

**INDEPENDENT ASSESSMENT ON EARTHQUAKE PERFORMANCE  
OF**

**605 - 613 Colombo Street  
605 – 607 Khmer Satay Noodle House  
609 – 613 Kiwi-Disposables**

**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 buildings at 605 - 613 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. There was no opportunity to inspect the buildings prior to the buildings being demolished.

## Location of Building

The buildings at 605 to 613 Colombo Street were constructed as part of a pre 1935 multi-title development on the west side of Colombo Street between Mollett Street and Tuam 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 on the properties 605 to 613 Colombo Street were part of an integral development. The development had a consistent façade along the Colombo Street frontage and each unit shared a common party wall with the adjoining units. The width and façade of the end units were visually different to the façade of the other units. The units had timber floors with the roofs supported on timber framing in turn supported on the un-reinforced masonry party walls. The Colombo Street frontages of the properties were very open at ground floor level and relatively open at first floor level.

Building permit records show that the first floor joists ran east-west between heavy steel beams which spanned between the unreinforced masonry party walls. The floor joists were also supported on a heavily penetrated un-reinforced masonry wall at the rear of each shop and on the 2-24 inch RSJ beams at the front of each shop. The masonry wall along the street frontage was supported on 2-24 inch RSJ beams. Due to the presence of the party walls between individual shops, the buildings originally had substantial strength in the east-west direction and were considerably weaker in the north-south direction.

## Compliance

The buildings were altered over the period 1945 to 1959 by removal of sections of the party walls. This work was consented by the Christchurch City Council.

In 1994 the Christchurch City Council processed building consent documentation for a fit out for the Khmer Satay Noodle House. It appears that the Christchurch City Council were satisfied that the Khmer Satay Noodle House fit out was not a change of use under the Building Act. The remaining documentation indicates that the building complied with the requirements of the Building Act due to the building pre-existing the Building Act.

## 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 passive approach to the upgrading of earthquake prone buildings.

The Christchurch City Council carried out a Hazards Appendage-Survey on 30<sup>th</sup> November, 1992. The survey identified the “Heavy parapet-note crack along the top of the parapet”. A Seismic Risk Buildings-Survey assessed the building as a building classification type B with a score of 14 requiring remedial action within 2 years. The results of the Seismic Risk Building-Survey in January, 1993 do not appear to have been communicated to the owner.

The Christchurch City Council did however communicate the likely earthquake risk/prone nature of a building to the owner when work was undertaken on the building in 1982 and recommended that the owner obtain an engineer’s assessment of the building at that time. On 14<sup>th</sup> December, 1982 the Christchurch City Council wrote to the owner of the building at 605 Colombo Street advising that the alterations proposed, were assessed as improving the value of the property and extending its economic life. The Council advised that “The Christchurch City Council had been empowered by Order in Council to administer Section 624 of the Local Government Act 1980, which provides the power for older buildings such as yours - constructed of load-bearing masonry or un-reinforced concrete, to be required by the Council to be secured against sudden collapse in a moderate earthquake”. The Council advised that the building permit requested by the tenant would not be issued until a report prepared by an independent registered consulting engineer examines the compliance of the building with the requirements of Section 624. A similar letter was sent to the tenant on 16<sup>th</sup> December, 1982. We are unable to find any further correspondence in respect of this issue and are uncertain as to whether the work involved in the building permit proceeded.

Subsequently, on the 20<sup>th</sup> October, 2005 the Christchurch City Council wrote to The building owner Benson Chen Holdings Ltd advising that a building consent was being processed for an alteration to the building and that “Council considered that, due to its age and construction type, the building is likely to be earthquake prone in terms of Section 122 of the Building Act 2004. Under this provision, Council may require the hazard to be removed by demolishing or strengthening the building.

Council appreciates that the exercise of their powers under this section of the Act could have significant cost implications that you may not have anticipated. It is also noted that the proposed alteration to the building will not significantly affect the structure of the building, and that no change of use to the premises is proposed.

Council will therefore not require you to take action on this matter at this time. However, you are advised that any future building consent applications for the premises, or any formal change to Council’s policy under the Act may initiate a request for an engineering report on the structure and subject to the report findings, a commitment by you as the building owner to an acceptable programme for strengthening.” This letter appears to relate to the Building Consent of 11<sup>th</sup> October, 2005. There is no documentation that establishes that the Christchurch City Council took any further action.

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 4<sup>th</sup> September 2010 Earthquake

The buildings suffered minor damage in the 4<sup>th</sup> September, 2010 earthquake. The Rapid Assessment-Level 1 survey undertaken on the 5<sup>th</sup> September, 2010 identified minor parapet cracks in the back wall. Properties 605-613 Colombo Street were assigned a green placard.

Buchanan and Fletcher inspected the buildings on the 14<sup>th</sup> September, 2010 and reported to insurers on building damage. On the 5<sup>th</sup> November, 2010 Buchanan and Fletcher were appointed by the insurers to carry out further visual inspections of the buildings 605-611 Colombo Street, and advise on temporary measures that needed to be taken if the building was to be continued to be occupied. The engineers required propping of the front edge of the verandah to reduce tension loads on upper brick walls and minimise the risk of the east wall being pulled into Colombo Street. The engineers advised that “Once propping complete, building will be adequate for occupation”.

On 12<sup>th</sup> October, 2010, Mainland Claims Management Ltd advised the insurers that “the damage is more extensive than originally thought and the area at the front of the building is considered dangerous to public”. On the 16<sup>th</sup> October, 2010 Mainland Claims Management Ltd, notified the insurers that the entire front wall was leaning out to Colombo Street and getting worse. They advised insurers that the engineers are saying that the un-reinforced brick cannot be repaired and demolition is the only option”.

On 22<sup>nd</sup> October, 2010 Mainland Claims Management wrote to Buchanan & Fletcher Ltd advising “We are most concerned regarding the cracks and condition of the building given that there is a restaurant below serving the public as well as the retail store to the left. Would you please revisit this property and advise if you believe there is anything further that can be done in the meantime to hold the front wall back or is there any prospect for repair of this building and if so, please prepare a scope of work to enable the works to be quoted and commence. As there is some urgency in this matter, we would appreciate your urgent attention”.

Buchanan & Fletcher reported on 5<sup>th</sup> November, 2010. “There did not seem to be any new cracks in the cross walls near the east frontage. However, the existing cracks appear to have widened since our first inspection. Above the roof there is clear evidence that the east wall has separated from the cross walls at each end of the building with a gap of in excess of 20mm.” Buchanan and Fletcher recommended that the east wall and parapet be tied back to the cross walls”. On 23<sup>rd</sup> November, 2010 sketch details of the strengthening work were received from the engineers. On 30<sup>th</sup> November, 2010 Mainland Claims Management Ltd requested Buchanan & Fletcher to arrange a quote from builders for the tie back. On 13<sup>th</sup> December, 2010 a quote was received from the builders. Insurers gave approval for the temporary repair to be undertaken.

The buildings suffered further damage as a result of the Boxing Day aftershock. The Rapid Assessment-Level 1 records that the front façade was leaning out and that the parapets above roof line appeared to have separated viewed from the other side by the Fire Department hoist. The Rapid Assessment-Level 1 noted that the building needs to be checked from the upper floor interior in the out of plane direction of the façade and indicated that the estimated overall building damage was 2 to 10%. The building was given a red placard. The Christchurch City Council wrote to the owners on 28<sup>th</sup> December, 2010 advising that the building was dangerous and issued a Section 124 (1) (b) Building Act 2004 notice. The Section 124 (1) (c) issued by the

Christchurch City Council on the 28<sup>th</sup> December, 2010 recorded that Council records show that the parapets above the roof line appear to have separated from the cross walls.

Remedial work only appears to have been undertaken to the property 615 Colombo Street. The remedial work restrained failure of the façade of 615 Colombo Street in the 22<sup>nd</sup> February, 2011 earthquake.

On 13<sup>th</sup> January, 2011 the engineers were requested to re-inspect the building. On 17<sup>th</sup> January, 2011 the engineers reported to Mainland Claims Management Ltd on the additional damage sustained to the building advising that an urgent decision on the fate of the building was needed to be made. On 9<sup>th</sup> February, 2011 the Christchurch City Council noted that the Section 124 notice expired on 31st January, 2011 and they requested a new engineering assessment on work to progress removing of the dangerous aspects of the building. On 20<sup>th</sup> February, 2011 Mainland initiated action to prepare for demolition of the building.

On 13<sup>th</sup> January, 2011 Mainland Claims Management Ltd emailed the owner advising that “as you are aware the building is leaning out over Colombo Street and there is a danger”. On 17<sup>th</sup> January, 2011 Mike Fletcher, the engineer, emailed Peter McLeod advising “separation between the east Colombo Street (walls and the cross walls) has definitely worsened since our last inspection on 2<sup>nd</sup> December, 2010. At the south end where the separation is biggest, there is now a gap of 50 to 60mm. The separation gets worse as you move from the north to south along the building but there are now signs of separation at every cross wall. The securing work we designed earlier, could still be carried out but more and or longer steel straps might now be required. The extent of mortaring and re-pointing of brickwork required will definitely have increased. We confirm that the Khmer Satay Noodle House should not be occupied unless the securing work is carried out. It is currently ok to occupy the Kiwi Disposal tenancy but this should be monitored daily. If there is any significant increase in cracks or gaps, contact this office immediately. It is now becoming urgent a decision is made to either secure or demolish the building”.

Mike Fletcher has advised that on the 17<sup>th</sup> January, 2011 the Khmer Satay Noodle House was not occupied but the Kiwi Disposables tenancy at 611 Colombo Street was still operating. On 21<sup>st</sup> January, 2011 the owners advised the Christchurch City Council that they had engaged engineers and were waiting on the engineers report. A Christchurch City Council re-inspection on 2<sup>nd</sup> February, 2011 identified that no evidence of work had been carried out. “The canopy propped accept that parapet and façade have moved. No roof access available so no assessment beyond previous report was possible”. The assessment commented under “Protection fencing required” with a question mark.

On 21<sup>st</sup> January 2011, Peter McLeod records in an email that “All went well on site until Robert mentioned the name of heritage buildings. Mike Fletcher says that this designation of a commercial property is a can of worms for decision makers so it may be awhile before any approval to demolish can be made. More later, Mike is back next week”. On 20<sup>th</sup> February, 2011 Peter McLeod had advised the building owner that they were preparing for demolition of the building in the near future.

On 22<sup>nd</sup> February, 2011 the building was badly damaged with the upper level front façade of 605-613 Colombo Street failing. The Rapid Assessment-Level 1 identified that the entire block was considered as one structure and that the building was badly damaged.

The entire block was demolished by 14<sup>th</sup> March, 2011.

## Structural Failure

There is evidence of vertical cracking of the masonry party walls close to the front façade following the 4<sup>th</sup> September, 2010 earthquake. This cracking widened in the subsequent aftershocks. The first floor façade of the buildings failed by an outward rotation of the façade about the first floor supporting beams in severe shaking during the 22<sup>nd</sup> February, 2011 earthquake.

The alterations in 1945 to 1959, although significant, do not appear to have contributed to the failure of the Colombo Street façade of the buildings.

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 22<sup>nd</sup> February, 2011 earthquake, the buildings are likely to have been subjected to a horizontal ground acceleration of 0.9g. This level of ground acceleration equates to an acceleration of 1.25g at first floor level. The front walls to Colombo Street have significant penetrations which affect both the weight and strength of the façade. The above figures act as a guide to demonstrate that the facades may not have survived the Canterbury earthquake sequence even if the facades had been adequately secured at roof level.

In an unsecured condition the failure of the facades was almost inevitable in the severity of shaking that occurred on 22<sup>nd</sup> February, 2011.

## Issues Arising from Review

### Rapid Assessments

There are limitations in the Rapid Assessment-Level 1 inspection, undertaken solely on the exterior of the building, as a means of assessing damage to an un-reinforced masonry building in a significant earthquake. The risk of collapse of un-reinforced masonry buildings, in whole or in part, from a significant aftershock, justifies a greater level of inspection and assessment prior to re-occupancy or public access near un-reinforced masonry buildings following a significant earthquake.

The Rapid Assessment process focuses on damage caused to the building by the recent earthquake. The process assumes that the risk that existed before the earthquake is acceptable in the period following the earthquake providing the building has only limited damage. Historically aftershocks have caused lesser levels of shaking than the initial earthquake. The Canterbury sequence of earthquakes has tragically identified the potential for an aftershock with an epicentre closer to a developed area to subject that area to more severe shaking than the initial earthquake. On the information available, the engineer undertaking the Rapid Assessment-Level 1 from the exterior of the building would not have been aware of the damage present inside the building.

It is suggested that all un-reinforced masonry buildings should be subject to a Rapid Assessment-Level 2 prior to occupancy or public access within the fall zone of the building.

### **Occupancy of Dangerous Buildings**

There is evidence that the Khmer Satay Noodle House and Kiwi Disposable tenancies were being occupied when there was known damage at the connection of the front façade to the party walls. It also appears that there were inconsistencies in the assignment of placards to the buildings 605-613 Colombo Street, but insufficient information is available to review the basis on which the placards were assigned. There is particular concern that the Christchurch City Council allowed the Kiwi Disposable tenancy to operate until mid January, 2011 after assigning a red placard to the building 605 Colombo Street on the 28<sup>th</sup> December 2010. It is suggested that greater care is needed in assigning placards so that consistent placards are provided to all entries to ground floor tenancies and the entry to any upstairs tenancy after a significant earthquake.

Buchanan and Fletcher commented on the 14<sup>th</sup> September, 2010 “recommend propping of front edge of verandah to reduce tension loads on upper brick walls and minimise risk of east wall being pulled into Colombo Street. Once propping complete, building will be adequate for occupation”.

On the 22<sup>nd</sup> October, 2010 Mainland Claims Management commented “We are most concerned regarding the cracks and condition of the building given that there is a restaurant below serving the public as well as the retail store to the left. Would you please revisit this property and advise if you believe there is anything further that can be done in the meantime to hold the front wall back or is there any prospect for repair of this building and if so, please prepare a scope of work to enable the works to be quoted and commence. As there is some urgency in this matter, we would appreciate your urgent attention”.

We are concerned that the Colombo Street façade was known to be inadequately restrained soon after the 4<sup>th</sup> September, 2010 earthquake and yet the ground floor tenancies were occupied and Colombo Street was not cordoned off within the potential fall zone of the inadequately restrained front façade. During the period of increased seismicity that occurs following a significant earthquake and in the knowledge of the deteriorating condition of the street façade, there is concern that the owners advisers and the Christchurch City Council did not consider that the buildings 605-613 Colombo Street should be assigned a red placard and Colombo Street cordoned off. The situation was compounded with the involvement of the insurer after the owner had lodged a claim and was awaiting confirmation of appropriate action from the insurer before undertaking securing works. It is important that all parties adequately address the safety of the public in the vicinity of a building until the building is isolated, strengthened or demolished.

Fortunately earthquakes are rare events. As advisers are not experienced in making assessment of damaged buildings in a period following a significant earthquake, it is suggested that more comprehensive briefing of advisers undertaking such assessments is needed in order to achieve an acceptable level of public safety. In particular it is suggested that the owner and owners representatives need to advise the territorial authority in the event that they become aware of any inconsistency between the displayed placard and the actual condition of the building.

### **Protection of the public and public spaces**

Tragically the Canterbury earthquake sequence has highlighted the danger to the public of inadequately restrained street facades to many un-reinforced masonry buildings. The 22<sup>nd</sup>

February, 2011 earthquake demonstrated the need for greater caution in the occupancy and access in the vicinity of un-reinforced masonry buildings following a significant earthquake.

In the absence of strengthening, the failure of many street facades of un-reinforced masonry buildings was almost inevitable given the severity of shaking that occurred on 22<sup>nd</sup> February, 2011. There is a need to adequately secure the upper level walls of un-reinforced masonry buildings, particularly the facades of buildings, which present a fall hazard over public spaces or adjoining buildings. These buildings pose a serious risk to the public and those that work in or near the building in the event of a significant earthquake. It is suggested that such a requirement should be a priority under territorial authority earthquake prone building policies.

### **Upgrading of un-reinforced masonry buildings**

The buildings forming the western side of Colombo Street from Mollett Street to 615 Colombo Street were constructed as a comprehensive development. All buildings had un-reinforced masonry walls, and timber floors supported off steel beams and a rear un-reinforced masonry wall. The damage that occurred to the buildings in the 22<sup>nd</sup> February, 2011 earthquake demonstrates the risk that un-reinforced masonry buildings pose to the occupiers of the building and people in the vicinity of the buildings at the time of such an event.

The Building Act provides two opportunities for the structural upgrading of buildings. These opportunities are:

- upon a change of use
- implementation and enforcement of an earthquake prone building policy.

Improved public safety in a significant earthquake relies on territorial authorities adopting and implementing meaningful programmes for strengthening and upgrading of un-reinforced masonry buildings and enforcing the provisions for structural upgrading when a building is subject to a change of use.

Records show that the Christchurch City Council were aware of the earthquake prone condition of the building in 1991. The delay in the Christchurch City Council implementing a policy on earthquake prone buildings and the removal or securing the parapets to buildings along the street frontages is unfortunate.

The perception that Christchurch was a low seismic hazard area and local attitudes to heritage were undoubtedly influences in the Christchurch City Council not adopting a proactive policy on earthquake risk, and subsequently earthquake prone buildings prior to being required to under the Building Act 2004.

### **Heritage considerations**

The Canterbury series of earthquakes have been devastating to the retention of heritage buildings in Christchurch. The buildings 605-613 Colombo Street had been identified by the Christchurch City Council as having heritage merit. The owners and insurers experienced frustration in obtaining consent to demolish the buildings once the dangerous condition of the façade was identified. The delays in approving the demolition consent by the Christchurch City Council due to heritage concerns is understandable, but in creating such delays, it is important that the cordoning of public spaces around the building be given priority until the hazard is removed.



**Barriers**

The building at 605 Colombo Street is recorded as being assigned a red placard after the Boxing Day earthquake. There seems to have been uncertainty as to the extent of the buildings 605-615 Colombo Street that were intended to be included under the red placard.

It would appear that the Christchurch City Council did not provide barriers with the intent of protecting the public from a failure of the damaged Colombo Street façade to and safely beyond the fall zone of the first floor façade and parapet. After a significant earthquake, the risk of an after shock is high and controlling authorities need to recognise the risk of failure of building facades to un-strengthened un-reinforced masonry buildings if a repeat of the tragic loss of life that occurred on the 22<sup>nd</sup> February, 2011 is to be prevented. This would require barriers to be erected to isolate beyond the full extent of the potential fall zone of un-strengthened un-reinforced masonry buildings following a significant earthquake when there is a risk of a significant aftershock. This is particularly important when the building has been assigned a red placard.

**Report Prepared By:-**

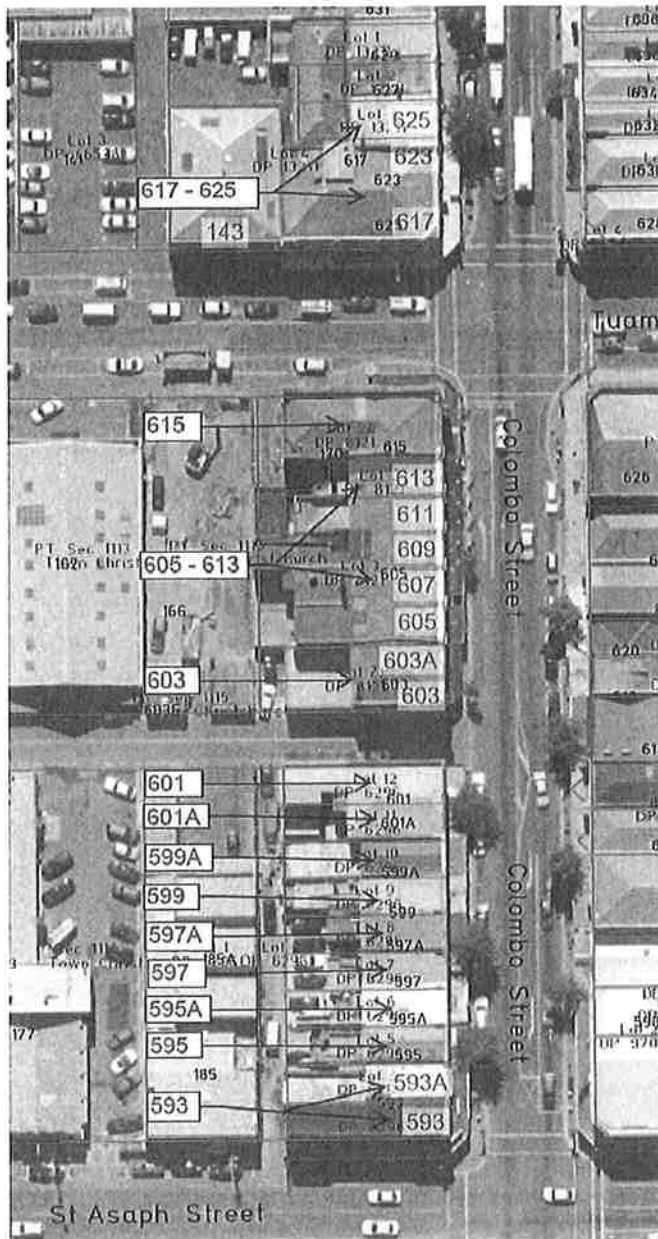
**Peter C Smith**  
BE, FIPENZ, CP Eng IntPE  
**Director**

**Report Reviewed By:**

**Jon Devine**  
BE(Hons) ME (Civil) CP Eng IntPE  
**Director**

## **APPENDIX 1**

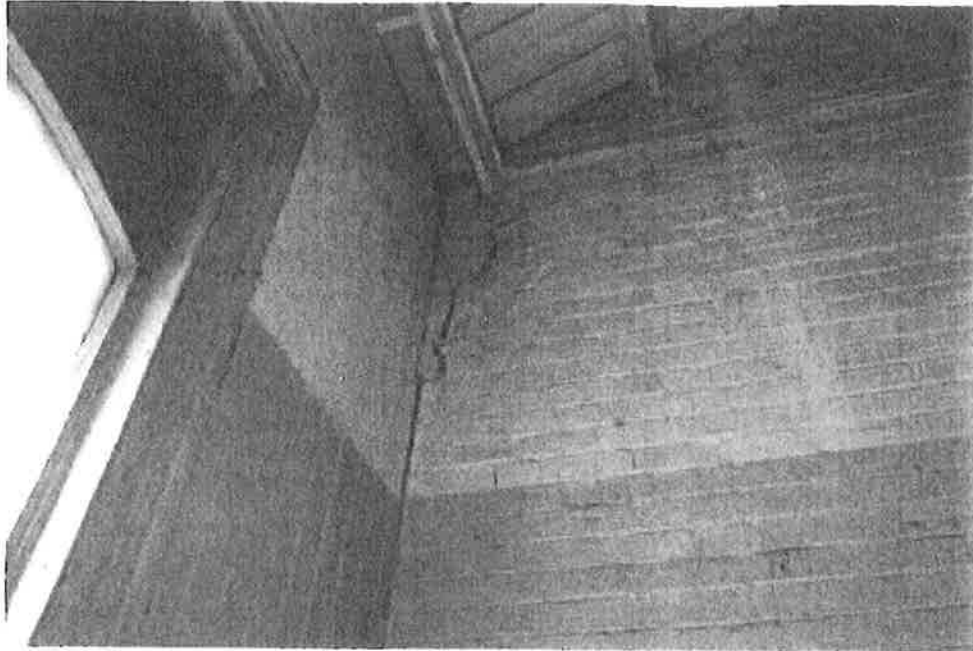
### **Site Plans**

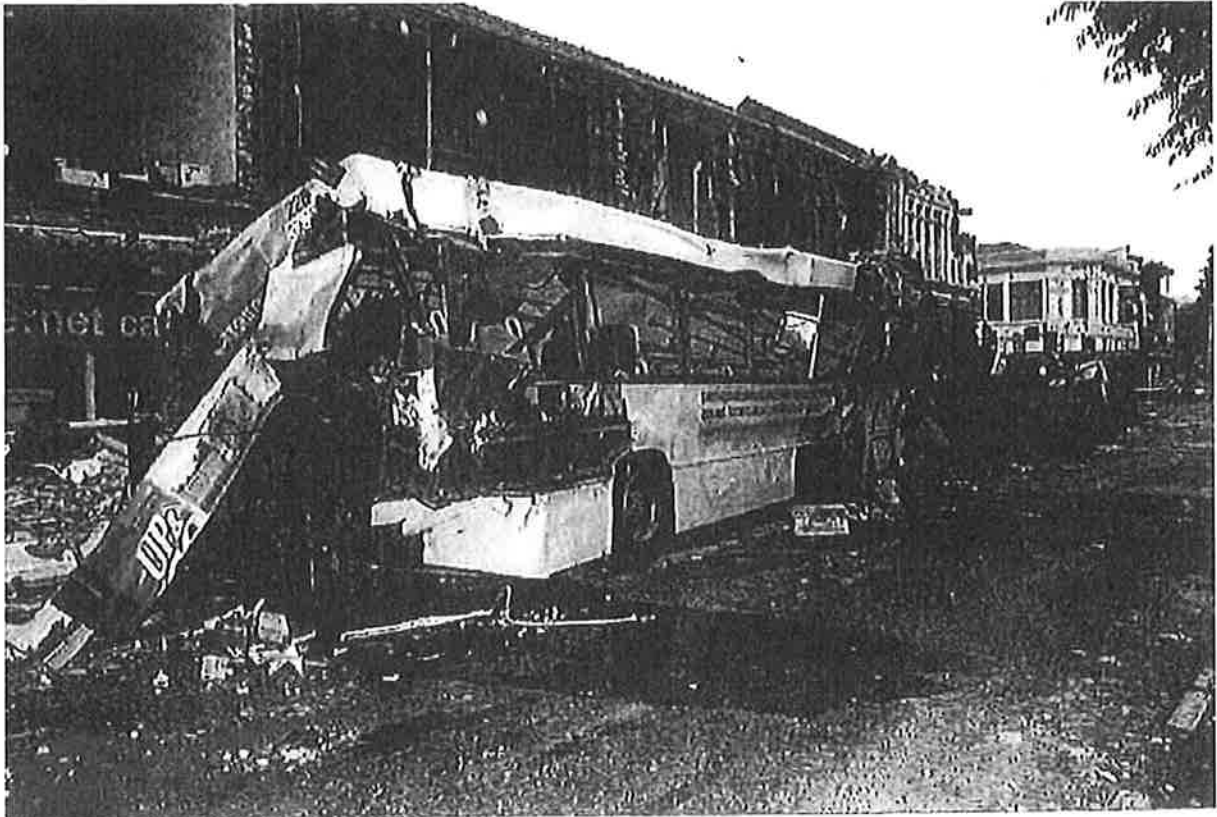




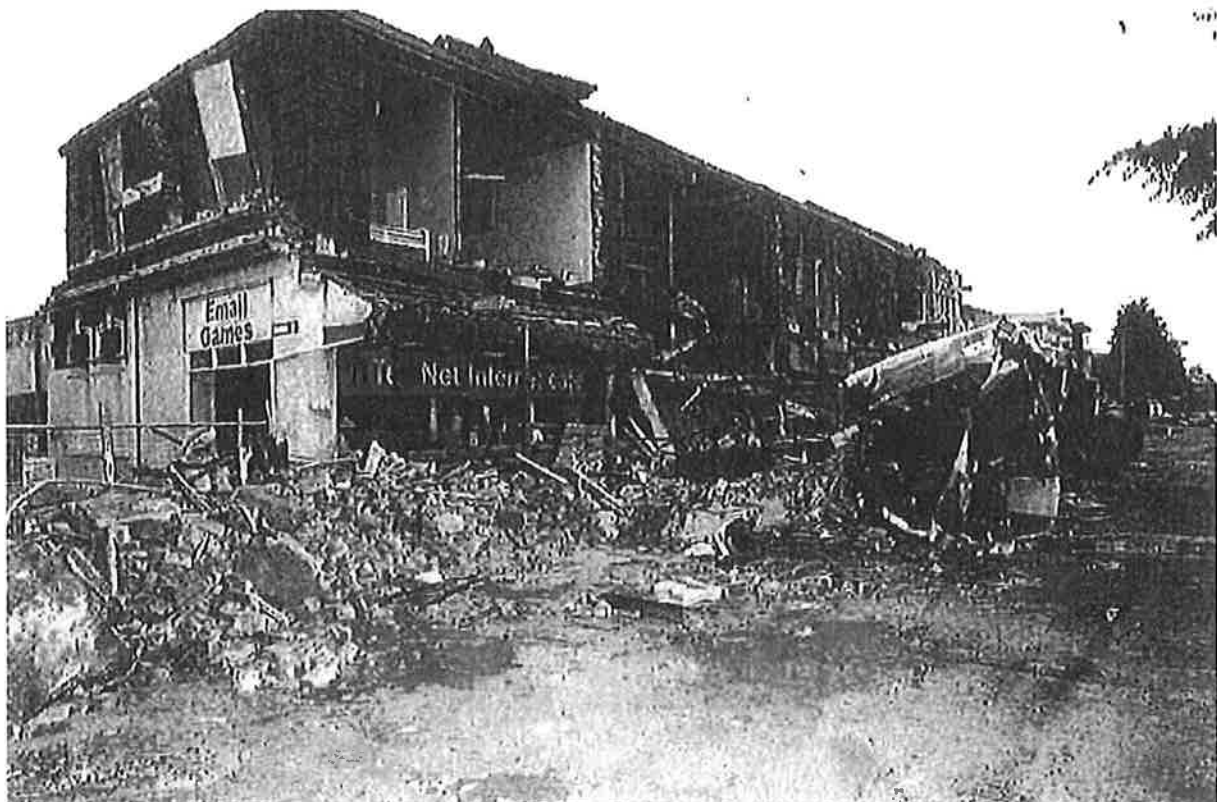
## **APPENDIX 2**

### **Records of damage following 4<sup>th</sup> September 2010 earthquake**





24



25