveyors to support the USAR operation in the CBD. Alistair set up his home garage as a centre of operations for his team of local and seconded surveyors to monitor in excess of 20 buildings within the CBD.

“Our surveyors ultimately acted as a ‘warning system’ for the rescuers,” he says. “Many rescuers had to crawl through confined spaces in the damaged buildings searching for survivors and survey monitoring was required to ensure structures had not moved following the constant aftershocks. The look of relief on the faces of the USAR team was sobering, especially when they were convinced of a building’s movement after an aftershock.”

Working around the clock, this team rapidly became critical to the USAR response as the demand to perform rescue missions for survivors increased.

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Stabilising nature

While much of the initial focus was on Christchurch’s CBD, the nearby Port Hills suburb of Sumner was one of the worst affected, suffering significant failures of cliffs and steep slopes. As a local resident familiar with the geography, Aurecon Senior Engineering Geologist, Camilla Gibbons, was immediately engaged to undertake preliminary inspections to identify imminent risks.

Camilla uncovered a large landslip of around 1.3 hectares and became responsible for monitoring and mapping this area, which threatened the sole main road into Sumner. Over time, more than 700 properties in Port Hills were purchased by the authorities due to high life-safety risk.

Camilla conducted regular presentations to keep the Port Hills community informed, penned a weekly website update and fielded calls from concerned residents.

“Over time, more than 700 properties in Port Hills were purchased by the authorities due to high life-safety risk.”
A year on, Carl Devereux recounted his initial thoughts in an interview with the Nelson Mail, saying:

“It was made all the more dramatic by floodlights and shadows cast by the fire trucks and the twisted wreckage of a lift tower still standing. We were soon crawling over the wreckage. I had always been worried about how I would cope in a major rescue operation, but I was surprised how quickly the training kicked in, as well as the knowledge from countless hours of studying earlier building collapses.

“International agencies advised us on protocol as we had not witnessed destruction on this scale. Working alongside those agencies and government broadened our thinking as to how to best map our way through the recovery. Decisions were made on a daily basis. There was no time for planning as the city was on its knees.”
An employee’s story

For Alistair Greig, Aurecon Technical Director and Head of Survey and a long-time resident of Christchurch, the tremor that day in February was so violent that he hit his head hard on a desk. “When everything stopped shaking, I remember seeing people underneath their desks. Initially, we weren’t too rattled. We assumed it was just another aftershock.” But Alistair followed protocol and coordinated the safe evacuation of the 50 Aurecon staff in the office. He then joined hundreds of city workers walking long distances home with limited access to communication.

“People in Christchurch weren’t shocked to experience another earthquake, but we were shocked to get such a big one. My sobering reality was in surreal observations of a shattered glass shopfront filled with expensive jewellery laid undisturbed on the ground, and handbags, half-eaten pizzas and glasses of wine left behind in once bustling cafes.”

“I am so incredibly proud of our team. They pulled together to get the job done while working in extremely stressful conditions and bearing witness to some sad and horrific scenes. Many of them then went home to their own earthquake reality.”
PROTECTING OUR COMMUNITY:

leadership in deconstruction and geotechnical support
The damage in facts

- Over 50% of CBD buildings severely damaged
- USD40 B damage
- 124 km of water mains damaged
- 10,000 homes damaged
- 600 km of roads seriously damaged
- 300 km of sewer pipes damaged
- 500,000 t of liquefaction silt
- 12 schools relocated leading to more than half of secondary students sharing sites and resources with other schools
“After exhaustive searches of every building in the city, the operation turned to recovery and the deconstruction of buildings began. Many buildings had to be carefully pulled apart rather than simply smashed to the ground.”

Carl Devereux, South Island Manager, Aurecon

Complex challenges face communities in the aftermath of a devastating natural disaster. Where do you start when hundreds of kilometres of water and sewer mains as well as roads need addressing, and social housing and major community facilities need rebuilding?

Christchurch also faced a huge number of rockfalls from multiple exposed bluffs which had tumbled down the hillsides; as well as cliffs which had collapsed and an imminent threat of boulders coming loose in outlying areas.

Close to 8000 properties were deemed to be so badly damaged that they were considered unlikely to be rebuilt. As Christchurch looked at how to recover, a complex series of deconstruction and geotechnical work around the city centre and Port Hills, as well as the rebuild of public infrastructure, took priority. The assessment and repair of horizontal infrastructure such as roads, and sewage and water pipes was

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prioritised to the worst-affected areas that impacted on the most people.

Assessing the damage

One of the most urgent requirements was building assessments as people could not safely return to their homes and workplaces until full damage reports were completed. Aurecon engineers flew in from across the world to support the Christchurch City Council (CCC) and the Stronger Christchurch Infrastructure Rebuild Team (SCIRT) to undertake detailed engineering evaluations of buildings, rockfalls, and public infrastructure. It was a process that took two years.

Four senior Aurecon engineers were also seconded into the Canterbury Earthquake Recovery Authority (CERA) to advise on deconstruction and geotechnical issues. This included helping to manage demolitions within the CBD’s red zone for many of the city’s tallest buildings, which were on the verge of collapse. These engineers helped ensure swift, controlled, safe and co-ordinated demolition. Uncontrolled demolition was considered an ‘extreme’ risk that could have led to further loss of life.

A blueprint for deconstruction engineering

All in all, there were more than 1200 commercial building demolitions in the CBD alone, including more than 140 tall buildings. CERA’s Significant Buildings Unit (SBU) demolition framework ultimately rewrote the rules for tall building demolitions, including navigating how to safely complete a fast track demolition programme in a highly competitive demolition tender market. The true success of this project can be measured in the safety record of the completed demolitions – despite several major aftershocks, none of the demolitions resulted in serious injuries or fatalities.

In particular, the Hotel Grand Chancellor and the Copthorne Hotel were both described by international experts as the most complex demolitions they had ever seen in a modern city.

The Hotel Grand Chancellor was the highest priority for demolition. Only two options were considered: implosion or a combination of cut and crane for the upper levels and high reach demolition for the lower levels. The latter was chosen and required close oversight by SBU engineers.

The legacy of this work is the SBU methodology for assessing high rise building damage and prioritising buildings for urgent demolition. Global demolition contractors now also have a better understanding of how to demolish earthquake damaged structures, while Christchurch was able to start to move forward.

"The question of whether or not to demolish a building is one of the toughest decisions an engineer has to make..."
A paramount commitment to safety

The situation in the Port Hills suburb was unique due to architecturally designed properties, which utilised construction material not common in the NZ industry and requiring differing deconstruction techniques. As these sites were in residential areas, demolition works had the potential to affect the general public and the impact on the only road in and out of Sumner.

Working closely with CERA, the Aurecon Geotechnical Team led by Jan, applied a Safety in Design approach, which promotes a zero harm culture and innovating to achieve this. Demolition solutions included cranes, helicopters and remote-controlled machinery. Other innovations included collaborating with the University of Canterbury for the use of an unmanned aerial vehicle (drone) to collect information from high-risk areas using high-definition cameras and advanced GIS field data capture systems.

"The situation in the Port Hills suburb was unique due to architecturally designed properties..."
In the hours following the February 2011 quake, it became apparent that landslides and tumbling boulders were a major hazard in Port Hills. 714 properties were red-zoned because the risk of further earthquake-triggered rockfalls was high.

Rapid response teams were mobilised to respond quickly after major aftershocks to inspect the region for further damage and rockfall. The Port Hills Geotechnical Group (PHGG), which comprised six consultancies managing nine sectors, was established to mitigate geotechnical risks, including rockfall, cliff collapse, landslides, and large retaining wall failures.

Aurecon’s Camilla Gibbons, together with her team of ten, were responsible for the rockfall, landslide, and cliff collapse work in two key sectors of Port Hills—one, which covered approximately one-third of the area; and the second, which displayed the most severe geotechnical damage.

Despite being under significant pressure to reopen some local croquet pitches, Camilla maintained they would not be opened until an inspection of the cliffs had been carried out. During a June aftershock, the cliff did fail and over half of the croquet pitches were inundated with slip material and large boulders.

Christchurch suffered from thousands of aftershocks and Camilla continued to inspect the most vulnerable areas in Port Hills after the earthquake in June 2011 which, from a rockfall perspective, was more damaging than the February quake. New sizeable failures and cracking occurred after a relatively minor 5.6 magnitude earthquake in June 2011 and she immediately ordered a partial closure of the main road to the Sumner township. The speed of her action was lauded when a larger 6.3 magnitude quake hit an hour later causing catastrophic failure of the 75-metre high cliff face. 15-metre thick sections collapsed on to the portion of the road that she had just closed to traffic. Thanks to her action, nobody was hurt and no vehicles were damaged.
Critical to a flourishing future city is the safety of its children. At the time of the 2011 quake, there were 215 schools across the region educating more than 76,000 students.

With 90 per cent of its buildings framed in timber, the New Zealand Ministry of Education decided to commission destructive testing of two standard types of timber-framed school buildings in the aftermath. These buildings performed very well in the earthquakes, with no major structural damage caused by ground shaking. Building damage, if any, was caused by liquefaction rather than shaking.

In late 2012, senior Aurecon structural engineering staff joined the New Zealand Ministry of Education’s Engineering Strategy Group (ESG) to provide technical leadership during the destructive testing process.

While it was widely accepted that timber frames have a relatively low risk of sustaining potentially life-safety hazard damage during earthquakes, engineers had previously given overly conservative results when determining earthquake resilience.

The tests confirmed that timber-framed buildings have a strength and resilience significantly greater than previously calculated and, in many cases, in excess of 100 per cent of the New Building Standard. They also indicated that a factor of two can conservatively be applied to the calculated strength of timber-framed buildings.

Today, the Ministry’s approach to assessing earthquake resilience of all school buildings uses the new calculation tools developed by Aurecon engineers and their ESG colleagues. This is saving hundreds of millions of dollars, which can now be spent ensuring classrooms are fit for 21st century teaching and learning in support of the future leaders of Christchurch – its children.

Protecting our schools and the future leaders of Christchurch

Safety testing our schools

View the earthquake resilience testing of timber-framed school buildings
FORMULATING A VISION FOR THE FUTURE:

moving beyond disaster towards recovery
"The recovery of central Christchurch is an enormous task that will involve everyone. It is a journey to be taken in partnership with the city's many stakeholders to ensure that central Christchurch recovers and progresses as a place for the community to be proud of."

Christchurch Central Recovery Plan

Christchurch's social and physical infrastructure suffered deeply. The damage equated to 20 per cent of national GDP and it was one of the first priorities for CERA to formulate a blueprint of repair to all facets of infrastructure and then ascertain priorities. It was an enormous challenge.

A blueprint for recovery

On 30 July 2012, the Minister went public with the Christchurch Central Recovery Plan. This ambitious framework to rebuild the city was carved and crafted over 100 days by a creative team of local and international designers, known as the Blueprint 100 consortium.

Central to the Recovery Plan was the voice and vision of the Christchurch community. A ‘share an idea’ campaign was launched via hundreds of discussion forums hosted in town halls and central

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spaces, coupled with an online crowdsourcing tool, to capture the imaginations and opinions of over 60,000 individuals in the reshaping of their city space. Ultimately, 106,000 great ideas from the community were harvested and integrated into the Recovery Plan.

Woven throughout the 106,000 contributions was the desire for an inclusive and accessible central city that catered for all ages, ethnic groups, and disabilities, through a broad range of environments, activities, buildings, services and facilities.

**Giving residents their future back**

Soon after the February 2011 quake, CERA mapped Christchurch into four zones - red, orange, green and white. 7857 properties were red-zoned as they were located on land so badly damaged it was unlikely to be rebuilt on in the near future. Thousands of other properties were also deemed uninhabitable because they required such major repairs.

CERA’s residential red zone offer in which the owners of damaged properties could sell their land and uninhabitable homes at market-related rates was crucial to recovery. It gave property owners the chance to move on with their lives and find a new, secure, and safe home. By the end of 2012, over 6300 property owners had signed a sale and purchase agreement and the government had spent USD989 million on buying the properties of owners who had settled.

“7857 properties were red-zoned as they were located on land so badly damaged it was unlikely to be rebuilt on in the near future.”

**Faith in the future**

Baden Ewart talks about his faith in the future of Christchurch, which he calls a diamond city.

**Beyond the red zone (Part 1)**

As part of his work with CERA, Aurecon’s Dr Jan Kupec, Technical Director and Geotechnical Engineer, reveals why areas of the Port Hills were red zoned.
CONFIDENCE AFTER CRISIS:

investing in the safer design of our city
"The rebuild of Christchurch is about recreating and planning for a new, resilient community that will be as vibrant as Christchurch always was. It is a human rebuild, not an engineering project, allowing plenty of room to look at the creation of places and infrastructure for people."

Giving confidence back to residents and business owners is one of the most important priorities during the period immediately after a disaster. This confidence is underpinned by reassuring residents that they can get out of their buildings safely without collapse during a major earthquake; that those buildings can be reoccupied quickly; and that businesses can be back on their feet and operable again. It is also about knowing that the ground beneath is safe and not susceptible to liquefaction.

**Promoting resilient building design**

For Christchurch, the construction of resilient building designs was critical to restoring confidence and has gained much momentum since the earthquakes.

Earthquake-resilient buildings boast the same primary structure as any conventionally designed building, but the resilient components are integrated into the...
conventional structural form to respond to significant events without causing irreparable damage to the primary structural elements. A focus on life safety and avoiding dangerous building collapse is key. To achieve this, such designs often utilise accessible replaceable components with sufficient ductility to dissipate seismic energy.

While ‘normal’ buildings will be fatigued after an earthquake sequence, resilient buildings can continue to absorb multiple earthquakes and be readily reinstated to pre-earthquake conditions.

There have been in excess of 26 new resilient building designs constructed, including: 151 Cambridge Terrace, Knox Church, the Tait Communications Building and the Christchurch Art Gallery.

“In general, any structural form is capable of resilient detailing so architectural and building functionality drivers are not compromised.”
When a landmark historical triple-gabled church cracked in the earthquakes, around 200 parishioners got to work. With help from the wider community, grants, and insurance funds, they raised nearly all of the required USD5.5 million required to see their beloved Knox Presbyterian Church rise from the rubble.

During the February 2011 earthquake, the exterior brick of Knox Church was badly damaged leaving the rich timber roof structure in a precarious state, but still standing. Aurecon reacted quickly to design temporary bracing for the roof structure while insurance claims could be completed and decisions made about the future of the Church.

The passion of its congregation saw the Church become one of the first heritage buildings and churches to be repaired and retrofitted with resilience design.

“When the Church was reopened, people were amazed at how much of the original Church building had been reused. People walk into the church and say ‘wow’ - it holds a lot of memories, but now they have created a modern heritage building,” says Parishioner Ron Keating.
Many areas of Christchurch were affected by soil liquefaction that made certain suburbs unliveable but Prestons, one of the largest greenfield residential developments in New Zealand, suffered no liquefaction, lateral spreading or any other seismically associated hazards during the entire earthquake series – all thanks to the presence of more robust soil.

Since the February 2011 quake, the Christchurch City Council (CCC) has rezoned 10,592 sections for housing and with the urgent need to house more than 10,000 displaced and homeless residents, new land subdivisions such as Prestons had to be urgently developed.

Prestons has become a sustainable residential precinct which can accommodate over 2300 houses, 8000 residents, commercial and retail developments, a school and supermarket. While a land development project of this scale in Christchurch would usually take up to 15 years to complete, the scale of the crisis meant that it was essential that this project be completed in less than half of that time.

As lead consultant, Aurecon assessed the stability of the land and provided project management, survey, contamination, advisory, civil, stormwater and urban design services to transform 203 hectares of land into this dynamic new subdivision. It boasts the first ever large vacuum wastewater system installed in a residential subdivision in New Zealand, which connects with the newly upgraded Christchurch City Council system. The vacuum sewer was preferred as it is a cost-effective, optimal engineering solution in terms of both performance and seismic resilience.

The whole site can also be serviced by one vacuum sewage pump station with pipes only needing to be placed in shallow trenches above the water table.

Because they are made of polyethylene, they can both stretch and bend making them extremely resilient during earthquakes, and able to provide uninterrupted service during a power outage. The vacuum system is not only earthquake resilient but reduces impact from construction, hazardous situations and pollution and waste, as well as conserves energy. This is just one of the innovations that are ensuring Prestons is a thriving new community in Christchurch.
After five years of closed doors, over 10,000 people visited Christchurch’s Te Puna o Waiwhetu Art Gallery during the opening weekend. This followed the largest releveling project undertaken in the southern hemisphere. The Gallery became the Civil Defence headquarters for seven months after the February 2011 earthquakes, and then needed extensive work and improvements before it could reopen.

"Then 15 months after the earthquakes, engineers recognised that the ground under the Gallery had liquefied," says Gallery Director, Jenny Harper. "The building had to be relevelled, repaired and strengthened to protect it from similar earthquakes and ensure the preservation of our priceless collections."

Restoring a cultural icon
In the first base isolation retrofit project in New Zealand to use triple pendulum double concave sliding isolators, relevelling and base isolating, Aurecon engineers helped the iconic Te Puna o Waiwhetu Art Gallery reach the highest international standards in seismic protection. This was fundamental to restoring the Gallery’s reputation for exhibiting and protecting priceless works of art. Today, it is one of the safest and most earthquake-resilient galleries in the world.

“You can’t quantify the place of this collection in people’s cultural hearts. The joy and tears on people’s faces when we reopened really told a story. I have never had as many random hugs as I did on that occasion; people were happy to have that building back. Everyone seems to be absolutely delighted - the schools, the teachers, the general visitors, the locals and tourists. Businesses around us are profiting hugely from having more people in the centre of town. It is really important to have cultural facilities such as this gallery open and available as much as we can.”

Jenny Harper, Christchurch Art Gallery’s Director, shares her joy at being able to reopen the Christchurch Art Gallery after five years.
THE COMMUNITY CONNECTION:

supporting Christchurch to get back together
“You can measure the strength of the community when disaster strikes. Our community spirit and resilience were phenomenal and they are days I’ll remember all of my life.”

Baden Ewart, Director - Former CCDU/CERA

During the months that followed the earthquakes, the depth of suffering affecting community groups became very apparent. People knew that infrastructure and essential services took priority initially, but it was also important to support community groups as soon as possible, so that residents could start to regain a sense of normality and had places to connect with others. Lianne Dalziel, Mayor - Christchurch City Council, says “It was extremely important to understand how other cities responded and recovered from disasters they encountered. People internationally were really open to help. I am actually overwhelmed at how much help people were willing to give.

“As a city our infrastructure is much stronger and we have processes in place to make sure we are checking that our buildings are safe after an aftershock or another earthquake. We are a much safer city than before.”
With countless gaps in the city’s architecture, an innovative group decided to find ways to fill those gaps with temporary installations designed for the community. Out of this realisation, Gap Fillers was born.

Their first project, the Blue Pallet Pavilion, was a transitional architecture project built by volunteer power over six weeks in late 2012, and harnessed the goodwill of Christchurch residents and businesses to construct a new temporary events venue. Created by emerging designers, supported by established professionals, and built from loaned, reused and donated materials, including over 3000 blue wooden pallets, it was a testament to the effectiveness of a collaborative and community-minded will and process.

Importantly, the Blue Pallet Pavilion helped to address the city’s need for new small-to-medium venues after the loss of demolished clubrooms and community halls. It also aimed to draw people back into the central city, supporting businesses and promoting it as a place for experimentation.
On June 2013, demolition of Christchurch’s Sumner Surf Life Saving Club was scheduled due to irreparable earthquake damage. The Club, which was founded in 1911, had been at its current site since the 1950s, overlooking a 400-metre stretch of golden sand lapped by waters that attract residents and tourists alike. Since the earthquakes, it had been operating from a portable cabin and a container.

Plans for a new pavilion were for a largely ground-level building with a patrol room above to give lifeguards an unobstructed 180-degree view of the beach. Aurecon surveyor and Club member Luke Keats, also a senior lifeguard, initiated the company’s planning, surveying, traffic, civil, water, geotechnical, structural engineering and building services support for this important community asset.

A sophisticated ground analysis was undertaken to check potential damage during future large earthquakes and associated risks. An innovative, cost-effective foundation solution that ensures resilience was adopted. This allowed the original site to be reused and the project accelerated in time for the 2016/17 summer patrols.

Luke first joined the club at age 15 and for him, the sight of the new clubhouse, which has always had lifesaving as its main focus, was a very welcome reminder of safe hands. The restoration means its continuation as an invaluable community facility base for the lifesaving patrols, which safeguard Sumner Beach in the busy summer months, and as a vital hub for local community groups and residents who use it for conferences, weddings, yoga and as a toy library.
AN ACCESSIBLE CITY:
getting the city moving again
“A well-formed and vibrant city centre produces economic and social benefits by bringing people together for business, cultural or social activities. The result is greater productivity, connectedness, development of human capital, sharing of ideas and a shared identity.”

Christchurch Central Recovery Plan

With the first signs of regeneration beginning to show and the government’s Earthquake Support Subsidy supporting businesses to re-establish themselves, the next step in Christchurch’s recovery was to build private sector confidence. Establishing Christchurch as an ‘accessible city’ and supporting inner city travellers in getting to and moving around in the central city, whether by bus, car, cycle or on foot, was crucial.

For Liz Robinson, a long-time Christchurch resident and an Associate at Aurecon, supporting Christchurch work towards becoming an accessible city was fundamentally about facilitating how people move around the central city by upgrading the transport system to provide a compact, people-friendly core.

“The transport system needs to be affordable, resilient, environmentally sustainable and practical.

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The streets, cycleways and walkways need to work well with the buildings and public spaces,” says Liz.

“The cycleways are designed not only for commuter cyclists but for those who want to appreciate what the city is all about. If we don’t get people back into the city, then we don’t have a central city, so we need to create this ease of connection.”

From inputting the urban streetscape to reconfiguring roads for cycle protection, expanded busways, curbs, surfaces and textures, planting, parking and tree pits to major cycleway routes, Aurecon has been heavily involved in the feasibility and implementation of the Council’s accessible city plans.

“If we don’t get people back into the city, then we don’t have a central city.”
As businesses returned to the Christchurch CBD, a single storeyed, L-shaped building rose from the ground. The USD53 million bus interchange was the first anchor project to be completed in the central city and opened in October 2015. It offered an airport lounge-style facility with retail and cafes around the edge, providing a sense of place for commuters and visitors alike.

In 2013, Aurecon was appointed by CERA to undertake the engineering and transport components of the interchange, focusing on an integrated transport and land use solutions for the interchange and its surrounding environment. The interchange has been designed to handle up to 115 bus movements per hour and by 2041, is expected to be used by about 7500 people per hour.
With tight constraints framing the new bus interchange site, a unique design was used to ensure the number of services could be accommodated. This required bespoke training for drivers to enable them to gain confidence in reversing out of the new parking bays. Aurecon's market-leading innovation in applying 3D modelling to visual training programmes prompted the creation of a virtual reality module for drivers to practice in a safe environment.

Simon Yorke, Aurecon's Advanced Design Technologist, explains that a virtual reality headset together with a steering wheel and pedals allowed the creation of a virtual reality driving simulator. This was one of the first applications of virtual reality technology in the engineering industry. The result was future-focused training for a future-proofed city.

**Future-focused training**
for a future-proofed city
OUR FUTURE IS STRONG:
the lessons learnt from a remarkably resilient community
“Our experience here in Christchurch has created a huge opportunity to collate all of our collective learnings and support other organisations and communities with advice on how to best tailor preparations for their own ‘what if?’ scenarios. That is the power of resilience.”

Dr Jan Kupec, Technical Director – Resilience Leader, Aurecon

Rebuild with resilience in mind

Resilience is all about outwitting challenges. Identifying weak spots encourages smarter investments and prepares a community for challenges, change or impending disaster. Christchurch experienced a unique and unprecedented loss. Key infrastructure was annihilated. Buildings that could fall did and now needed to be replaced. But with replacement design comes the onus and common interest to build with greater resilience in mind.

“It is now about thinking of the potential for flooding, earthquakes, fire and social destruction. Then it’s about asking the ‘what if?’ questions and working together to ascertain how to deal with these as a community, as a group, and as an organisation. That’s where the power of resilience is the most effective. We are a much safer city than before,” says Jan.

Continued on the next page...
Glean from others’ experience

“For me, I felt that it was really important to understand how other cities have both responded and recovered from the challenges that they have confronted. What I found was that people internationally were really open to help.” says Mayor Dalziel.

When disaster strikes, in any form, many existing systems and lines of communication are no longer available. Yet individuals still have knowledge and experience. New systems and process will need to be found or created, yet by combining local knowledge with external experience the outcome will be better than the original.

See devastation as an invitation for inspiration

The Christchurch recovery was, in many aspects, a world-first. With no international best practice or guidelines for earthquake-related demolitions of this scale, the team had to see potential through the lens of innovation. “With not having a CBD for many years, our central city became a source of inspiration as people had to rethink how they did things before and come up with new ways to entertain or provide residents with shopping or eating-out options”, says Liz Robinson of Aurecon. The success of the city’s Recovery Plan was rooted in the mindset of the people, who saw a city in ruins as a clean slate on which to write new opportunity.

Cover all the bases

Peter Townsend, CEO, Canterbury Employers’ Chamber of Commerce, says the success story of Christchurch City was the brilliance of the rebuilding effort which could be pinned on a meticulously efficient contingency plan. Well-organised and executed security systems allowed the restoration process to flow smoothly and the city to steadily exceed its former prime.

Trust is key in crisis

Margot Christeller, former contractor to CERA, says building relationships stands you in good stead when disaster strikes. “You do have to be prepared, but you don’t know what you have to be prepared for. It was the small teams who knew each other that were the most effective because they had already developed trust.

Mayor Dalziel also noted the way that people came together and executed positive solutions as neighbourhoods and local communities had built a really incredible sense of self-competence and faith in partnership. “There was no excuse not to know your neighbours after September 2010 and, by February 2011, we were already well connected,” she said.

Empathy assists the path to recovery

Many of the residents took great comfort and reassurance in seeing first-hand how present and involved the teams were in their individual situations during the early days of recovery. Communication was of huge importance to all responders, no matter where they were deployed, says Aurecon’s Carl Devereux.

"We were sending our people to residents’ meetings to engage with them on a personal level and support them with advice on issues and concerns. Many of our people were residents themselves and the more we did that, the more we got an innate understanding of damage, risk and sentiments.” By keeping an ear to the ground and tending to the needs of afflicted communities, considerable friction was mitigated in a time that was already tenuous at best.
Don’t underestimate the power of personal investment

Ultimately any city is about its people. The vibrancy and longevity of neighbourhoods and businesses hinge upon the degree to which its people give of themselves to ensure its success. Because of their long-standing investment and generational ties to Christchurch, its residents were simply not willing to wave the white flag over their inheritance. “Our citizens really proved their ‘can do’ attitude by picking up each other’s books and bricks. Good people came together and got on with it, and that’s why we are so advanced when it comes to dealing with a crisis of this magnitude,” says Mayor Dalziel.

Within the business arena the same principles applied. Peter Townsend witnessed the sacrifice that business owners were willing to make. “Your business is part of who you are. It is part of your soul, part of your family, part of your community, part of your social circle and definitely part of your commercial circle. People did almost anything they could to save their businesses - we saw people risking their lives to save their business.”

Be willing to export your lessons learnt

The Christchurch calamity proved to be a catalyst for world-class innovation. Many of the response systems and engagement tools had never been utilised within such limited timeframes or on such a mass scale before. These lessons learnt could make all the difference for others who’ve undergone a tremendous crisis, expediting the rate and quality of response to large-scale devastation.

“With our lessons learnt, we can add value to global conversations about disaster. What they may be struggling with is what we struggled with, but we have had some successes and, as good global citizens, we have a moral obligation to share and help others to recover from disaster,” says Dr Jan Kupec of Aurecon.

“Societies cannot respond to events of this magnitude without strong relationships between central government, local government and the private sector. Importantly, the private sector will invest when they are confident about the commitment of the government. For Christchurch, supporting property rights is especially important. We had to protect property rights on the one hand but, at the same time, where necessary, use the powers of central government to acquire property to consolidate. This helped people look after their family, look after their business and secure a good future,” says Baden Ewart, formerly Director of the CCDU/CERA.

The importance of strong partnerships between government and private sectors

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