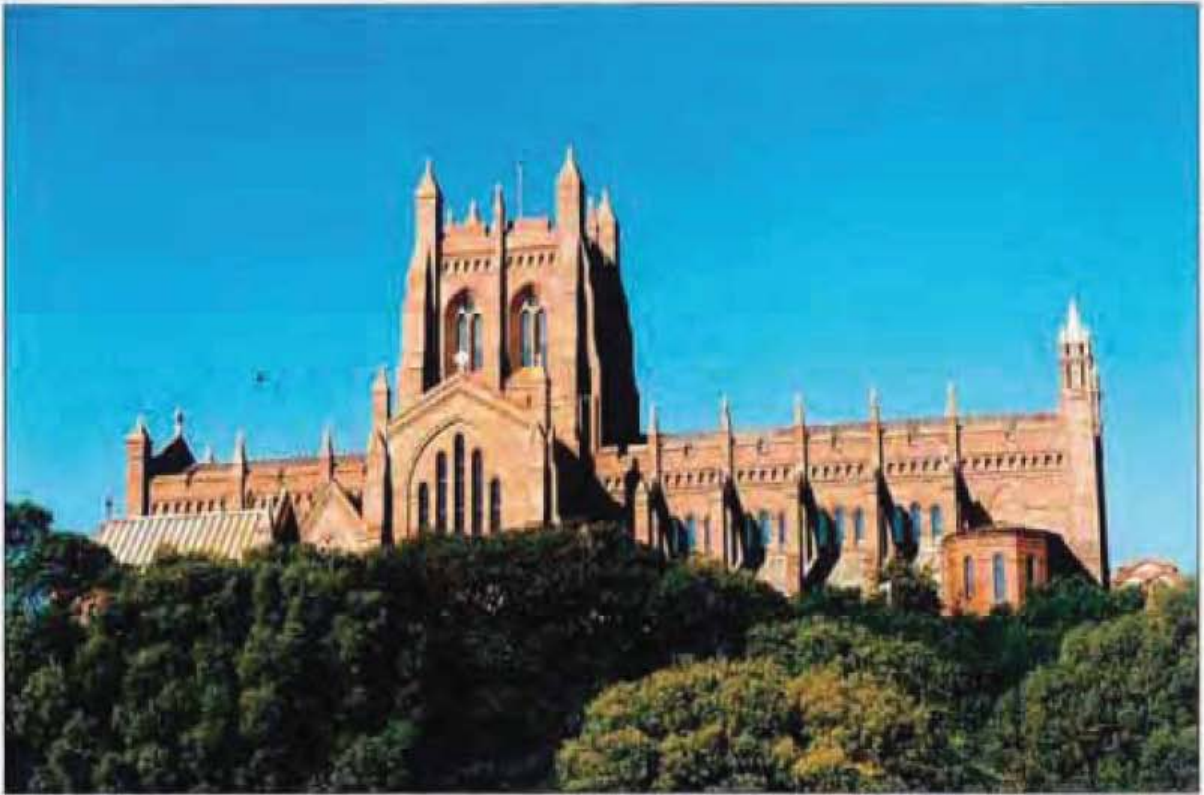


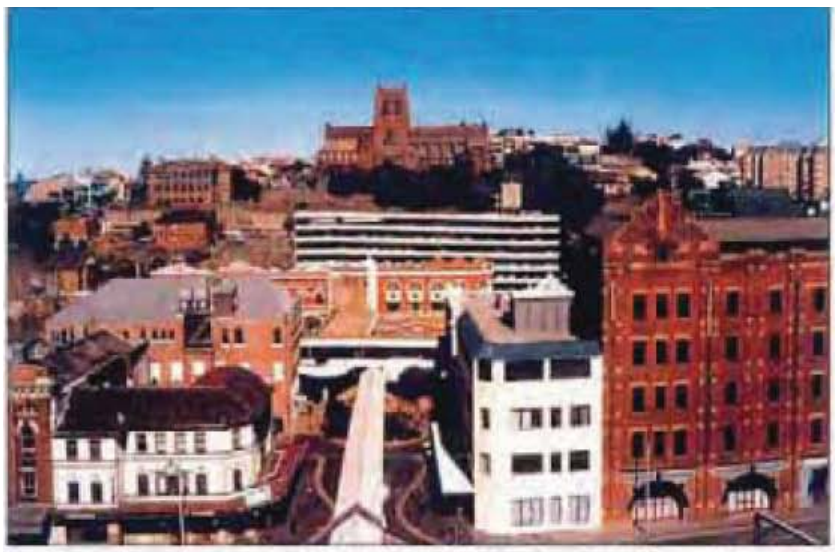
# CASE HISTORY

## CHRIST CHURCH CATHEDRAL NEWCASTLE, NEW SOUTH WALES, AUSTRALIA



Christ Church Cathedral is an extraordinary piece of architecture in a dramatic setting. Australia's largest provincial cathedral, dating back to 1893. Stylistically the building expresses the significant changes from the Victorian period of architecture with its reliance on academic correctness to the freer realization of the federation period and its influence by the Arts and Crafts movement in Australian architecture.

At 10:27am, on Thursday 28<sup>th</sup> December 1989, the city of Newcastle in New South Wales was struck by the first significant earthquake to affect an Australian urban area. The earthquake registering 5.6 on the Richter scale and with a modified mercalli index of up to VII had an epicenter approximated 14 km south west of the city's centre. The most important building to be severely damaged was Christ Church Cathedral.



Christ Church Cathedral Dominates Newcastle skyline.

# CASE HISTORY

## CHRIST CHURCH CATHEDRAL – THE DAMAGE



Earthquakes had previously occurred in Australia only in sparsely populated areas, and most practicing structural engineers and building authorities knew little, if anything about earthquake design requirements.

The effect of the earthquake was largely as might be expected: high set stone crosses and other decorations fell to the ground, flying buttresses were dislodged, shear cracking occurred in the north and south walls and out-of-plane movements occurred in the east wall, dislodging windows.

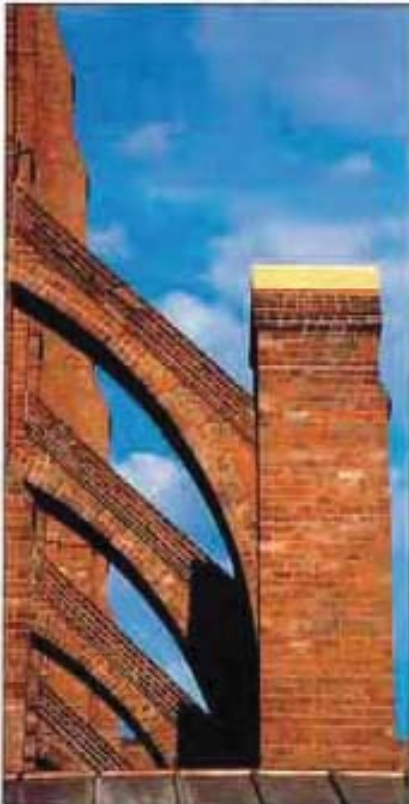
Work on a building such as Christ Church Cathedral is governed by state heritage legislation which invokes the international Council on Monuments & Sites.

(ICOMOS) principal derived from the world body's Venice Charter. To repair and strengthen the Cathedral, reinforcement of the walls was necessary, with least visual intrusion or damage to the existing fabric. Materials had to be found which were compatible with the masonry of the building and which ensure the long life for which cathedrals are noted.



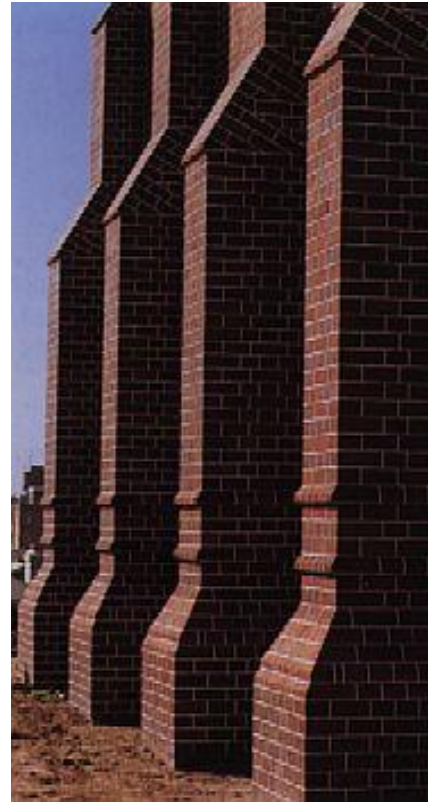
# CASE HISTORY

## CHRIST CHURCH CATHEDRAL NEWCASTLE, NEW SOUTH WALES, AUSTRALIA, RESTORED



The Cathedral has enjoyed a unique position as a focus for the lives of the people of Newcastle, the region and in many respects the State and Nation in terms of tourism and perception on Newcastle as a city.

Its restoration, in some part due to the unique capabilities of the Cintec anchor, ensures that the edifice has returned to its former glory and is stronger, and ready to face another 100 years.



# CASE HISTORY

## CHRIST CHURCH CATHEDRAL NEWCASTLE, NEW SOUTH WALES, AUSTRALIA – THE REPAIR



The Cintec Anchor System was chosen by the engineers to solve the Cathedral's problems when it became obvious that no other company had the materials, experience and expertise to meet all the requirements. Bill Jordan, a structural engineer who runs the Cintec operation in Australia, convinced the consulting engineers and architects that Cintec was the best solution with the lowest risk. Only Cintec was able to offer a high strength stainless steel anchor body coupled with a purely cementitious grout which was controlled by a woven sock to prevent escape. Trial installations and tests were undertaken before Cintec's accredited installer, Australasian Concrete Services Pty Ltd was contracted to place over 4 km of Cintec anchors.

The aim of the repair and reinforcement work was to turn the building from a brittle to a ductile structure, able to resist future earthquake. Cintec anchors were used to reinforce walls and piers, horizontally and vertically. Some steel frames were used where they could not be seen, behind parapet and in the tower.



Cintec anchors used on the project ranged from 215 mm long RAC cavity ties to 32 meter long anchors in the nave walls which were manufactured from 32 mm diameter "Hi-proof" grade 316 deformed stainless steel bar. All the long anchors had to be manufactured on site, with long vertical anchors being installed by crane.

The 32 meter anchors were the longest ever installed by Cintec and amongst the longest in the world.

Water could not be used for drilling because of the damage it could do to the building, so all drilling was carried out with non-coring, polycrystalline diamond bits using air for cooling and cuttings removal.



Down-the-hole video was used to verify the integrity of all drill holes and each hole was surveyed for its full length using techniques specially developed on site by the surveyors.



20 m vertical anchor being placed by crane in the project which saw anchors up to 32 m horizontally, Cintec's longest to date.