# INDEPENDENT ASSESSMENT ON EARTHQUAKE PERFORMANCE
# OF
# 173 Gloucester Street( 255-271 Manchester 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**

**January 2012**

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## 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 173 Gloucester Street (incl. 255-271 Manchester 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 building at 173 Gloucester Street was located on the north west corner of the intersection of Gloucester and Manchester Street with a street frontage on the north side of Gloucester Street and the west side of Manchester Street.

The location of the building in the Christchurch CBD is identified in the site plan in Appendix 1.

## Description of Building

The building at 173 Gloucester Street was two storey building with external walls constructed of un-reinforced masonry. The building had a light weight roof with timber roof framing and timber first floor. The building façades were ornate and well maintained. The building had a heavy tiled roof supported on timber framing.

The building facades had significant openings to the ground floor street frontages and the upper storey portion of the Gloucester Street and Manchester Street facades. The building had reasonably significant parapets to both street facades.

The Christchurch City Council record that the building was construction in 1907.

It is understood that the building was not classified as a heritage building in the City Plan and appears to have no classification with Historic Places Trust.

## Compliance

At the time of reporting we have not received Christchurch City Council's compliance records in respect of the building and the Seismic Building Survey of 25th of November, 1991 there is a note advising that the parapet was removed under Building Permit No 74/503.

Assuming that the building was not subject to a substantial alteration or change of use following the introduction of the Building Act:1991, the building is likely to have complied with the requirements of the Building Act:1991 due to the building pre-existing the Building Act:1991 and no alterations or change of use having been undertaken since the introduction of the Building Act:1991.

## 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 building 173 Gloucester Street on the 25th November 1991. The building was rated with a score of 13 which resulted in the building being B classification earthquake risk building. Under the proposed seismic risk building survey, a B classification building was to require remedial action within two years. The Seismic Risk Building-Survey identified that the parapets had been removed in 1976. The form also notes that the building had been secured in 1976 (interim strengthening due in 1997)

A Hazardous Appendage Survey identified the Hazardous Appendage Survey commented *CNR building, O.K. for H.A.S. new roof.* The form also noted under cornice, *small (2 bands – 250mm O/H).*

We are unaware of any action taken by the Christchurch City Council to require the building owners to strengthen or upgrade the building.

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 2010.

## Events Subsequent to 4th September 2010 Earthquake

A Rapid Assessment-Level 1 was undertaken of the building corner Manchester/Gloucester (267 – 269 Manchester) on 5th September, 2010. The Rapid Assessment recorded *No noticeable damage to an URM Bldg.* The building was assigned a green placard. A subsequent Rapid Assessment-Level 2 was undertaken of the building on the corner of Gloucester Street and Manchester Street incorporating Map World – Fish and Chip Shop / Shoe Repair Shop on the 14th September, 2010. The Rapid Assessment identified *minor cracks in brick wall (south side), crack in arch window lintel (south side).* The Rapid Assessment-Level 2 assigned a G2 placard and noted *get a structural engineer's assistance to check and provide appropriate crack repair details.* The Rapid Assessment-Level 2 also noted *minor cracks in joint between the brick wall and large windows on east side, minor cosmetic cracks in gib wall lining and ceiling in stairs area, minor vertical cracks in joint between brick and block walls in rubbish room. Fish and Chip Shop minor cracks in gib ceiling. There are minor cracks in brick wall, mainly on the south side and also minor internal cracks in timber wall and ceiling. No damage in Shoe Repair Shop and in Dairy. No access to the Take-away Shop.*

The Rapid Assessment-Level 2 recommended :

- *Repair the crack in the arch window lintel on the south side ASAP. Also repair all other cracks in the walls and ceiling*
- *check the arch lintel above Dairy for any loose bricks. Remove/secure if found to be loose*
- *support arrangement (eg. steel bands) to external arch lintels shall be provided to prevent sudden failure of lintel blocks (consult a structural engineer)*

A further Rapid Assessment-Level 2 by Maxim was undertaken on 20th September, 2010. The building is identified as Manchester Street and Gloucester Street Map World.

The Rapid Assessment form noted *some cracking to foundations. South wall brick parapet cracking and cracks to façade. Slight movement to internal lining of 10mm to back wall. Ceiling to NE parapet and + cracks to glass.*

The Rapid Assessment-Level 2 assigned a green placard and commented *fill cracks in parapet + bricks with epoxy resin once scaffold erected. Refix windows to brick work.*

A series of photographs were provided with the Rapid Assessment-Level 2 recording the extent and location of cracking.

On the 1st April, 2011 Opus International Consultants wrote to Wendy Blackwell, Claims Officer, Anthony Runacres and Associates Ltd confirming that Opus International Consultants Ltd had been engaged by Anthony Runacres and Associates Ltd to carry out a structural inspection of the building at corner of Gloucester and Manchester Street (173 Gloucester Street) due to damage resulting from 22nd February, 2011 M6.3 Christchurch earthquake and ensuing aftershocks. The letter recorded that the inspection was limited to an external visual inspection of the building. No linings or finishes were removed to expose structural elements. The inspection recorded that the first and second storey external walls and columns and some of the internal partition walls were constructed of un-reinforced masonry. A reinforced concrete bond beam / parapet wall was noted at roof level. The roof framing was noted as timber and the roof cladding of heavy tiles.

The Opus International Consultant report advised that the building had sustained significant damage from the earthquake and aftershocks on the 22nd February, 2011. The following damage was noted.

1. *The un-reinforced masonry on the upper floor along the Manchester Street (East) façade has almost entirely collapsed from out of plane failure. (Refer to Photograph 1). The walls along the south façade (along Gloucester Street) have much less damage (photographs 3 and 4). This can probably be explained by the larger component of seismic shaking during the 22nd February, 2011 event being in the East-West direction.*

2. *There is a large section of the reinforced concrete bond beam/parapet on the upper level of the east façade that is hanging precariously in place, held only by a few reinforcing bars to the remaining parapet (which could also easily collapse pulling with it other parts of the wall). This presents a falling hazard (refer to photograph 2).*

3. *A large portion of the south west corner of the upper floor walls has collapsed (south façade). This is probably result of pounding with the neighbouring building to the west (refer to photograph 5).*

4. *Significant damage to the walls and columns occurred on the ground floor of the building. One of the columns on the Manchester Street façade was damaged to the extent that this caused misalignment of the upper level floor (refer to photograph 1).*

*We agree with the current red placard that has been previously assigned outlining that the building is unsafe to approach or enter.*

The report proceeded to recommend that the building be demolished.

## Structural Failure

The structural failure of the building has been described in some detail in Opus International Consultants report of the 1st April, 2011. This report identified that the un-reinforced masonry wall on the upper floor along the Manchester Street frontage almost entirely collapsed from out of plane failure. The walls to the south façade along Gloucester Street suffered less damage. There was greater damage at the west end of the south façade and the junction with the adjoining building.

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 unsecured 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 Christchurch City Council records establish that the building at 173 Gloucester Street had been secured in 1976, at which time it is understood the parapets were removed. The damage that occurred to the building 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**

We are uncertain as to why two Rapid Assessment-Level 2's were undertaken after a Rapid Assessment-Level 1 on 5th September, 2010 assigned the building a green placard and noted no noticeable damage.

It is of concern that the Rapid Assessment – Level 1 did not identify the damage that was recorded on the Rapid Assessment- Level 2's that were subsequently undertaken despite the Rapid Assessment – Level 1 assigning a green placard. It is suggested that a Rapid assessment – Level 2 should be undertaken on all un-reinforced masonry buildings which have not been strengthened to at least 33% of current code.

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.

**Report Prepared By:-**

**Peter C Smith**
BE,FIPENZ,CPEng IntPE
**Director**

**Report Reviewed By:**

**Jon Devine**
BE(Hons) ME (Civil) CPEng IntPE
**Director**

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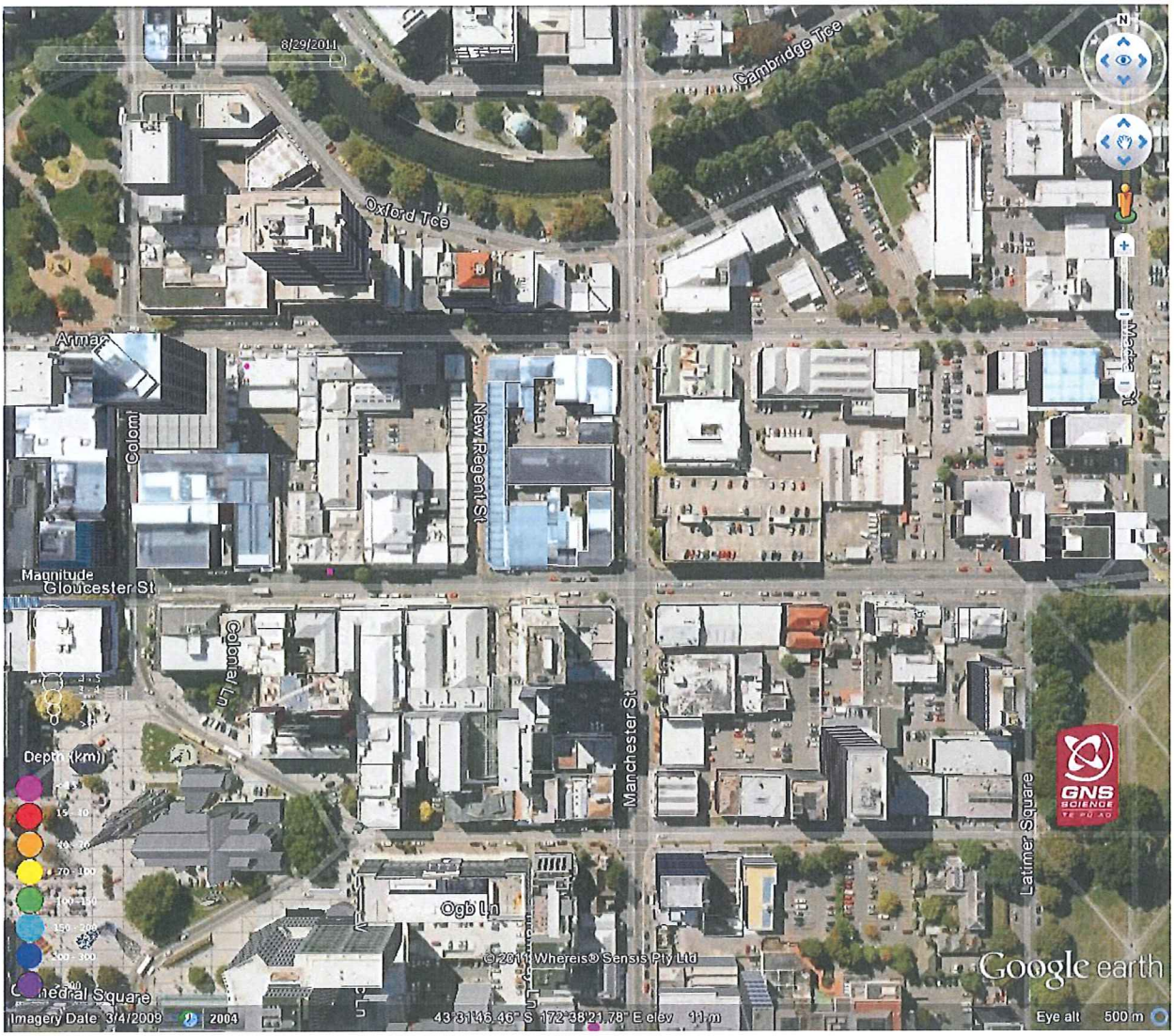
# APPENDIX 1

## Site Plans

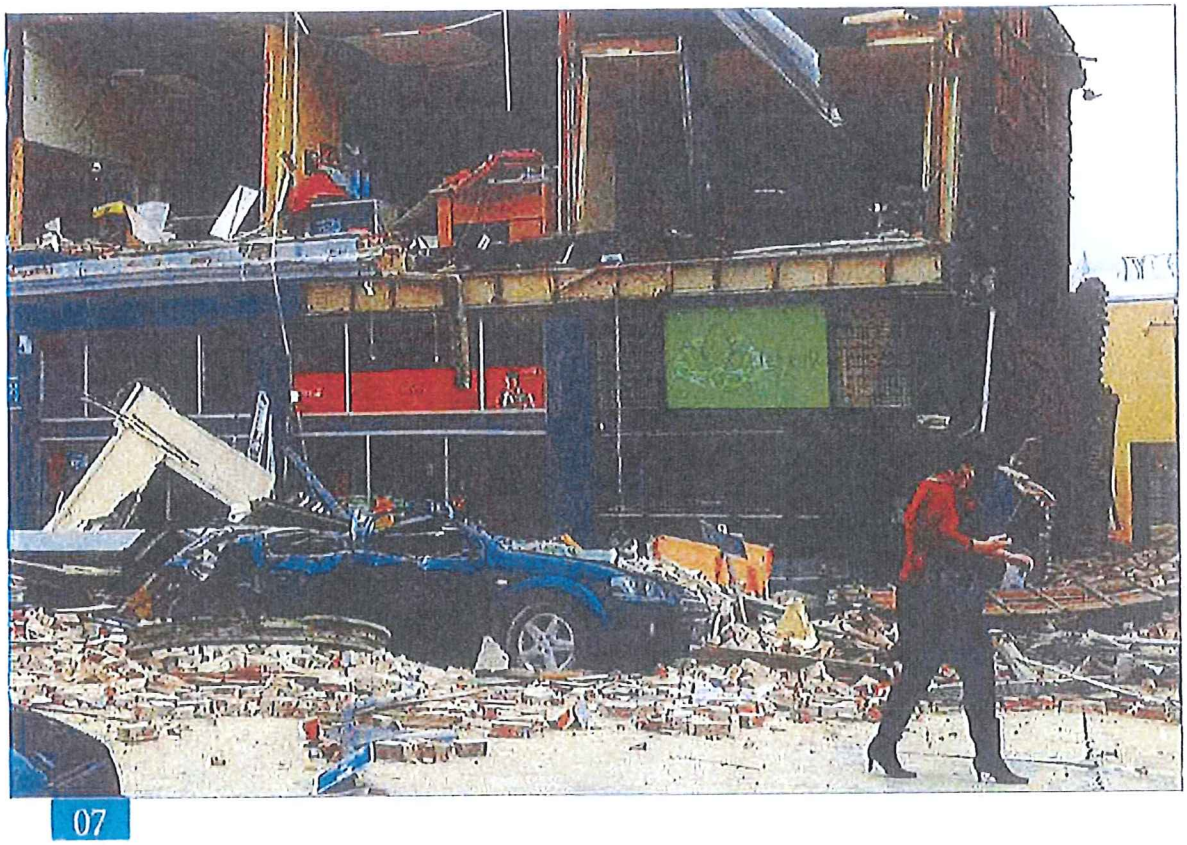


# APPENDIX 2

**Photos of damage following 4th September, 2010 earthquake**

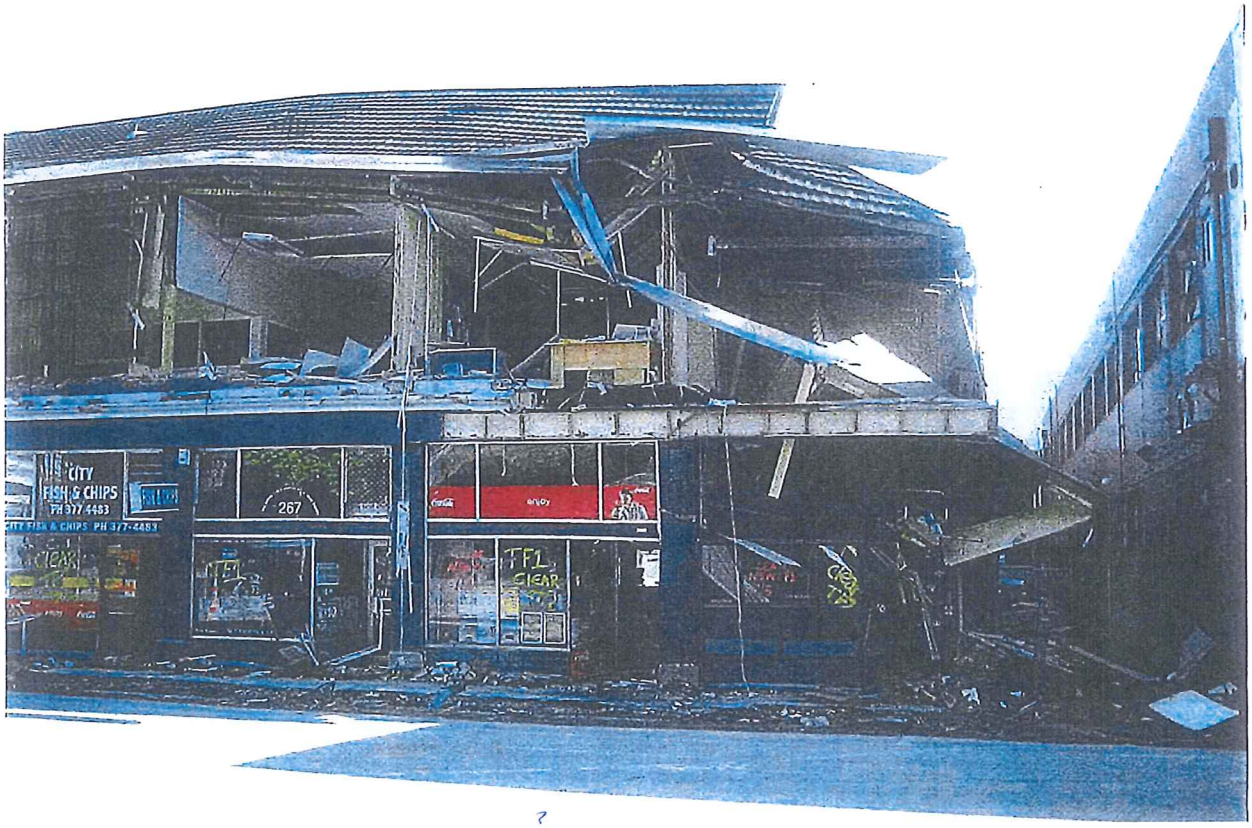
# APPENDIX 3

**Photographs following to 22nd February, 2011 earthquake**





MANCHESTER ST

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