THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

ENGINEERING

QuakeCoRE
NZ Centre for Earthquake Resilience

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Preliminary update - Mw7.8 Kaikoura Earthquake

(16-17 November 2015, supplement to 15 November update)

Upper Part of South Island

Contents

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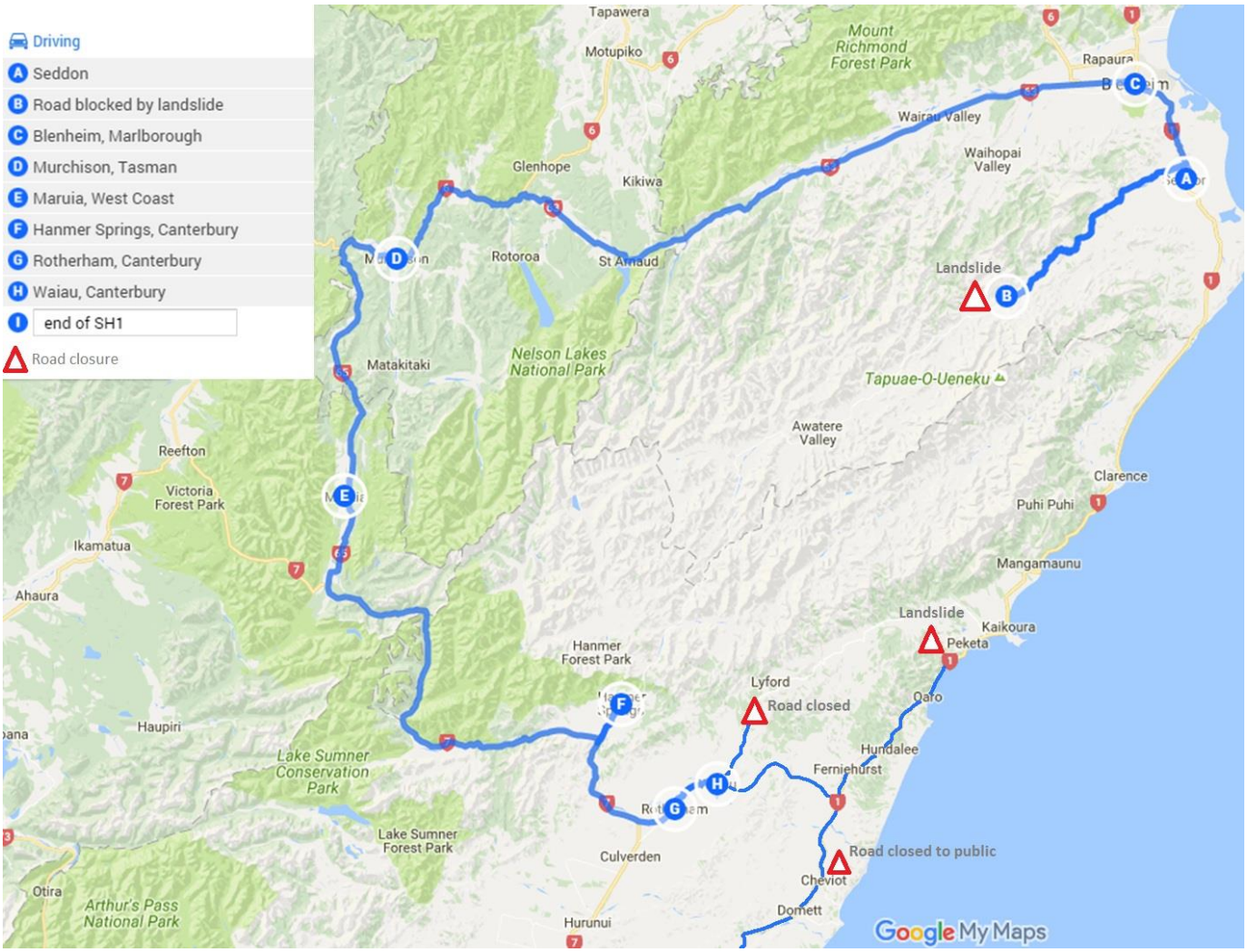
Preliminary update - Mw7.8 Kaikoura Earthquake

(16-17 November 2015)

Upper Part of South Island

This is a preliminary set of notes from observations made on 16 -17 November 2016 with the route taken is shown below.



State Highway 1 – Heading North of Cheviot

- Road closed to public from Cheviot onward, professional and roadwork personnel allowed further with permission.
- 4WD access to get through the stretch of road from Cheviot onward. The roadwork teams started to fill some of the larger crevasses and levelling smaller slips.
- Going south to north, just before Peketa (-42.449696, 173.575200) is the furthest possible accessible point before one gets to a large rock fall. Machinery started to nibble through but didn't get very far. One of the first tunnels (-42.458537, 173.549893) has been cleared and is passible with caution.
- Large slips along most of the road stretch along SH1 heading north of Cheviot.
- Large number of landslides and rockfalls.
- Large number of GPS tagged photos collected. More photos at http://www.eqclearinghouse.org/2016-11-13-kaikoura/maps-and-photos/photo-gallery/

Landslide into a creek below. State Highway 1, north of Leads Road

Movement of payment due to land sliding below

Significant damage to the road pavement and movement of retaining structure

Significant damage to the road pavement

Major movement of a retaining wall

Significant damage to the road pavement and railing

Major bulging of the road pavement due to land slip above

Significant road pavement deformation near SH1

End of the road – Attempts are being made to start removing the rock fall
(-42.449696, 173.575200)

Bridges

Bridge along Inland Road, open for emergency heavy vehicles. Major damage to the bridge structure, all columns showing signs of plastic hinges (-42.634382, 173.066299)

Buckling of the bridge side railing due to deck movements

Breaking of the railing supports due to significant displacements of the deck structure

Loosening of connections

Significant deferential movement of bridge girders

Hinging of bridge columns (see close-up)

Significant spalling at the base of column. Longitudinal reinforcing bar buckling

Significant spalling at the base of column (southern column). Longitudinal reinforcing bar buckling

Major settlement of abutments, Oaro overbridge #1790 (-42.512124, 173.506385)

Upto 1.0 meter of differential movement observed

Under bridge deck, visible hinging of the columns

Hinging at the top of column

Plastic hinging at the top of column

Signs of hinging at the column base

Signs of hinging at the column base

Lateral movement of the bridge abutment, not observed damage of the bridge structure (-42.513496, 173.506657)

Historic steel bridge originally constructed in 1887. No observed damage, open to all traffic (SH7A leading to Hanmer Springs) (-42.584195, 172.782635)

Movement of the Waiau River bridge #1842 deck and potential rotation of the pier (-42.655400, 173.033227)

Damage to the Waiau River bridge #1842 abutment (evidence of ground movement in the vicinity) (-42.655495, 173.031173)

Landslips and Rockfall

Cleared rock fall on SH70 towards Waiau

Land slide being cleared SH70 towards Waiau (by pass available)

Major rock fall on SH70

Example of typical rock fall on SH1, numerous cases along the stretch of road from Chevron to Kaikoura

Example of commonly observed landslides (photo taken along Leads Road)

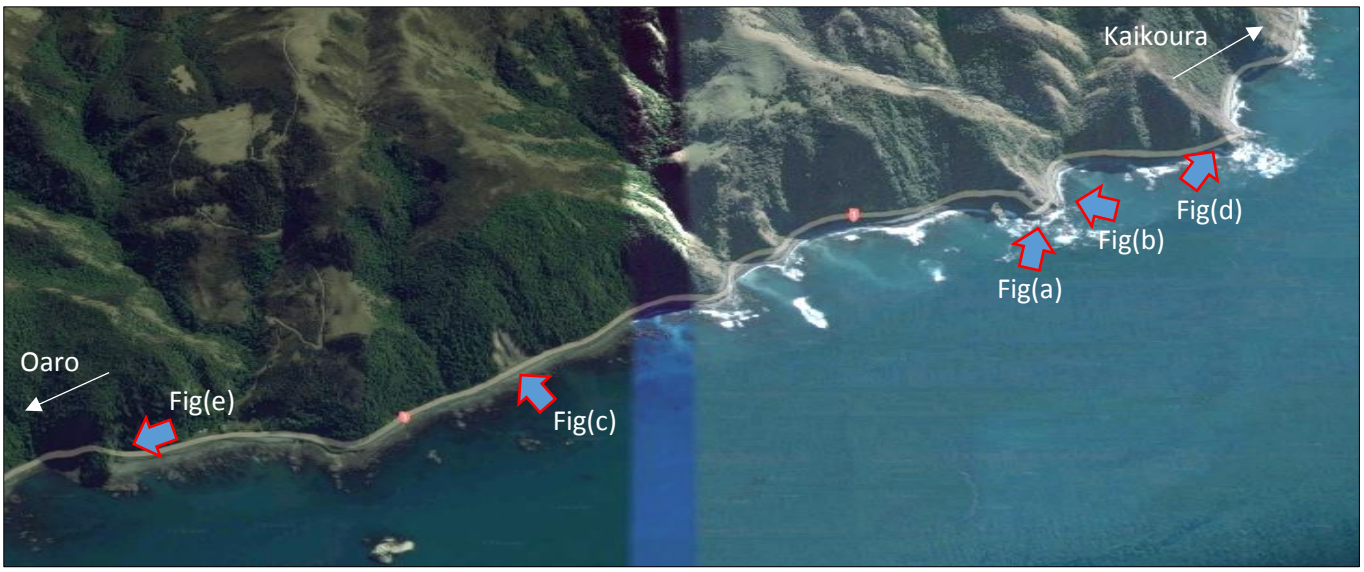
Example of commonly observed initiation of ground spreading (photo taken along Leads Road)

Example of commonly observed along Leads Road

Major rock fall on Leads Road

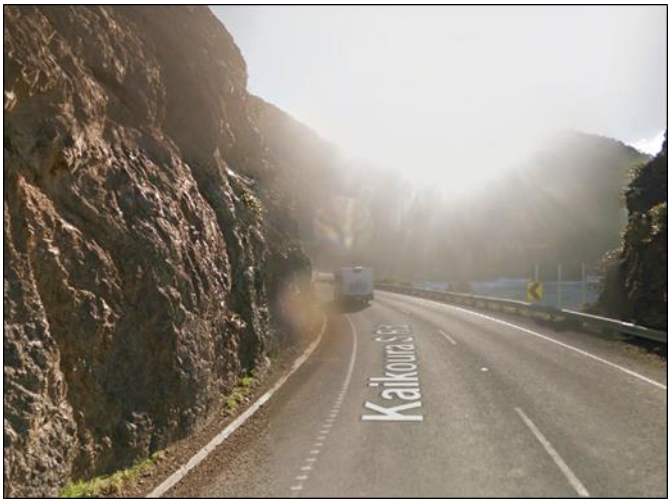
Major slide along SH1

Major rockfall near coast along SH1, near miss of residential dwelling



Aerial view of the coastal SH1 showing location of subsequent photographs

(a) Major rock fall over SH1



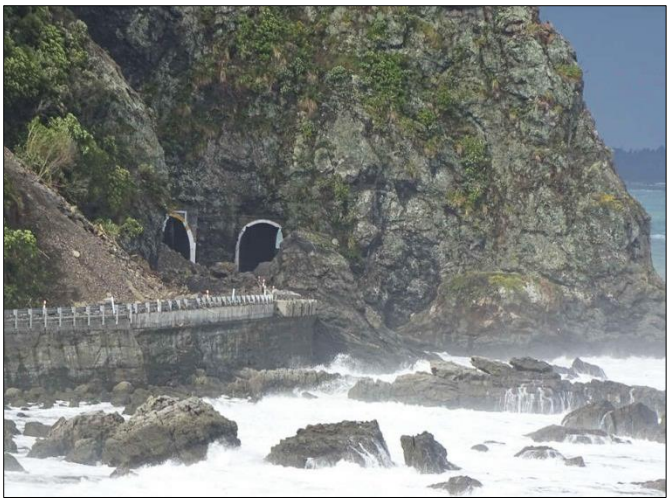
Pre-earthquake (Google street view)

(b) Mojor rock fall over SH1 – attmets were been made to partially cleared

Pre-earthquake (Google street view)

(c) Damge to retaining structure and rock fall protection system

Pre-earthquake (Google street view)



(d) Blockage of tunnel entry due to rock fall, looking south

Rockfall over SH1, looking north

Commonly observed rock rolling path. Multiple examples along SH 70 towards Waiau

Typical example of soil sliding – blocking railway lines and tunnel entry

(e) Entry tunnel blocked due to rock fall, looking south

Building Damage

Seddon

- Damage to non-structural elements – veneer
- Damage to non-structural elements – masonry chimneys. Seems that most of the masonry chimneys have been previously removed (or lowered at roof line) in the past.
- Damage to non-structural elements – ceilings
- In-plane damage to RC with in-fill masonry buildings
- Historic masonry buildings: The entrance arch of the **Seddon War Memorial** (1926) is damaged

Seddon War Memorial (1926) – no visible damage

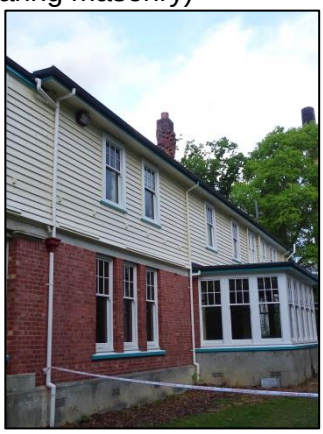
War Memorial entrance arch, significant damage

Hanmer Springs

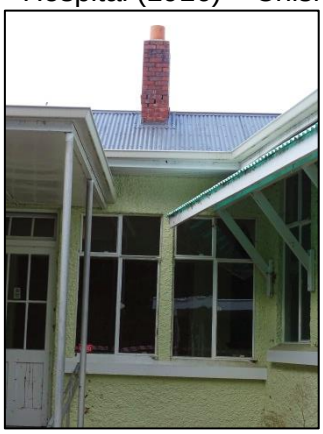
- Damage to non-structural elements – masonry chimneys
- Historic masonry buildings: Significant damage to chimneys at the **Queen Mary Hospital** (1916). No damage to loadbearing masonry walls.

Queen Mary Hospital (1916) – Nurses' Hostel (no damage to loadbearing masonry)

Clay brick cavity masonry building - Queen Mary Hospital (1916) – Chisholm Ward (no damage)



Nurses' Hostel – Chimneys damage



Chimneys – large concrete chimney appears to be undamaged

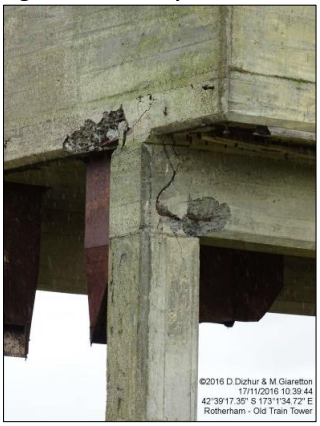
Rotherham

- Limited <u>damage to non-structural elements</u> – masonry chimneys and veneers
- <u>Historic buildings:</u> Chimney collapse and observed crack-pattern in the **Watters Cob Cottage** (1880ca.), heavy damage at the column base and column-to-beam joints in the **Old Train Tower**.

Watters Cob Cottage – minor damage and collapse of chimney

Watters Cob Cottage, internal view

Old Train Tower



Hinging of the column-to-beam joints

Column base detail

Waiau

- <u>Extensive damage to non-structural elements</u> – masonry chimneys and veneers.
- <u>Historic buildings:</u> Chimney collapse and extensive damage on the **Cob Cottage museum** (1860, red tagged) while the timber **Presbyterian church** (1888) is green tagged. Heavy damage with tilting of the bell tower in the **All Saints Church** (1924, red tagged). Chimneys collapse and extensive crack-pattern in the **Waiau Lodge Hotel** (1910, red tagged).

Cob Cottage museum (earth structure)

Cob Cottage museum – evidence of textile reinforced mortars used as retrofit

Damage to the Cob Cottage museum

Presbyterian Church – timber framed building with no damage

All Saints Church, stone and lightly reinforced concrete

Tilting of the bell tower (note significant settlement of tower foundation)

Close-up of the significant bearing failure of tower foundation

Significant cracking of corners and gable wall

In-plane damage

Interior view

Waiau Lodge Hotel, vintage concrete structure

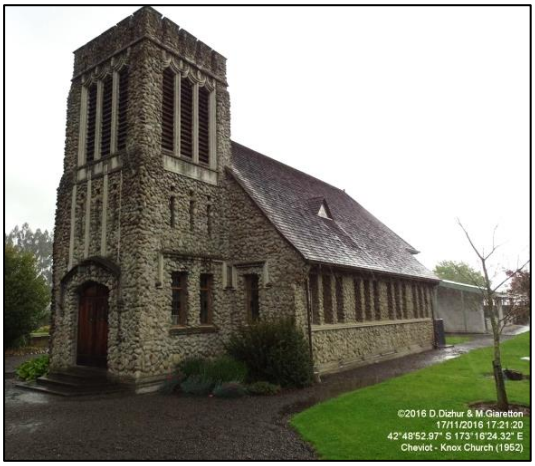
Horizontal cracking showing evidence of pier rocking

Cracking around widow openings

Partial collapse of chimney

Cheviot

- No visible damage was observed in the buildings (outside inspection only)
- Historic masonry building: **Knox Presbyterian Church** (1952), no visible damage was observed (external inspection only).



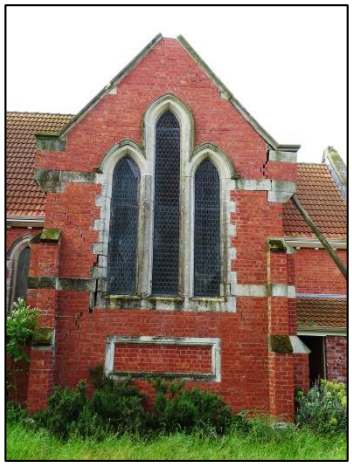
Knox Presbyterian Church, stone and concrete with no damage observed

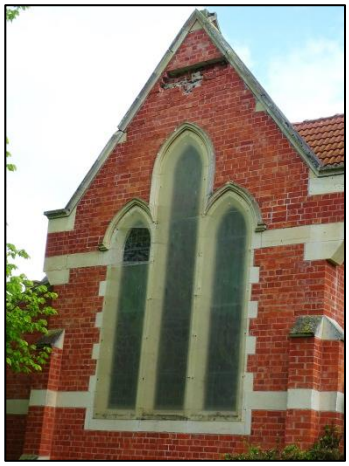
Knox Presbyterian Church – rear view with no observed damage

Waipara

- Historic masonry building: **Glenmark St Paul's Church** (1906), diffuse earthquake damage that seems to be dated prior the 14/11/16 Kaikoura Earthquake (external inspection only).

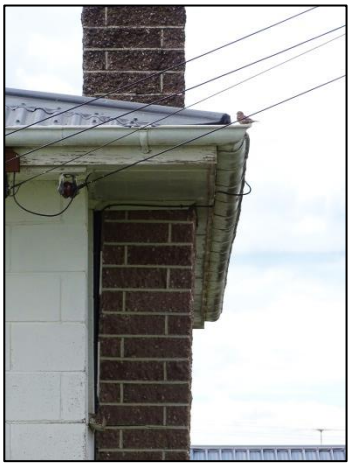
Glenmark St Paul's Church – damaged also following the 2010/2011 Canterbury earthquakes





In-plane damage and gable end walls

Non-Structural Elements – Chimneys



Out-of-plane detachment of the chimney stack, Seddon

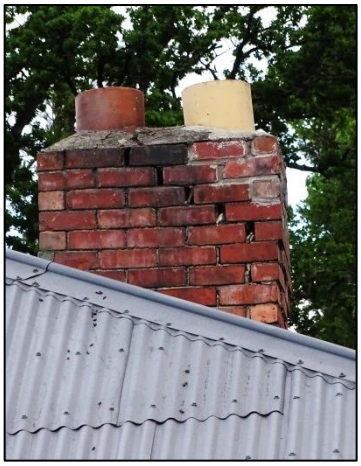
Example of removed chimney, Seddon

Example of removed chimney, Seddon

Horizontal crack at the chimney base and torsion, Hanmer Springs

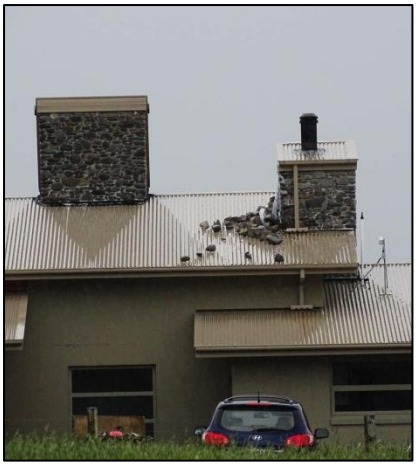
Horizontal crack at the chimney base and sliding, Hanmer Springs

Extensive dislodgment of the bricks, Hanmer Springs

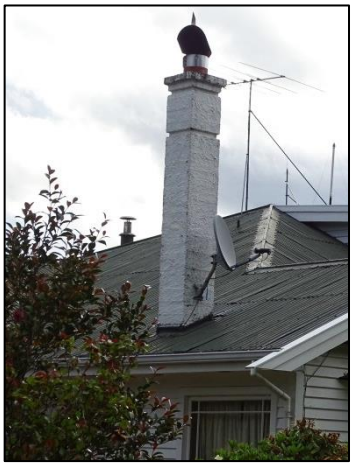


Dislodgment of the bricks, Hanmer Springs

Collapse, Hanmer Springs



Local collapse of one of the chimneys of a recent buildings, Hanmer Springs



Non-damaged tall chimney, Hanmer Springs

Non-damaged tall chimney, Rotherham

Vertical crack-pattern, Waiau

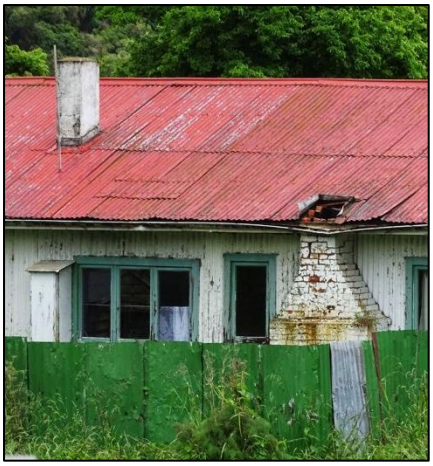
Inward collapse, Waiau

Full collapse, Waiau

Collapse of the chimney stack, Waiau

Waiau

Waiau



Oaro

Non-Structural Elements – Veneers

Out-of-plane collapse, Seddon

Close-up

Ties

Recently constructed veneer building, Seddon

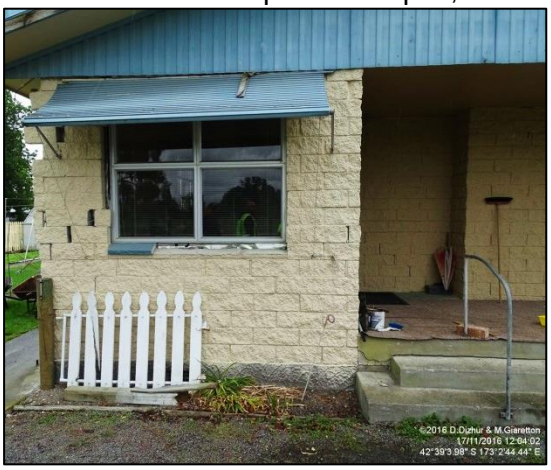
Out-of-plane collapse

Ties

Detachment at the top of the veneer wall and initiation of out-of-plane collapse, Seddon

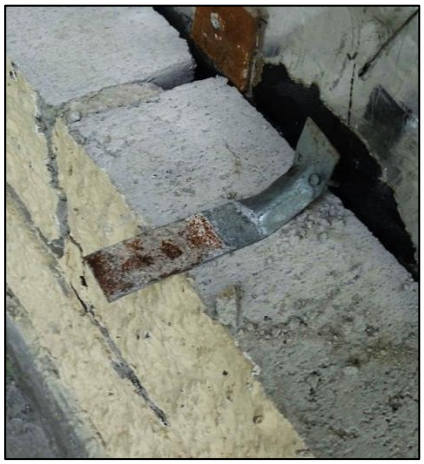
Dislodgement of the veneer blocks, Seddon

Torsion of the top part of the column, Seddon



Significant damage to veneer dwellings, Waiau

Heavy solid veneer cladding blocks



General lack of used ties

Corner damage and collapse of large veneer panels, Waiau

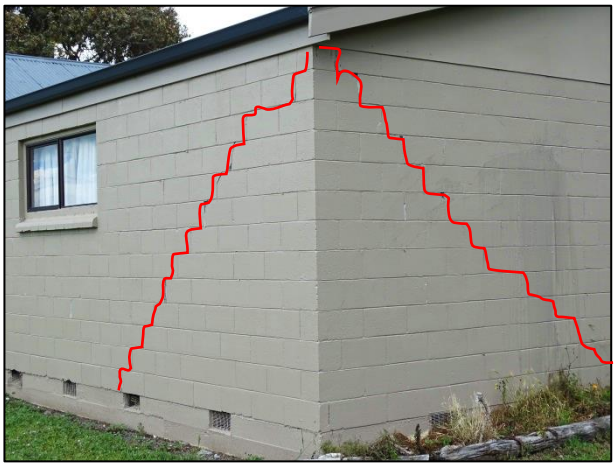
Collapse of large veneer panels, Waiau

In-plane and out-of-plane damage to veneer, Waiau

Collapse of moder brick veneer system, Waiau

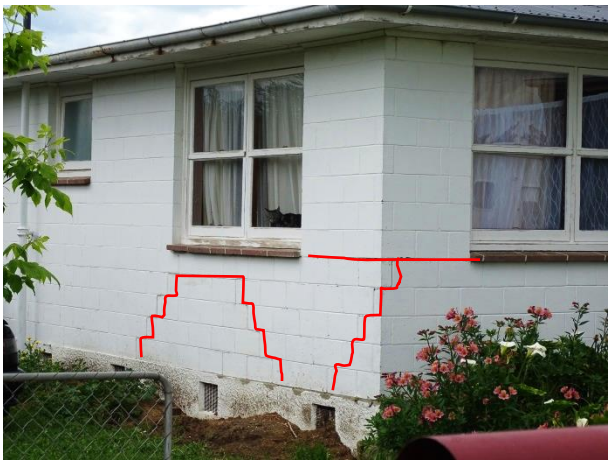
Collapse of moder brick veneer and chimney, Waiau

Other-Structural Damage



Concrete blocks building, corner damage, Seddon

Dislodgement of the concrete blocks and close-up, Seddon



Concrete blocks building, corner damage, Seddon

Concrete blocks building, corner damage, Seddon

Concrete blocks building, out-of-plane collapse, Waiau

Concrete blocks building, extensive cracking and dislodgment of the blocks, Waiau