ADDINGTON WATER TOWER
EARTHQUAKE REPAIR WORK

A summary of work undertaken following the Canterbury earthquakes of 2010 and 2011. The work was completed between October 2017 and March 2018. Thanks to John Radburn, Project Director for the Heritage Programme, for supplying this content.

1. STRUCTURAL DAMAGE FROM THE EARTHQUAKES

Observed damage to the building included:

- There was evidence of minor movement of the foundations. It appeared that the outer edge of the northern foundation had crushed against the paving.
- There was cracking of the concrete walls, to a moderate level in the region of the four round windows some 7 metres above ground level. This cracking appeared to have widened since the earthquake to repair date, with additional spalling. Some of this cracking appeared to be at horizontal construction joints in the concrete work.
- There was further minor cracking elsewhere in the lower parts of the concrete walls.
- Areas of the plastered exterior finish were more extensively cracked, but the cracks themselves appeared generally to be hairline.
- There was a hairline crack in the foundation in front of the entry door.

2. STRUCTURAL STRENGTHENING AND HOW THIS WAS ACHIEVED

The building is currently assessed at 68%NBS.

The proposed work comprises repair to the earthquake damaged concrete walls, including the new steel support structures.

The new structure consists of four elements:

1. Steel rods drilled and epoxied into the concrete to secure the concrete rings surrounding the window on each face of the building. New concrete rings will be cast to replace damaged portions.

2. A new steel PFC beam installed on the inside face of the tower to laterally secure the concrete above the door on the northwest face.
3. New steel support hoop for the underside of the door head to support the concrete and prevent any loose concrete falling down.
4. Two reinforcing bars were grouted into the face of the lintel to enhance the in-plane resilience of the wall. This provides a means for moment and shear transfer to be maintained even if the wall has cracked.

The attached Scope of Repair goes into detail about the non-engineering matters including painting, bird protection and electrical; please refer to this document.

In brief, the earthquake damage repaired included:

- Crack repair to cracked and spalling concrete internal and external
- Crack repairs to 1960s concrete ring beam
- Repairs to all areas of cracked and spalled plaster
- New acrylic plaster topcoat to all previously plastered external areas of the building
- Paving lifted and re-laid with fall to drain
- Installed an internal portal frame to stich the cracks together at 7-9m

Upgrades

- Required to meet code
  - switchboard
- Trapdoors
  - Installed new stays to internal trapdoors
  - Installed pneumatic stays, hinges and catches to main roof hatch door
- Safety
  - Steel ladder cover and fall arrest system to internal stairs and an anchor point for fall restraint system for maintenance work on the roof
- Requested by Asset Owner
  - Installed stainless steel bird spikes on concrete ring beam and roof
- Lighting
  - Exposed ThermoPlastic-Sheathed cable (TPS) internal lighting wiring anchored within conduit
  - Installed new compliant sub-board (new electric switchboard from Cave Rock project used when that shelter was converted to solar)
  - Single pendant internal fitting replaced with bulkhead lights at each level (3)
  - Upgrade all four external existing damaged floodlights to new LED flood lights
  - Replaced damaged clear acrylic sheets to the top of the external floodlight boxes with new, thicker 15mm acrylic sheets
  - Added new galvanised grill on side of lightbox to prevent leaf ingress

Maintenance work undertaken

- Pre-construction moss treatment and clean
- Degraded materials
  - Roof ply and membrane
  - Repaired rotten and damaged wooden windows
  - Replaced one balustrade pole
  - Replaced waterproofing to tank roof
  - Replaced mastic at bottom of tank where it connects to concrete ring beam
  - Welding seams treated as part of the paint system
  - Window rings replaced
- Painting (note: no internal painting)
  - Wooden windows (external only)
  - Entrance doors and frames (touch-up only)
  - Tank
  - Facia board (at top of tank)
  - Steel and wood section to balustrades (top of tank)
- Entrance Doors
  - Installed strike plate
- Removed 20 tonnes of bird droppings from building and tank
- Applied "Hot Foot" product to steel bars of balustrades

3. REPAIR TECHNIQUES USED. EXTRACTED FROM THE "ENGINEERS DESIGN FEATURES REPORT"

Means of Compliance - Compliance with the New Zealand Building Code is to be generally via MBIE cited compliance documents, as follows:

(a) Clause B1, Structure

The design of the building has currently been undertaken in accordance with what we consider 'current engineering best practice'. Specifically, as follows:

- Minimum level of Building Code compliance
- All relevant cited Standards (including amendments) within B1/VM1
- Assessment of the strength of the existing structure
- NZSEE "Assessment and Improvement of the Structural Performance of Buildings in Earthquakes"
- Assessment of the stability of the existing structure
- NZSEE "Seismic Design of Storage Tanks:2009"

(b) Clause B2, Durability

Durability issues with regard to the structural elements, and within our scope of work are implicitly covered by our design using the referenced standards for B1 (Structure).

An example is concrete durability, which is addressed by providing adequate concrete strength and cover to reinforcement as specified in the Concrete Standard NZS 3101, and referred to as a compliance method in the section B2, cl 3.0 of the Building Code. Construction methodology - The length of the steel members has been sized to allow movement thru the door, with minimal site welding required to join the pieces together.

COMMENT ON ANY CORROSION OF STEEL REINFORCING

- Little found

COMMENT ON ANY DETERIORATION OF THE CONCRETE

- Little found

COMMENT ON ANY CONTINUING USE AS A WATER TANK

- Not in use as a water tank. An interesting fact is that the water tank had accumulated 20 tonnes of bird droppings that had to be removed.

THANKS TO THE CONTRACTORS, ARCHITECTS, ENGINEERS AND FUNDERS

- **Conservation Architect** – William Fulton, Fulton Ross Team Architects
- **Structural Engineer** – Mathew Gordon, Structex
- **Contractor** – Josh Simon, Simons Construction
- **Project Managers** – Insight Unlimited
- **Funders** – Insurer and Christchurch City Council

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