



# A UNIQUE COMPLEX

The Arts Centre of Christchurch is one of the most important heritage sites in New Zealand. Its complex of High Victorian Collegiate Gothic buildings occupies a five-and-a-half acre (about 2.25 hectare) central city block and is the largest collection of this style of heritage structure in the Southern Hemisphere. All 23 Category 1 heritage buildings on the site suffered significant levels of damage in the series of earthquakes since September 2010.





*The College Hall from the corner of Worcester Boulevard and Rolleston Avenue: steel frames and post-tensioned rods secure the north and south gables from possible collapse. Image courtesy of Liz Hodgson, Christchurch Arts Centre.*

Built from basalt and limestone, and typically lined with red brick, the first building – the Clock Tower – was erected in 1877. This was followed swiftly by Christchurch Girls’ High School in 1878. Christchurch Boys’ High School was completed in 1887, the same year the School of Engineering was founded as part of Canterbury College (later to become the University of Canterbury).

The Arts Centre’s distinctive architectural style was established by Benjamin Mountfort, one of early Canterbury’s foremost architects. The Clock Tower, College Hall (1882) and the Mechanical Engineering Laboratory (1891) were all built to his design. By 1906, a Hydraulics Laboratory and an Electrical Engineering Laboratory had been added. Interestingly, unlike today’s engineering laboratories, the School of Engineering’s rooms were designed to be of average size with no additional height allowance. Presenting a unified façade along Worcester Boulevard, these buildings most recently housed the celebrated Court Theatre.

These heritage buildings’ seismic performance has been significantly compromised by their geometric inter-

relationship. In the late 1800s, it was common practice to create a new addition by adding three perimeter walls to the wall of an existing structure. In this manner, there are eight separate additions along the north facing elevation of the complex, in effect forming one massive structure. Similar additions occur throughout the site.

“Following the earthquakes, differential movement of these interconnected structures has resulted in walls that moved outwards by 70 to 100 millimetres,” Project Director John Trowsdale, who is managing the seismic restoration of the Arts Centre on behalf of Holmes Consulting Group, says.

As consultant engineers to the Arts Centre over the past 20 years, the Holmes Group previously completed important securing works across the site and some limited additional seismic strengthening works. Securing works such as large steel rosettes and steel tensioned rods are obvious in many exterior elevations.

Nevertheless, the September 2010 earthquake caused damage to buildings throughout the site. At that time, Holmes Group engineers designed temporary protection and propping for several

building elements, including the tower on the Chemistry Building and the College Hall turret structure. These works allowed the majority of the centre to reopen to the public. However, on 22 February 2011, the complex sustained considerable additional damage. The Observatory Tower suffered collapse and the adjoining building lost masonry from roof gables and chimneys. Large shear and flexural cracks appeared in the walls of many of the buildings. The site was closed to the public.

“Internally, the level of damage sustained to the buildings is far more significant than can be seen from the exterior,” Mr Trowsdale says. “In some places daylight is clearly visible through the 600- to 800-millimetre-thick walls. The red bricks on internal faces dislocated and fell as the walls moved.”

To plan the reconstruction, Mr Trowsdale and his team moved into the only occupiable building on site, the Registry additions. Initially they performed observation and damage mapping for all the buildings, alongside providing immediate securing and shoring design solutions. An essential component of the securing work was

ensuring the buildings' watertightness.

"It is one thing to have earthquake damage to heritage fabric. To allow preventable water damage is another. We are being very pro-active in this area," he says.

Mr Trowsdale's team worked with Arts Centre staff to collect, label and store broken masonry and other heritage fabric for later reinstatement. Wooden crates are now lined up adjacent to the buildings to store roof slates, the removal of which will allow a plywood diaphragm to be installed over existing sarking.

Where possible, tall stone chimneys have been removed, measured and deconstructed, and the stone stored. Holmes Group engineers are planning to design lightweight alternatives, clad with an 80-millimetre-thick layer of the original stone.

Currently, the engineering team's main effort is in performing a non-linear time history analysis. This involves constructing a three dimensional computer model of each building, capturing the geometric relationships between wall, roof and floor diaphragms, and all of the material properties. Earthquake records from previous quakes are then scaled to the intensity required by the present building code and run through the computer model. The computer program analyses the movements and response of buildings in step increments of 200 to 500 per second of earthquake input. This intensive computing exercise has been completed for the College Hall and Clock Tower block, with a view to introducing a number of seismic separations which will enable the buildings to behave as separate structures in future seismic events. Effectively, this means providing an inconspicuous gap between the buildings.

A team from Fletcher Construction is working with the engineers to repair damage to the Chemistry building and complete preparatory work for restoring the College Hall and Clock Tower block. When the strengthening repairs begin, a number of methodologies will be employed, which will include introducing concrete shear elements and using fibre-

reinforced polymers. Supplementary foundation elements will be added, and roof and floor diaphragms will be strengthened and tied to walls.

The task to repair the Arts Centre is monumental. The owner – the Arts Centre of Christchurch Trust Board – is determined to see the complex repaired and restored to its former state. Mr Trowsdale and his team are committed to assisting in this endeavour,

which could take between 10 and 12 years to complete.

"The heritage value of these buildings is enormous," Mr Trowsdale says. "It's a tremendous privilege to provide strengthening and restoration solutions which will ultimately allow the people of Christchurch to return to the Arts Centre with confidence."

» WRITER Claire Le Couteur



### WHAT IS HIGH VICTORIAN GOTHIC ARCHITECTURE?

Gothic architecture with its tall, exuberant forms and decoration dominated British building at the time of the settlement of Christchurch in the mid-19th century. Victorian architects favoured varying colours and textures inside and out, pointed window arches, steeply pitched roofs, elaborate porches, tall chimneys, turrets and gargoyles.

The Arts Centre complex presents a unified series of buildings exhibiting many of these features.