

**INDEPENDENT ASSESSMENT ON EARTHQUAKE PERFORMANCE
OF
753 - 759 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**

December 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 753-759 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 possible before the buildings were demolished.

Location of Building

The buildings were located on the west side of Colombo Street between Armagh Street and Gloucester Street. The location of the buildings in the Christchurch CBD is identified in the site plan in Appendix 1, together with the direction of the epicentre of the main earthquakes.

Description of Building

The buildings at 753-759 Colombo Street were two storey buildings with external walls constructed of un-reinforced masonry. The buildings had a light weight roof with timber roof framing and timber first floor. The building façades were ornate and well maintained.

The buildings had significant openings to the ground floor street frontage and the upper storey portion of the Colombo Street frontage was also heavily penetrated. The buildings had reasonably high parapets to the Colombo Street frontage.

Christchurch City Council record that the buildings were constructed in 1905. The buildings had heritage and historic places status.

Compliance

Christchurch City Council records indicate that the building at 759 Colombo Street was strengthened to Christchurch City Council requirements in 1996. We understand that the adjoining premises at 753 to 757 Colombo Street were not strengthened.

A review of the Christchurch City Council records indicates that the buildings complied with the requirements of the Building Act 1991 due to the buildings pre existing the Building Act and the alterations in 1996 complying with the Christchurch City Council requirements.

Christchurch City Council Policy on Earthquake Prone Buildings

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

The Christchurch City Council undertook a Seismic Risk Building-Survey on the buildings 753-757 Colombo Street on the 22nd November 1991. The buildings were rated with a score of 16 which resulted in the buildings being A classification earthquake risk buildings. Under the proposed seismic risk building survey, an A classification was to require immediate action. The survey noted the parapets as hazards and under appendages it noted *“large cornice/ cracked*

several architectural stones (lintels etc). Also noted on the form was "C.C.C Advised strengthening 31/10/79. No BP No or correspondence to confirm strengthening was conducted: assume no work done."

A Hazardous Appendage Survey identified

<i>Parapet</i>	<i>Large >1m</i>
<i>Chimney</i>	<i>Hazardous, cracking-significant</i>
<i>Loose Masonry</i>	<i>Significant</i>
<i>Mortar deterioration</i>	<i>Significant</i>
<i>Cracking</i>	<i>Significant</i>

The form commented "2-3 storey (One of the worst examples in Christchurch). Significant mortar deterioration in joints in large cornice approx 500mm(O/H). Significant mortar deterioration in parapet and on parapet capping stone. Very hazardous. See Photos. Probably an area of the heaviest pedestrian traffic in central Christchurch."

The Christchurch City Council, City Engineers Department wrote to the owners of the building 753 Colombo Street (Assumed to be 753-759) on 11th April 1994 advising that the Christchurch City Council believed the building to be earthquake prone in terms of S66 of the Building Act and that no building consents would be issued for the building until the owner satisfactorily addressed this matter.

We understand that the buildings at 751-759 were in one ownership. The building 759 Colombo Street was damaged by fire in 1999 and the ground floor of the tenancy 759 Colombo Street was strengthened in 1999 with the installation of two concrete frames below first floor level in the north-south direction and diaphragm strengthening to the first floor. The strengthening was designed to the requirements of the NZ National Society for Earthquake Engineering Draft Guidelines for Assessing and Strengthening Earthquake Risk Buildings. (Feb 1995) Refer design features report in Appendix 2. The building consent application is dated 14th October, 1999, the Building Consent was issued on 19th November, 1999 and a Code Compliance Certificate was issued on 10th April, 2000.

The records of strengthening work indicate that strengthening was limited to the installation of 2 reinforced concrete frames within the building 759 Colombo Street. (Often referred to as 753)

In a Conservation Covenant (Pursuant to Section 77 Reserves Act 1977) the Christchurch City Council undertook to pay the Church Property Trustees, as owners of the property, \$35,000.00 as a contribution to the seismic upgrading of the 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

The buildings at 753-759 Colombo Street appear not to have been significantly damaged in the 4th September, 2010 earthquake. A Rapid Assessment-Level 1 was undertaken on the 5th September, 2010 which assigned the buildings a green placard. The Rapid Assessment-Level 1 recommended that the parapets and corbels required a detailed inspection.

On the 9th September, 2010 there is a record of Lewis Bradford having completed a brief inspection of the buildings 753, 755, 757 and 759 Colombo Street.

Lewis Bradford commented;

753 Colombo Street

I have not seen anything structurally that would indicate the building structure has been compromised. There is a chimney above this property that has some cracks in it, the chimney is not in immediate danger of falling however I would recommend that it be removed in the near future. Following this inspection it would appear that structurally there is no reason this building cannot be occupied.

755 Colombo Street

I have not seen anything structurally that would indicate the building structure has been compromised. There is a chimney above this property that has some cracks in it, the chimney is not in immediate danger of falling however I would recommend that it be removed in the near future. Following this inspection it would appear that structurally there is no reason this building cannot be occupied.

757 Colombo Street

There is some damage to an insitu concrete wall at the rear of the building and will require strengthening. The insitu concrete wall has also pulled away from a masonry wall and will need to be structurally tied together. As the building is currently not tenanted these works do not need to be completed immediately, however they will need to be completed before the building is re-tenanted.

759 Colombo Street

I have not seen anything structurally that would indicate the building structure has been compromised. Inspection within the roof space indicates that this part of the building may have previously been seismically strengthened. Following this inspection it would appear that structurally there is no reason this building cannot be occupied.

On the 8th October, 2010 Lewis Bradford reported to Church Property Trustees on the condition of the tenancy 757 Colombo Street;

Structural Damage

Flexural cracking of an insitu concrete column has occurred at the rear of the building. Repair works will involve a skilled tradesmen epoxy grouting these cracks. It is recommended that contact be made with Jeff Hawker at Sika for the most appropriate repair method.

Separation has occurred between the blockwork exterior and insitu concrete walls at the rear of the property. Repair works will involve a skilled tradesmen installing a 150x10mm EA at the top of the wall, 2-M16 Hilti HIT-HY150 anchors are to be used to fix the EA to each wall.

Two chimneys located on the roof of the building have suffered cracking due to the recent seismic activity. They are not in immediate danger of falling however it is recommended that they be removed as part of the repair work to 757 Colombo Street. The contractor is responsible for the reinstatement of all waterproofing to these areas.

Conclusion

Apart from the points raised above there are no apparent issues with this building, which appears to be in good condition for its age.

The buildings appear not to have been damaged in the 26th December, 2010 earthquake.

The buildings suffered significant damage in the 22nd February, 2011 earthquake. A rapid assessment – Level 1 was undertaken on the 12th March, 2011 which identified that the upper storey façades had collapsed. T. M. Consultants inspected the buildings and reported on the 22 March, 2011 that the buildings were not structurally safe to occupy.

We understand that the buildings have subsequently been demolished.

Structural Failure

Although we were unable to inspect the buildings prior to demolition, we have been able to review photos of the damage prior to demolition. From the photographs it would appear that the front façades above window head level rotated outwards from the support at the window head level, collapsing onto the footpath in Colombo Street.

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. Based on GNS Science records of measurements of accelerations in the Christchurch CBD during the 22nd February, 2011 earthquake, the building was likely to have been subjected to a ground accelerations of 0.9g. This level of ground acceleration equates to an acceleration of 1.25g at first floor level. The above figures demonstrate that the partially secured facade could not be expected to have withstood the severity of shaking that occurred on the 22nd February, 2011.

Issues Arising from Review

Upgrading of un-reinforced masonry buildings

The buildings at 753 - 757 Colombo Street had not been significantly altered since construction. The building at 759 Colombo Street has been strengthened as part of fire reinstated the premises. The damage that occurred to the buildings in the 22nd February, 2011 earthquake demonstrates the risk that un-reinforced masonry buildings pose to the occupiers of un-reinforced masonry buildings and people in the vicinity of un-reinforced masonry buildings at the time of a severe earthquake.

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.

Protection of public spaces

Tragically the Canterbury earthquake sequence has highlighted the danger to the public of inadequately restrained street facades to many earthquake prone buildings. The 22nd February,

2011 earthquake demonstrated the need for greater caution in the occupancy and access in the vicinity of earthquake prone buildings following a significant earthquake.

There is a need to adequately secure the upper level walls of earthquake prone 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.

Consideration should be given to prioritising the strengthening and upgrading of parapets, facades and other elements that have the potential to cause loss of life in public spaces and adjoining buildings in a significant earthquake.

Rapid Assessments

The Rapid Assessment process focuses on damage caused to the buildings by the recent earthquake. The process assumes that the risk that existed before the earthquake is acceptable in the period following the earthquake, providing only minor damage has occurred to the buildings. 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. There would appear to be a need for a central authority to assess the likelihood of a severe aftershock following any significant earthquake (say Richter magnitude 6 and above) and determine the minimum strength requirements for occupancy of un-reinforced masonry buildings in the period immediately following a significant earthquake.

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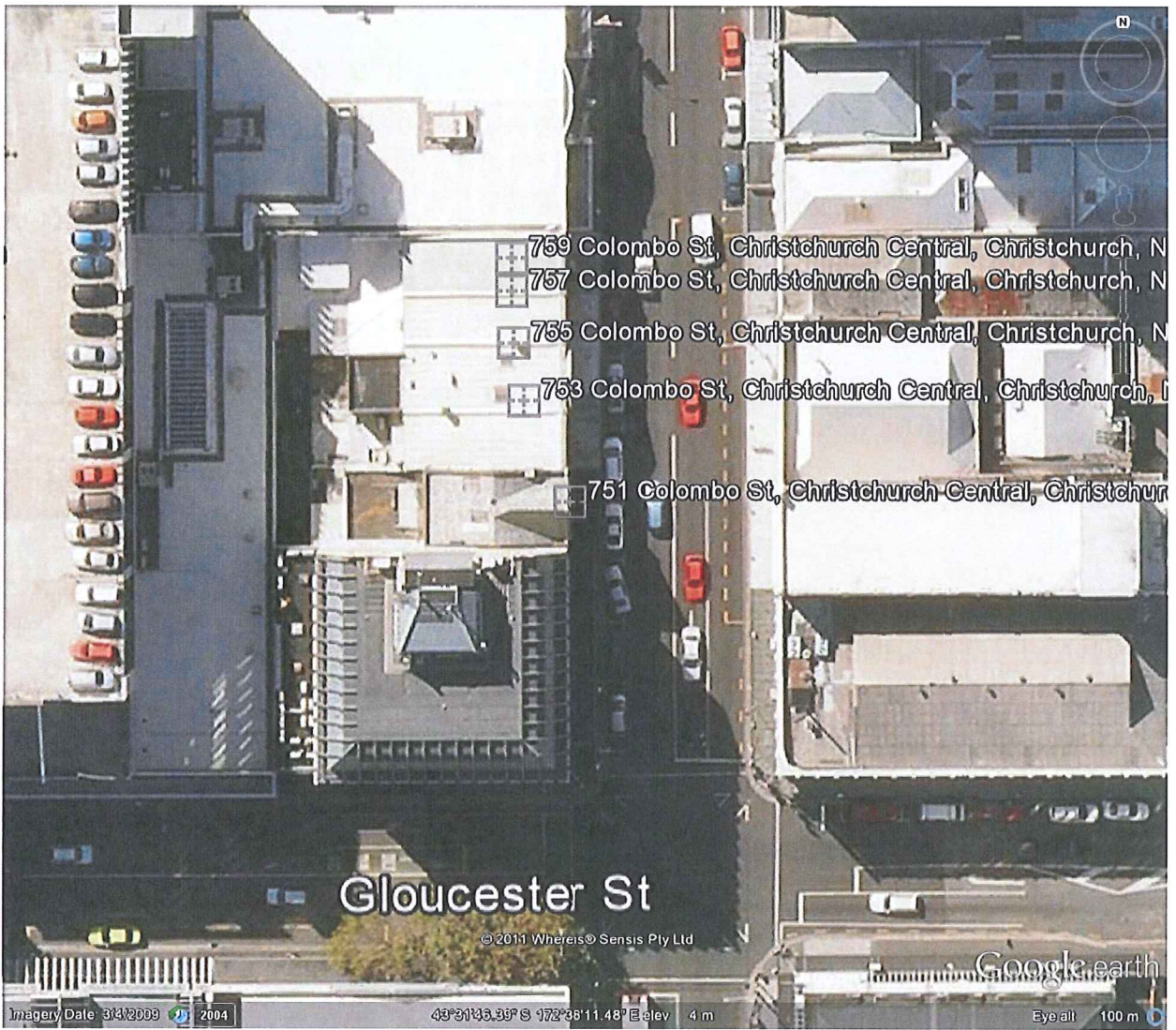
Jon Devine
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G/E110604 753-759 Colombo Street – Dec '11

APPENDIX 1

Site Plans





APPENDIX 2

Structural Design Features Report for the 759 Colombo Street Seismic Strengthening

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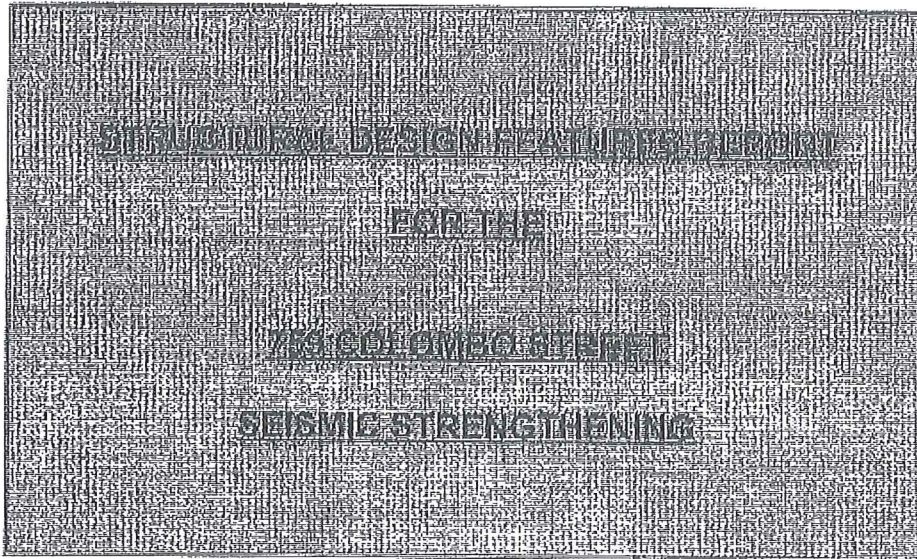
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753 Colombo



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990503/S/1



Design Engineer : Andrew Freeman

Director-In-Charge : Barry Ramsay

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R.B. Ramsey, M.Sc. (London), D.I.C., B.E. (Hons), F.I.P.E.N.Z., K.J. Simcock, B.E. (Hons), M.E., M.I.P.E.N.Z., M.P. Gray, B.E. (Hons), M.I.P.E.N.Z.

Wall Face Loads

The brick walls comply with the dynamic analysis method suggested in the "Bulletin of New Zealand National Society for Earthquake Engineer, Vol 18, No. 2, June 1985", titled "Seismic Behaviour of Unreinforced Masonry Walls" by M.J.N Priestley, and also employed in the 1995 revision of the "Guidelines for Assessing and Strengthening Earthquake Risk Buildings". Using this method the expected failure accelerations for ground floor, first floor and parapet range between 0.90g and 0.94g.

Use of Building

The current use of the building and shop adjacent (to South) is as a retail outlet for Allstar Trading. The future use of the combined shop is the same.

M.T. Freeman
Design Engineer
POWELL FENWICK CONSULTANTS LIMITED

TO Christchurch City Council
 ATTENTION John Taylor
 SENDER Barry Ramsay
 DATE 02 June 1994
 NUMBER OF PAGES (INCLUDING THIS PAGE) _____



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MESSAGE Re: 753 Colombo Street

The calculated "Cd" values for this building are shown below

transverse

existing rear wall and new RC portal 0.15

longitudinal

existing brick walls 0.14 shear
 0.21 flexure

Consent 94004499



DIRECTORS I.L. Ford, B.E., F.I.P.E.N.Z., R.B. Ramsay, M.Sc. (London), D.I.C. B.E.(Hons), F.I.P.E.N.Z., K.J. Snykock, B.E. (Hons), M.E. M.I.P.E.N.Z., G.J. Upritchard, B.E., C.Eng., M.I. Mech. E., M.I.P.E.N.Z.

APPENDIX 3

Photos of damage following 22nd February, 2011 earthquake







