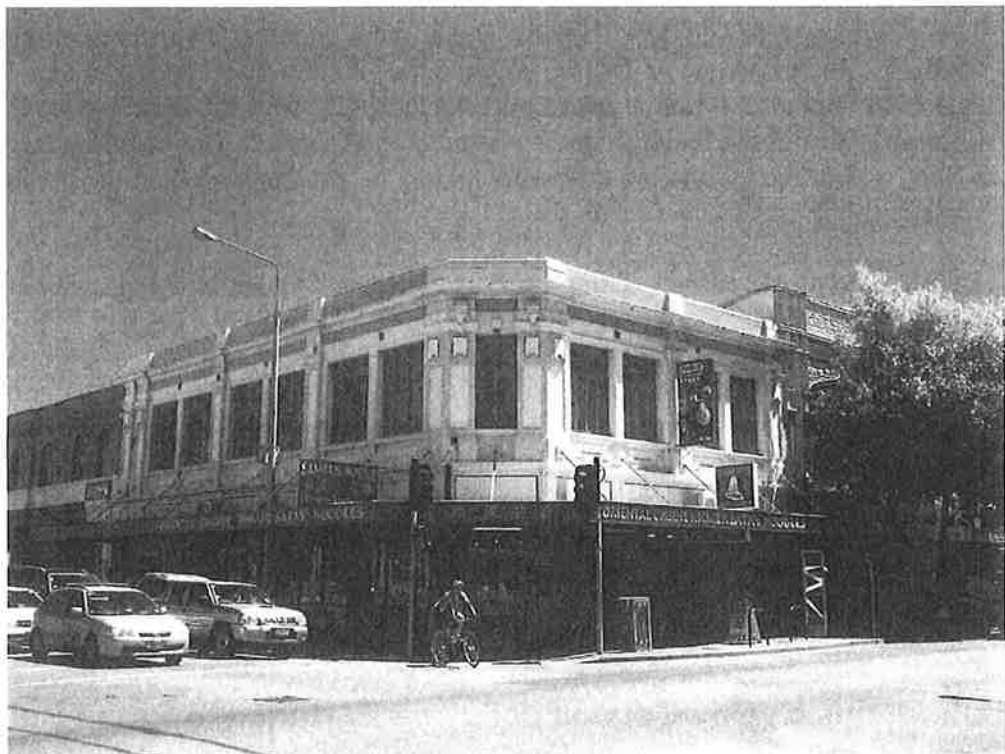


**INDEPENDENT ASSESSMENT ON EARTHQUAKE PERFORMANCE
OF
617 to 625 Colombo Street**

**FOR
Royal Commission of Inquiry into building failure
caused by the Canterbury Earthquakes**

**Report prepared by Peter C Smith and Jonathan W Devine
OF
Spencer Holmes Ltd**

November 2011



Introduction

This report has been commissioned by the Royal Commission of Inquiry into building failure caused by the Canterbury Earthquakes to review the performance of the building at 617 to 625 Colombo Street, Christchurch during the Canterbury earthquake sequence.

The report is based on documentation provided by the Royal Commission of Inquiry into building failure caused by the Canterbury Earthquakes. No inspection of the building was undertaken prior to the building being demolished.

Location of Building

The building 617 Colombo Street was located on the corner of Colombo Street and St Asaph Street. The building had the addresses of 143 Tuam Street, 623 and 625 Colombo Street. The building was constructed with common party walls with the buildings 627 and 629 Colombo Street.

The location of the buildings in the Christchurch CBD are shown on the aerial photograph of Christchurch included in Appendix 1.

Description of Building

The buildings at 617 to 629 Colombo Street are a series of two storey unreinforced masonry buildings. The buildings on the sites 617 to 625 Colombo Street appear to have been constructed as a single building which is interconnected integrally with the buildings on sites 627 and 629 Colombo Street, each building sharing common party walls. The buildings are constructed with a light weight roof supported on timber trusses in turn supported on the perimeter by masonry walls.

The street frontages of the buildings to Tuam Street and Colombo Street are relatively open.

Compliance

The building is recorded as having had few alterations other than the strengthening work since construction. Stage 1 strengthening of the buildings 617 to 629 Colombo Street was undertaken in 1994 with Stage 2 strengthening being undertaken in 2000. The Christchurch City Council records indicate that the buildings complied with the requirements of the Building Act 1991 due to the building pre existing the Building Act, the strengthening having been approved by the Christchurch City Council and no other alterations or change of use occurring since the introduction of the Building Act 1991.

Christchurch City Council policy on Earthquake Prone Buildings

We understand that the Christchurch City Council applied and was granted powers under Section 301A of the Municipal Corporations Act and that the Christchurch City Council adopted a generally passive approach to the upgrading of earthquake risk buildings.

On 23rd March, 1982 the Christchurch City Council wrote to the building owners advising that as the building was being scaffolded, it may be an appropriate time to consider the structural

stability of the building and its appendages. The letter indicated that if the owner did not take advantage of this opportunity, they should advise the Council in writing of their intentions in regard to the future of the building. There is no further correspondence provided in respect of this matter.

The Christchurch City Council undertook a Seismic Risk Building-Survey on the 28th November, 1991. The building was assessed as a building classification A earthquake risk building with a score of 15. The assessment noted a cracked parapet (horizontally), numerous horizontal crack through columns and that a significant proportion of the ground floor elevation was plate glass with little shear resistance. The Building Classification A required immediate action.

A Hazardous Appendage-Survey was undertaken by the Christchurch City Council on the 19th May, 1992. The survey identified that the two storey office building had horizontal cracking in the parapets. The Christchurch City Council appear to have communicated the likely earthquake prone nature of the building to the owner when work was undertaken on the building and recommended that the owner obtain an engineers assessment of the building. The Christchurch City Council appear not to have followed up on the recommendation.

The Christchurch City Council records indicate that stage 1 seismic strengthening was undertaken in 1994 and stage 2 in 2000. Stage 1 strengthening provided lateral load resistance to 0.075g. Our interpretation of the correspondence is that on completion of the Stage 2 strengthening the building would achieve a lateral load resistance of 0.14g. All work appears to have been completed to the Christchurch City Council requirements and there appears to be no outstanding compliance issues. The Christchurch City Council records that stage 2 of the seismic strengthening was undertaken in September, 2000.

In a Project Information Memorandum dated 23 November, 2009 the Christchurch City Council comment "Due to changes in the definition of Earthquake Prone Buildings in the Building Act 2004, Council's current records do not fully identify all buildings which may be potentially earthquake prone. The effects of this change is that buildings built prior to 1976 may now need to be assessed against the requirements of the Building Act 2004, requiring building strength to be one third of the current building code. Consent applicants may be asked to engage a structural engineer to assess the building to determine if the building is above the earthquake prone standard as specified in the Building Act Regulations and to provide this information with any consent application to the Council. Note: Prior strengthening work may no longer be sufficient to comply with the Building Act 2004".

In building consent ABA 10097109 for a shop fit out there is a note that upgrading is not required as "value of work is less than 25%". We assume this to be a trigger adopted by the Christchurch City Council for strengthening of earthquake prone buildings.

The Christchurch City Council's first policy in respect of earthquake-prone, dangerous and insanitary buildings policy was introduced in 2006.

This policy was reviewed in early 2010.

Events Subsequent to 4th September 2010 Earthquake

A Rapid Assessment -Level 1 of Sampan House at 617 Colombo Street on the 5th September, 2010 identified cracking to the parapet and broken glazing to the north elevation. The building

was assigned a green placard and the overall building damage was assessed at between 2 and 10%.

A Rapid Assessment- Level 2 was undertaken on the building 617 Colombo Street (143 Tuam Street) on the 7th September, 2010 which identified some minor cracking to walls. The inspection recommended a green placard G2 and assessed the damage between 0 and 1%. The report recommended inspection of the upper level and repair of cracks in the brick walls. The assessment allowed occupancy before repair.

On 15 September, 2010 Beca undertook a visual inspection of 625 Colombo Street. As a result of this inspection, a Rapid Assessment-Level 2 form was completed by Beca and submitted to Christchurch City Council. The Rapid Assessment-Level 2 was delivered to the Civil Defence emergency response team and resulted in the posting of a green G2 (Occupiable, repairs required) placard. The assessment noted the observed hazards/damage being the cracking to the internal blockwork walls. A subsequent visit to inspect the party wall between 623/625 and 627 Colombo Street (from 627 side), revealed a number of cracks within the wall which were not evident from 623/625 Colombo Street. No cracking was observed from ground floor level. The walls were lined with plasterboard and soundproofing material at first floor level preventing inspection of the masonry wall.

The building at 625 Colombo Street is recorded as having suffered little damage in the 4th September, 2010 earthquake. The Rapid Assessment-Level 1 records some broken glass at upper ground floor level; the building was given a green placard with an estimated overall building damage of 0 to 1%. The rapid assessment noted cracking to the parapet and broken glazing to north elevation. The Rapid Assessment-Level 1 is noted as covering the Silk Road Food Post tenancy in Colombo Street.

Beca prepared a report for The Best Little Law House Ltd in December, 2010. Following an inspection of the buildings Beca concluded

1. "The buildings do not pose an immediate risk to their occupants, however repairs will be required to the damaged walls and to prevent further collapse to the masonry parapets.
2. Preliminary Assessment of Existing Lateral Load Capacity using the Initial Evaluation Procedure (IEP) has been undertaken. The IEP is an approximate estimation of the lateral load capacity of **11% NBS**.
3. These buildings are therefore considered to be earthquake prone. Since the estimated level of lateral load resistance of the overall structure in its current form is <33%NBS there is a requirement to bring the building up to a higher standard.
4. The buildings **do not** have a heritage listing in the Christchurch City Plan and the properties **are not** listed by the New Zealand Historic Places Trust."

There is no recorded damage to the buildings as a result of the 26th December 2010 earthquake.

As a result of the 22nd February, 2011 earthquake, the front façade of the buildings 623 to 629 Colombo Street collapsed into Colombo Street. The roof partially collapsed and the brick party walls and internal walls were damaged. The Rapid Assessment-Level 1 undertaken on the building 625 Colombo Street on 26th February, 2011 recommended demolition. (NOTE: This relates to building 623 to 625 Colombo Street).

The building at 143 Tuam Street was identified as having a damaged parapet and the building was assigned a yellow placard after the 22nd February, 2011 earthquake. The building was

initially assessed at an estimated overall building damage of 11 to 30%, which was reduced soon after to 2 to 10%. A Rapid Assessment-Level 2 was undertaken on 617 Colombo on 18th March, 2011. This assessment identified moderate damage to the access stairs to the upper level and to the façade to the neighbouring building. The building was confirmed as a yellow placard Y2, requiring detailed engineering evaluation with an estimated overall structural building damage of 2 to 10%. The assessment noted issues with shared access with the neighbouring building that is likely to require demolition-needs to be resolved. Parapet needs to be made secure.

On 9th April, 2011 the building was given a red placard. Concern was held for the safety of the parapet at the north-east corner of the building at 143 Tuam Street.

Beca reported to the owner on the 6th May, 2011. Beca expected the building 625 Colombo Street to be demolished. It appears that Beca considered the condition of the building 617 Colombo Street to be worthy of further assessment. The building has subsequently been demolished.

Structural Failure

The failure of the Colombo Street façade to the buildings at the sites 623 and 629 Colombo Street appears to have been an outward rotation of the first floor facades and parapet about the first floor support. (Refer photos appendix 3)

The code lateral load coefficient for a façade to an elastic responding structure in Christchurch at the time of the earthquake sequence was 0.86g. The analysis of un-reinforced masonry construction is not covered in the NZ Building Code. The industry uses the New Zealand Society for Earthquake Engineering guidelines “Assessment and Improvement of the Structural Performance of Buildings in Earthquakes” 2000 and Assessment and Improvements of Un-reinforced Masonry Buildings for Earthquake Resistance” 2011. Calculations using these documents indicate that a 225mm thick un-reinforced masonry wall spanning 3m from first floor level to roof level in an un-reinforced masonry building, assuming no edge restraint, would meet code requirements. Based on GNS Science records of measurements of accelerations in the Christchurch CBD during the 22nd February, 2011 earthquake, the buildings were likely to have been subjected to a ground accelerations of 0.9g. This level of ground acceleration equates to a 1.25g acceleration at first floor level. The analysis assumes no vertical acceleration occurs when the wall is subjected to the horizontal acceleration. Clearly the walls to St Asaph Street and Colombo Street have significant penetrations which affect both the weight and strength of the façade. The above figures demonstrate that the facades may not have survived the Canterbury earthquake sequence had the facades been secured at roof level by fixings designed for the then full code requirements.

The facades which were restrained to a lateral load coefficient as low as 0.14g, were unlikely to remain stable in the severe shaking that occurred during the 22nd February, 2011 earthquake, although the level of securing did prevent failure of the facades to the buildings 143 Tuam Street and 623-625 Colombo Street.

Issues Arising from Review

Upgrading of un-reinforced masonry buildings

The front façades of the buildings 623 to 629 Colombo Street collapsed into Colombo Street as a result of the 22nd February, 2011 earthquake. The roof partially collapsed and brick party walls and internal walls were damaged. It is significant that end buildings of a series of interconnected

un-reinforced masonry buildings of similar height at 593, 601A, 603 Colombo Street lost their street facades and were significantly damaged in the 22nd February, 2011 earthquake while the street facades to the strengthened building 617-621 Colombo Street were retained, presumably as a result of the strengthening work undertaken on the building. The reason for the failure of the strengthened facades to the buildings at 623 to 629 Colombo Street is unknown, but was not unexpected given the low level of seismic strengthening and the severity of shaking during the 22nd February, 2011 earthquake.

The retention of the façades to the buildings 617- 621 Colombo Street demonstrates the benefit of strengthening to as low as 20% of current code requirements while the failure of the street facades to the buildings 623 to 629 Colombo Street highlights that strengthening of the facades of un-reinforced masonry buildings to such a low level is unreliable in a severe earthquake. This level of strengthening may however save lives in a moderate earthquake.

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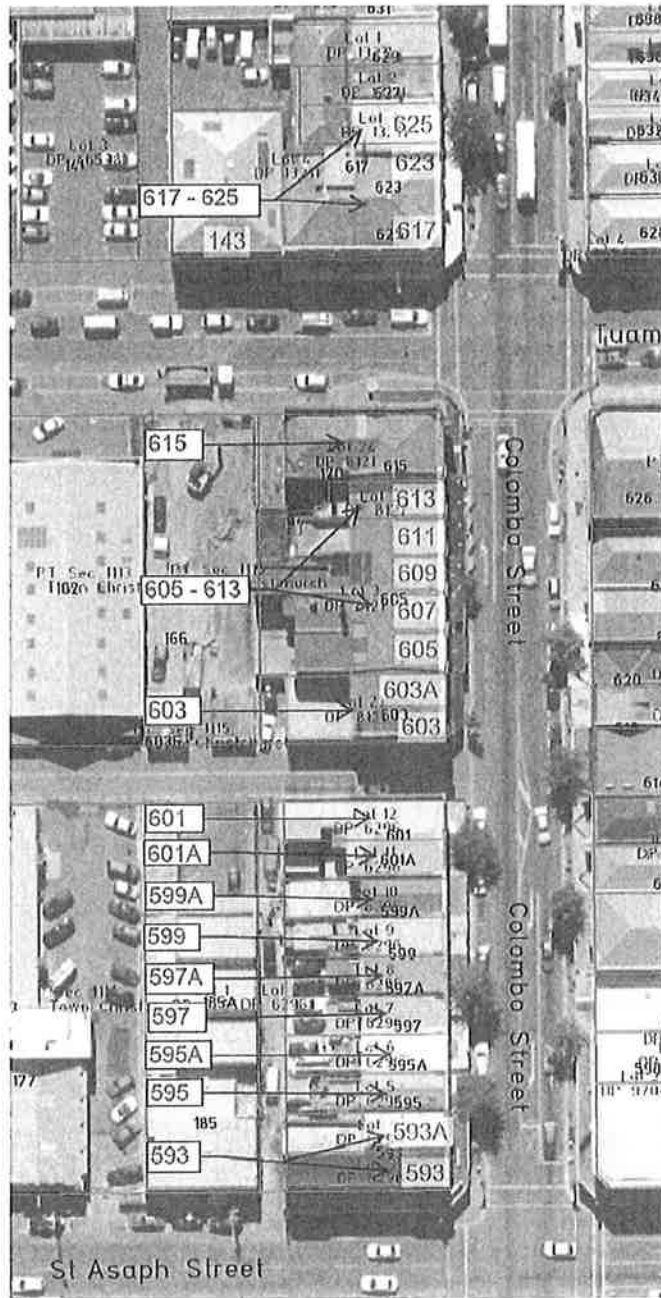
Report Reviewed By:

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APPENDIX 1

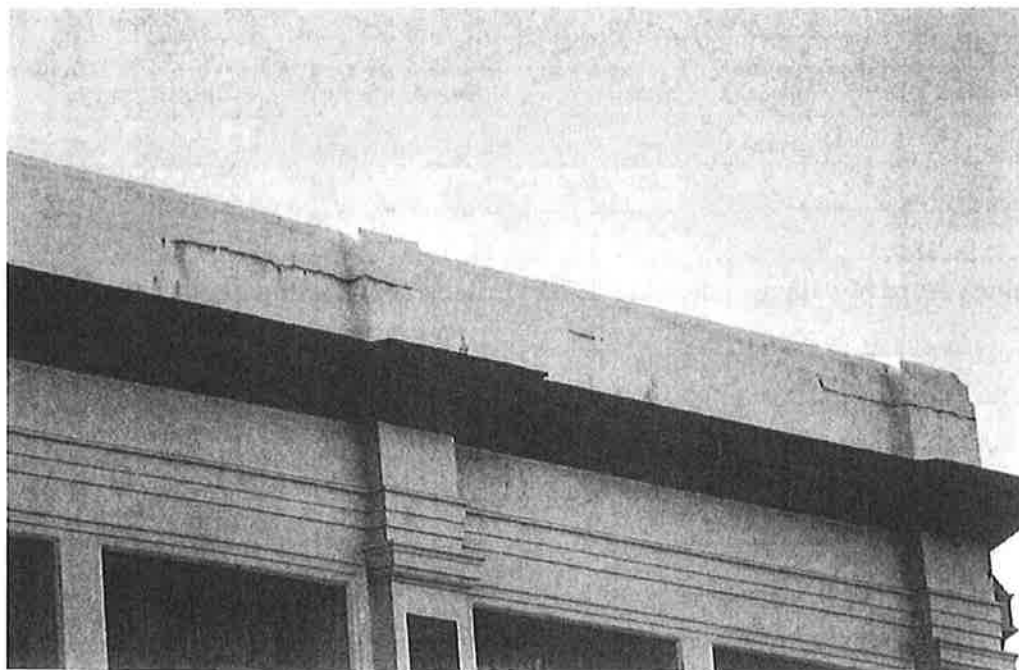
Site Plans





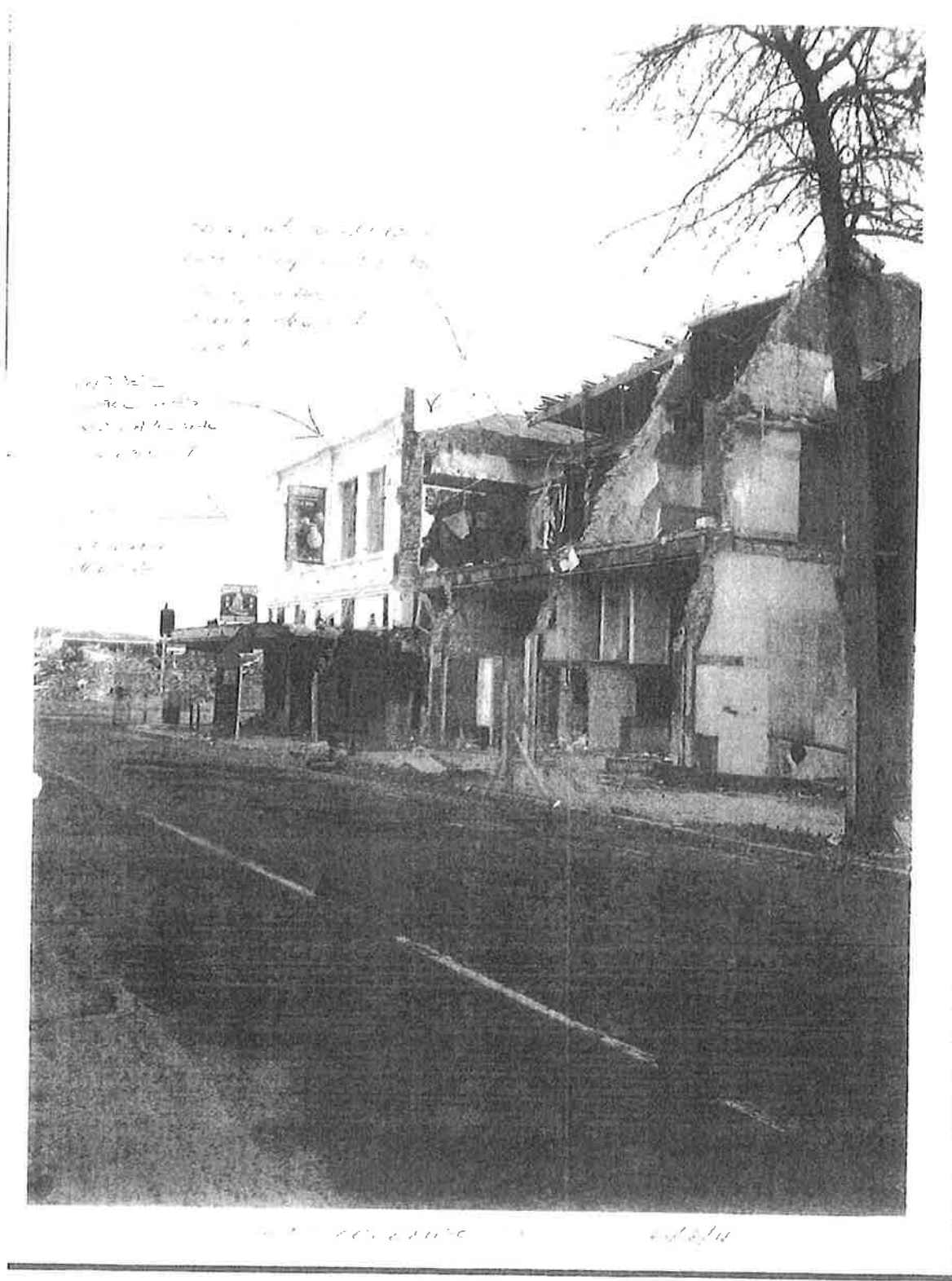
APPENDIX 2

Parapet damage prior to Canterbury earthquake sequence



APPENDIX 3

Photographic record of damage following 22nd February 2011 earthquake



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