Christchurch City Council

Bridgewater Courts Housing Complex PRO 1347

Detailed Engineering Evaluation

Quantitative Assessment Report

Christchurch City Council

Bridgewater Courts Housing Complex

Quantitative Assessment Report

14 Bridge Street, South Brighton, Christchurch 8061

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Summary

Bridgewater Courts Housing Complex
PRO 1347

Detailed Engineering Evaluation
Quantitative Report - Summary
Final

Background
This is a summary of the quantitative report for the Bridgewater Courts Housing Complex, and is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011. This assessment covers the 23 residential units on the site.

Key Damage Observed
The residential units suffered minor-to-moderate damage to non-structural elements. This consisted predominantly of stepped cracking to the exterior blockwork veneer walls. In some locations the apex veneer block has become dislodged.

Level Survey
All floor slopes assessed were less than the 5mm/m limitation set out in the MBIE guidelines [6].

Critical Structural Weaknesses
No critical structural weaknesses were found in any of the buildings.

Indicative Building Strength
No buildings on the site are considered to be earthquake prone.

Table A: Summary of Seismic Performance

Block	DEE Code	% NBS based on calculated capacity.
Block A	PRO 1347 B001	54%
Block B	PRO 1347 B002	43%
Block C	PRO 1347 B003	43%
Block D	PRO 1347 B004	43%
Block E	PRO 1347 B005	43%
Block F	PRO 1347 B006	54%

The residential blocks have estimated seismic capacities ranging from 43%NBS to 54%NBS as limited by the bracing capacity of timber framed walls.

Recommendations

We make the following recommendations:

- A strengthening works scheme be developed to increase the seismic capacity of all blocks to at least 67% NBS. This may also need to consider compliance with accessibility and fire requirements.
- Undertake remedial repair works to wall cracks and opened wall joints.
- Remove dislodged blocks from roof apex area.
- Undertake a veneer tie investigation especially in areas where the veneer appears to have pulled out.
- A geotechnical site investigation be carried out to determine the liquefaction potential of the site and the shallow bearing capacities of the soils if this information is required for future construction on the site.

Contents

1 Introduction

Opus International Consultants Limited has been engaged by Christchurch City Council to undertake a detailed seismic assessment of the Bridgewater Courts Housing Complex, located at Bridge Street, New Brighton, Christchurch, following the Canterbury Earthquake Sequence since September 2010. A site investigation was conducted by Opus on 12 June 2013.

The purpose of the assessment is to determine if the buildings in the village are classed as being earthquake prone in accordance with the Building Act 2004.

The seismic assessment and reporting have been undertaken based on the qualitative and quantitative procedures detailed in the Detailed Engineering Evaluation Procedure (DEEP) document (draft) issued by the Structural Engineering Society (SESOC) [2] [3] [4] [5].

2 Compliance

This section contains a brief summary of the requirements of the various statutes and authorities that control activities in relation to buildings in Christchurch at present.

2.1 Canterbury Earthquake Recovery Authority (CERA)

CERA was established on 28 March 2011 to take control of the recovery of Christchurch using powers established by the Canterbury Earthquake Recovery Act enacted on 18 April 2011. This act gives the Chief Executive Officer of CERA wide powers in relation to building safety, demolition and repair. Two relevant sections are:

Section 38 – Works

This section outlines a process in which the chief executive can give notice that a building is to be demolished and if the owner does not carry out the demolition, the chief executive can commission the demolition and recover the costs from the owner or by placing a charge on the owners' land.

Section 51 – Requiring Structural Survey

This section enables the chief executive to require a building owner, insurer or mortgagee to carry out a full structural survey before the building is re-occupied.

We understand that CERA require a detailed engineering evaluation to be carried out for all buildings (other than those exempt from the Earthquake Prone Building definition in the Building Act). CERA have adopted the Detailed Engineering Evaluation Procedure (DEEP) document (draft) issued by the Structural Engineering Society (SESOC) on 19 July 2011. This document sets out a methodology for both initial qualitative and detailed quantitative assessments.

It is anticipated that a number of factors, including the following, will determine the extent of evaluation and strengthening level required:

1. The importance level and occupancy of the building.

2. The placard status and amount of damage.

3. The age and structural type of the building.

4. Consideration of any critical structural weaknesses.

Christchurch City Council requires any building with a capacity of less than 34% of New Building Standard (including consideration of critical structural weaknesses) to be strengthened to a target of 67% as required under the CCC Earthquake Prone Building Policy.

2.2 Building Act

Several sections of the Building Act are relevant when considering structural requirements:

Section 112 - Alterations

This section requires that an existing building complies with the relevant sections of the Building Code to at least the extent that it did prior to the alteration. This effectively means that a building cannot be weakened as a result of an alteration (including partial demolition).

The Earthquake Prone Building policy for the territorial authority shall apply as outlined in Section 2.3 of this report.

Section 115 – Change of Use

This section requires that the territorial authority is satisfied that the building with a new use complies with the relevant sections of the Building Code 'as near as is reasonably practicable'.

This is typically interpreted by territorial authorities as being 67% of the strength of an equivalent new building or as near as practicable. This is also the minimum level recommended by the New Zealand Society for Earthquake Engineering (NZSEE).

Section 121 – Dangerous Buildings

This section was extended by the Canterbury Earthquake (Building Act) Order 2010, and defines a building as dangerous if:

1. In the ordinary course of events (excluding the occurrence of an earthquake), the building is likely to cause injury or death or damage to other property; or
2. In the event of fire, injury or death to any persons in the building or on other property is likely because of fire hazard or the occupancy of the building; or
3. There is a risk that the building could collapse or otherwise cause injury or death as a result of earthquake shaking that is less than a 'moderate earthquake' (refer to Section 122 below); or
4. There is a risk that other property could collapse or otherwise cause injury or death; or
5. A territorial authority has not been able to undertake an inspection to determine whether the building is dangerous.

Section 122 – Earthquake Prone Buildings

This section defines a building as earthquake prone (EPB) if its ultimate capacity would be exceeded in a 'moderate earthquake' and it would be likely to collapse causing injury or death, or damage to other property.

A moderate earthquake is defined by the building regulations as one that would generate loads 33% of those used to design an equivalent new building.

Section 124 – Powers of Territorial Authorities

This section gives the territorial authority the power to require strengthening work within specified timeframes or to close and prevent occupancy to any building defined as dangerous or earthquake prone.

Section 131 – Earthquake Prone Building Policy

This section requires the territorial authority to adopt a specific policy for earthquake prone, dangerous and insanitary buildings.

2.3 Christchurch City Council Policy

Christchurch City Council adopted their Earthquake Prone, Dangerous and Insanitary Building Policy in October 2011 following the Darfield Earthquake on 4 September 2010.

1. The policy includes the following:
2. A process for identifying, categorising and prioritising Earthquake Prone Buildings, commencing on 1 July 2012;
3. A strengthening target level of 67% of a new building for buildings that are Earthquake Prone;
4. A timeframe of 15-30 years for Earthquake Prone Buildings to be strengthened; and,
5. Repair works for buildings damaged by earthquakes will be required to comply with the above.

The council has stated their willingness to consider retrofit proposals on a case by case basis, considering the economic impact of such a retrofit.

If strengthening works are undertaken, a building consent will be required. A requirement of the consent will require upgrade of the building to comply 'as near as is reasonably practicable' with:

- The accessibility requirements of the Building Code.
- The fire requirements of the Building Code. This is likely to require a fire report to be submitted with the building consent application.

Where an application for a change of use of a building is made to Council, the building will be required to be strengthened to 67% of New Building Standard or as near as is reasonably practicable.

2.4 Building Code

The Building Code outlines performance standards for buildings and the Building Act requires that all new buildings comply with this code. Compliance Documents published by The Department of Building and Housing can be used to demonstrate compliance with the Building Code.

On 19 May 2011, Compliance Document B1: Structure, was amended to include increased seismic design requirements for Canterbury as follows:

- Increase in the basic seismic design load for the Canterbury earthquake region (Z factor increased to 0.3 equating to an increase of 36 – 47% depending on location within the region);
- Increased serviceability requirements.

2.5 Institution of Professional Engineers New Zealand (IPENZ) Code of Ethics

One of the core ethical values of professional engineers in New Zealand is the protection of life and safeguarding of people. The IPENZ Code of Ethics requires that:

Members shall recognise the need to protect life and to safeguard people, and in their engineering activities shall act to address this need.

1.1 Giving Priority to the safety and well-being of the community and having regard to this principle in assessing obligations to clients, employers and colleagues.

1.2 Ensuring that responsible steps are taken to minimise the risk of loss of life, injury or suffering which may result from your engineering activities, either directly or indirectly.

All recommendations on building occupancy and access must be made with these fundamental obligations in mind.

3 Earthquake Resistance Standards

For this assessment, the building's earthquake resistance is compared with the current New Zealand Building Code requirements for a new building constructed on the site. This is expressed as a percentage of new building standard (%NBS). The loadings are in accordance with the current earthquake loading standard NZS1170.5 [1].

A generally accepted classification of earthquake risk for existing buildings in terms of %NBS that has been proposed by the NZSEE 2006 [2] is presented in Figure 1 below.

Description	Grade	Risk	%NBS	Existing Building Structural Performance
Low Risk Building	A or B	Low	Above 67	Acceptable (improvement may be desirable)
Moderate Risk Building	B or C	Moderate	34 to 66	Acceptable legally. Improvement recommended
High Risk Building	D or E	High	33 or lower	Unacceptable (Improvement required under Act)

Improvement of Structural Performance	
Legal Requirement	NZSEE Recommendation
The Building Act sets no required level of structural improvement (unless change in use) This is for each TA to decide. Improvement is not limited to 34%NBS.	100%NBS desirable. Improvement should achieve at least 67%NBS
	Not recommended. Acceptable only in exceptional circumstances
Unacceptable	Unacceptable

Figure 1: NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE Guidelines

Table 1 below compares the percentage NBS to the relative risk of the building failing in a seismic event with a 10% risk of exceedance in 50 years (i.e. 0.2% in the next year).

Table 1: %NBS compared to relative risk of failure

Percentage of New Building Standard (%NBS)	Relative Risk (Approximate)
>100	<1 time
80-100	1-2 times
67-80	2-5 times
33-67	5-10 times
20-33	10-25 times
<20	>25 times

3.1 Minimum and Recommended Standards

Based on governing policy and recent observations, Opus makes the following general recommendations:

3.1.1 Occupancy

The Canterbury Earthquake Order[1] in Council 16 September 2010, modified the meaning of "dangerous building" to include buildings that were identified as being EPB's. As a result of this, we would expect such a building would be issued with a Section 124 notice, by the Territorial Authority, or CERA acting on their behalf, once they are made aware of our assessment. Based on information received from CERA to date and from the MBIE guidance document dated December 2012 [6], this notice is likely to prohibit occupancy of the building (or parts thereof), until its seismic capacity is improved to the point that it is no longer considered an EPB.

3.1.2 Cordoning

Where there is an overhead falling hazard, or potential collapse hazard of the building, the areas of concern should be cordoned off in accordance with current CERA/territorial authority guidelines.

3.1.3 Strengthening

Industry guidelines (NZSEE 2006 [2]) strongly recommend that every effort be made to achieve improvement to at least 67%NBS. A strengthening solution to anything less than 67%NBS would not provide an adequate reduction to the level of risk.

It should be noted that full compliance with the current building code requires building strength of 100%NBS.

3.1.4 Our Ethical Obligation

In accordance with the IPENZ code of ethics, we have a duty of care to the public. This obligation requires us to identify and inform CERA of potentially dangerous buildings; this would include earthquake prone buildings.

[1] This Order only applies to buildings within the Christchurch City, Selwyn District and Waimakariri District Councils authority.

4 Background Information

4.1 Building Descriptions

The site contains 23 residential units which were constructed in 1977. The units are numbered 1 to 23. A site plan showing the locations of the units is shown in Figure 2. Figure 3 shows the location of the site in Christchurch City. The units are grouped together to form 'sub-blocks' with 2, 3, 4 or 5 units per sub-block. Each sub-block consists of an irregular site arrangement and accommodates a combination of 3 different floor plan layouts.

The units within each sub-block are separated by 190mm block masonry fire walls which (based on information available for other similar blocks of the same era) are potentially filled with reinforcement around their perimeter.

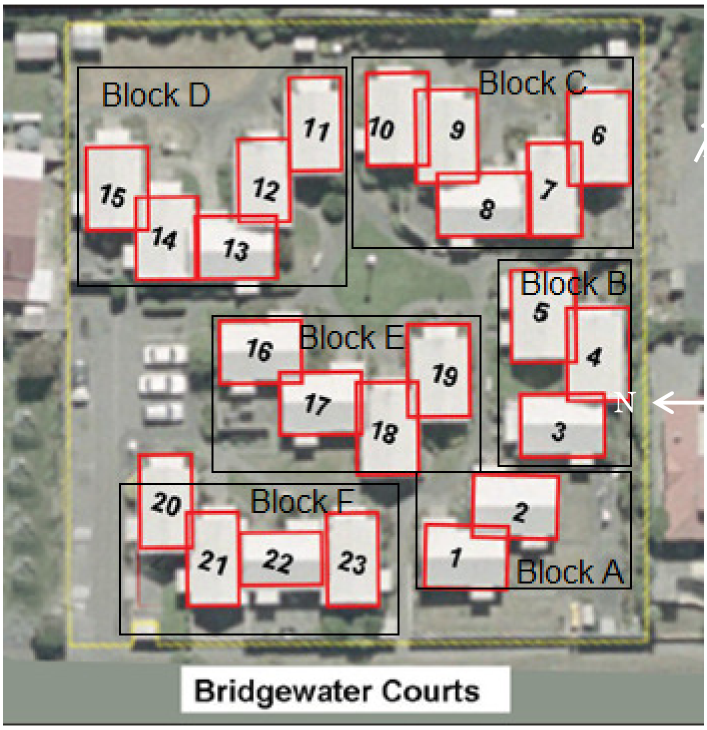


Figure 2: Site plan of Bridgewater Courts Housing Complex.

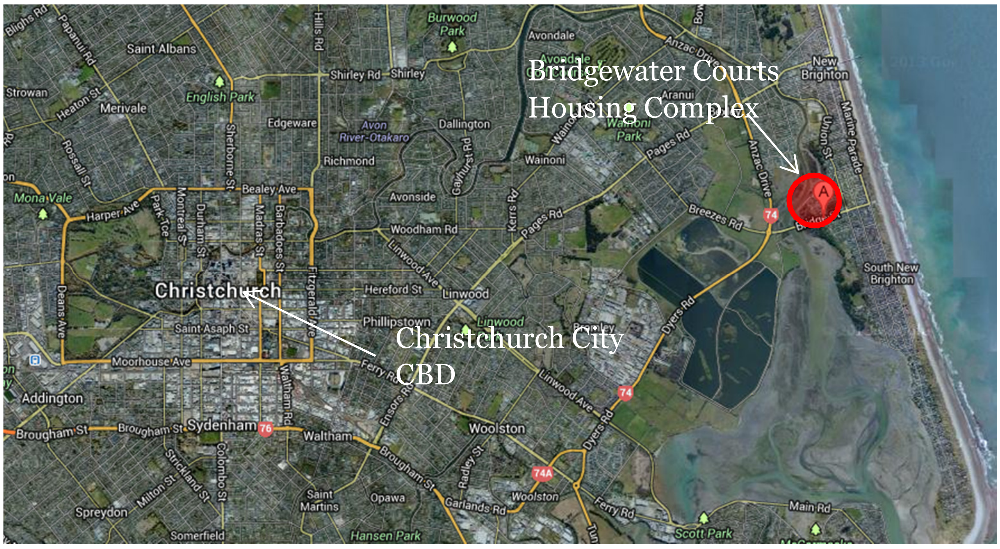


Figure 3: Location of site relative to Christchurch City CBD *(Source: Google Maps).*

The residential units are timber-framed buildings with timber roof trusses supporting light-weight metal roofs. Walls and ceilings are lined with GIB board. The primary cladding is 90mm block veneer. Foundations are strip footings. The concrete slabs are 100mm thick and are shown on the drawings as not reinforced and not tied to the foundations.

Figure 4, Figure 5 and Figure 6 show typical floor plans for the 3 different unit layouts which were produced from site measurements by Opus.

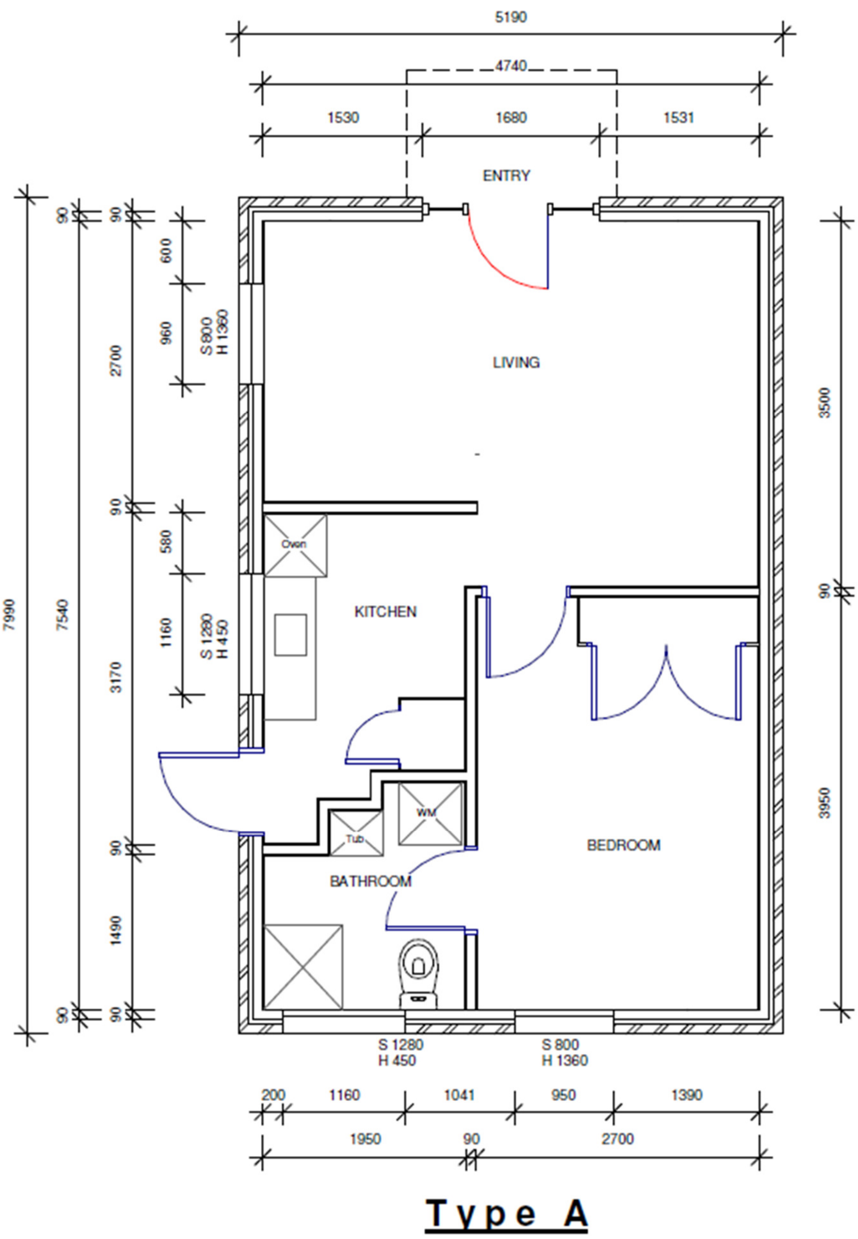


Figure 4: Floor plan unit type A.

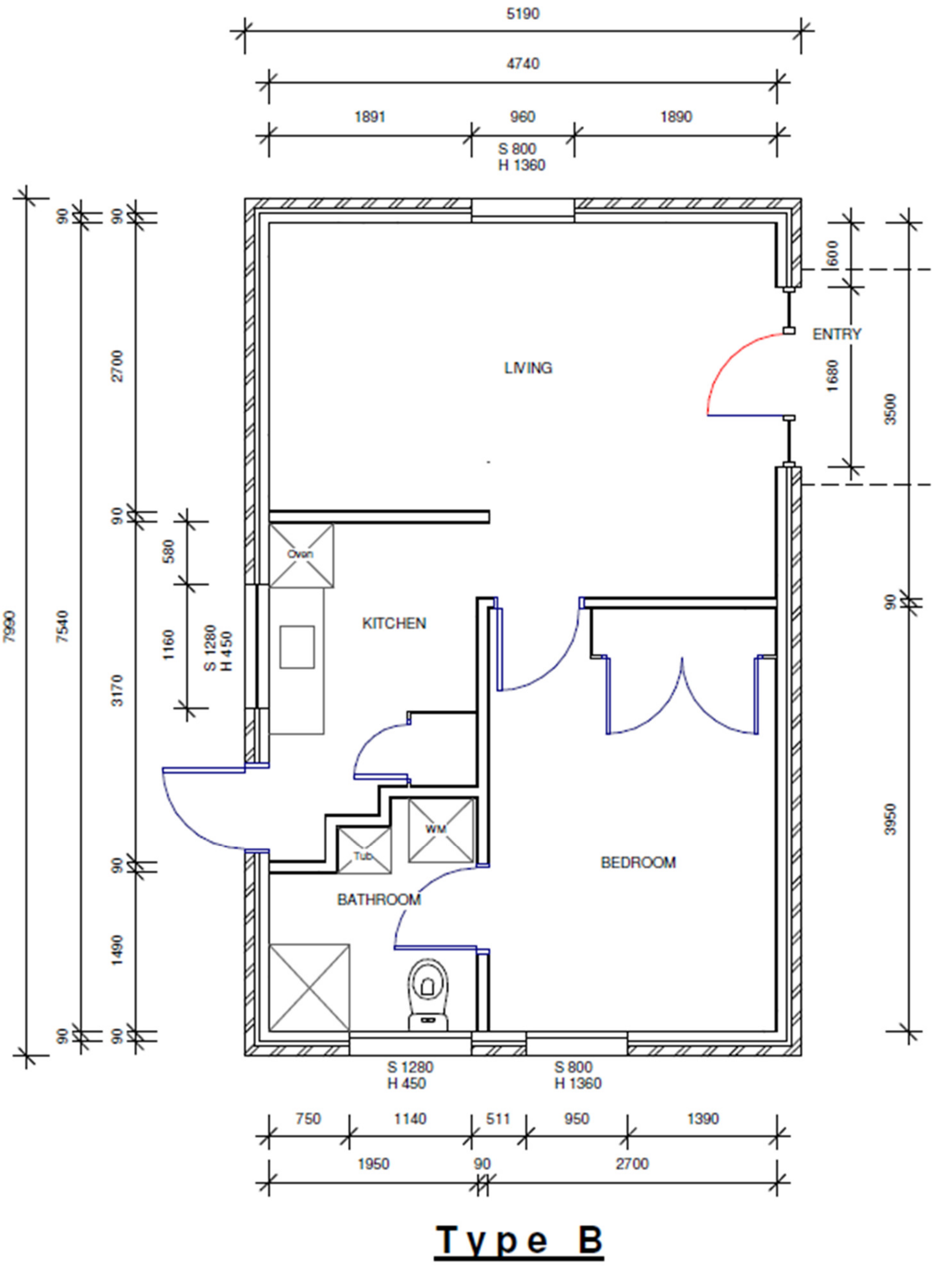


Figure 5: Floor plan unit type B.

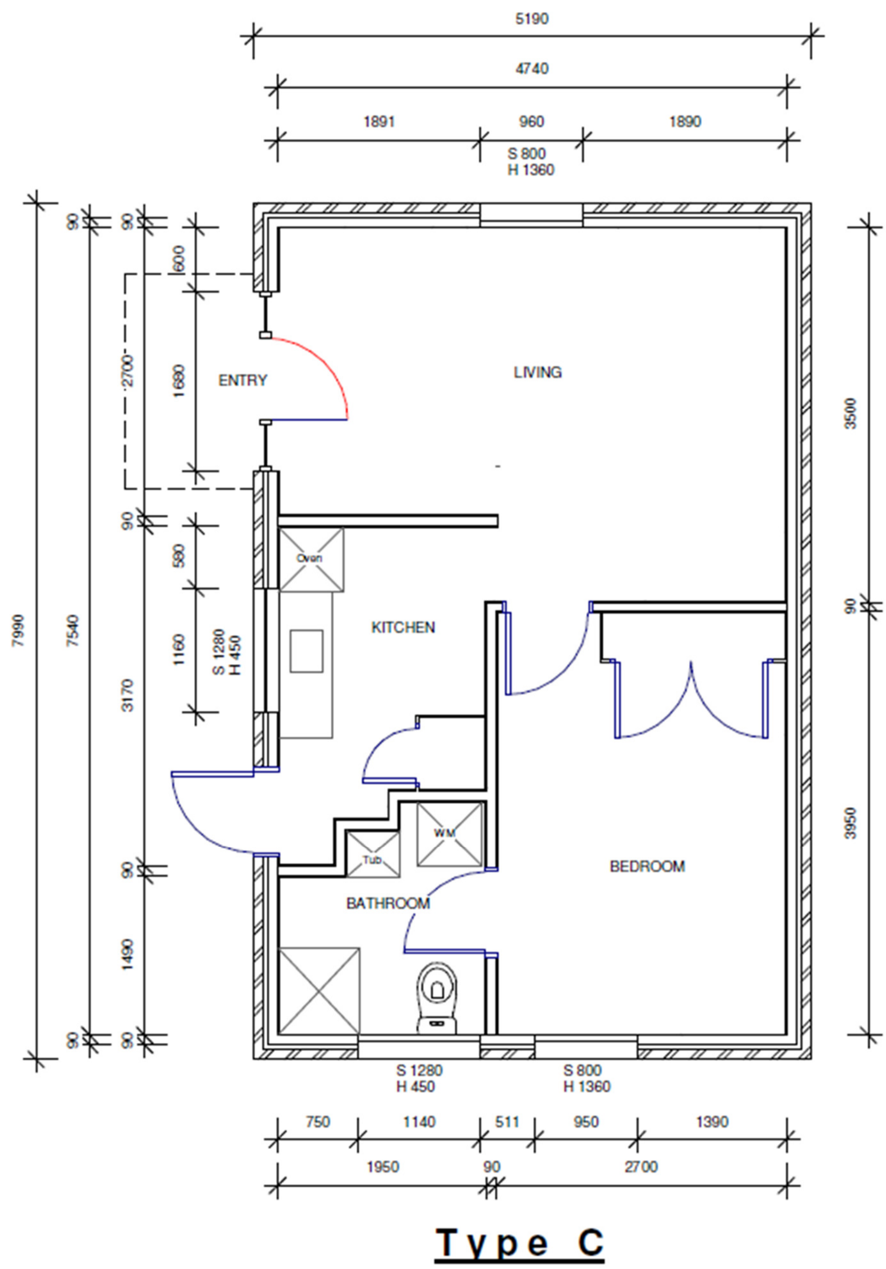


Figure 6: Floor plan unit type C.

4.2 Survey

4.2.1 Post 22 February 2011 Rapid Assessment

A structural (Level 1) assessment of the buildings/property was undertaken on March 4th, 2011 by Opus International Consultants. Stepped cracking to external block veneers was observed as well as the occasional dislodging of some veneers at the apex of end walls. A summary of the damage to the buildings is provided in section 5.

4.2.2 Level Survey

A full level survey was not deemed to be necessary at Bridgewater Courts Housing Complex as it is located in a TC2 zone. Properties in TC2 zones suffered minor to moderate amounts of damage due to liquefaction and/or settlement. In lieu of a full level survey, a laser level was placed in each unit so that differentials in vertical levels could be measured at the extreme ends of the unit. These values could then be used to determine the floor slope of the entire unit. For this site all floor slopes were less than the 5mm/m criteria imposed by MBIE guidelines.

4.3 Original Documentation

A complete set of architectural and structural drawings (dated 1976) and a limited number of specifications were provided by CCC.

In addition, typical floor plans of a 3 different types of residential unit have been produced by Opus to help confirm as-built measurements.

The drawings have been used to confirm the structural systems, investigate potential critical structural weaknesses (CSW) and identify details which required particular attention.

Copies of the design calculations were not provided.

5 Structural Damage

This section outlines the damage to the buildings that was observed during site visits. It is not intended to be a complete summary of the damage sustained by the buildings due to the earthquakes. Some forms of damage may not be noticeable during a visual inspection due to being 'hidden' behind cladding, interior linings, etc.

Overall, all residential units appear to have suffered no significant structural damage. It is noted that a majority of the units suffered varying levels of stepped cracking to their exterior blockwork veneer. The veneer blocks at the apex of some end elevations have become dislodged especially in the block containing units 11-15 and 20-23.

Note: Any photo referenced in this section can be found in Appendix A.

5.1 Residual Displacements

No significant ground settlement was observed in any of the units.

5.2 Foundations

No significant foundation damage was observed in any of the 23 residential units.

5.3 Primary Gravity Structure

No damage was evident in the timber framing or roof structure.

5.4 Primary Lateral-Resistance Structure

Some cracking of GIB ceiling diaphragms and wall linings was observed in many of the units (photos 17 and 18). This was consistent throughout all the units visited.

5.5 Non Structural Elements

Stepped cracking to external block veneers along mortar joints and through the block itself was observed on most unit facades (photos 5-13). This appears to have occurred primarily around where wall openings are located. Also consistently observed was cracking of the mortar in the vertical veneer blockwork junction between units (within a sub-block).

Blockwork veneers at the apex point of end elevations have been dislodged on some units (photos 14-16).

5.6 General Observations

The buildings appeared to have performed as reasonably expected during the earthquakes. They have suffered distributed amounts of minor to moderate damage which is consistent with the heavy nature of the cladding and the age of the buildings.

6 Detailed Seismic Assessment

The detailed seismic assessment has been based on the NZSEE 2006 [2] guidelines for the "Assessment and Improvement of the Structural Performance of Buildings in Earthquakes" together with the "Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury, Part 2 Evaluation Procedure" [3] draft document prepared by the Engineering Advisory Group on 19 July 2011, and the SESOC guidelines "Practice Note – Design of Conventional Structural Systems Following Canterbury Earthquakes" [5] issued on 21 December 2011.

The residential blocks B, C, D, E, and F have differing combinations and arrangements of Block A (basic block). The analysis was thus simplified by conducting four different types of block analysis. Then the overall capacity of blocks B, C, D, E, and F were calculated by utilising the known capacity of Block A.

6.1 Critical Structural Weaknesses

The term Critical Structural Weakness (CSW) refers to a component of a building that could contribute to increased levels of damage or cause premature collapse of a building.

No critical structural weaknesses were identified in any of the blocks.

6.2 Quantitative Assessment Methodology

The assessment assumptions and methodology have been included in Appendix 3. A brief summary follows:

Hand calculations were performed to determine seismic forces from the current building codes. These forces were distributed to walls by tributary area and relative rigidity. The capacities of the walls were then calculated and used to estimate the % NBS.

6.3 Limitations and Assumptions in Results

The observed level of damage suffered by the buildings was deemed low enough to not affect their capacity. Therefore the analysis and assessment of the buildings was based on them being in an undamaged state. There may have been damage to the buildings that was unable to be observed that could cause the capacity of the buildings to be reduced; therefore the current capacity of the buildings may be lower than that stated.

The results have been reported as a %NBS and the stated value is that obtained from our analysis and assessment. Despite the use of best national and international practice in this analysis and assessment, this value contains uncertainty due to the many assumptions and simplifications which are made during the assessment. These include:

- Simplifications made in the analysis, including boundary conditions such as foundation fixity.
- Assessments of material strengths based on limited drawings, specifications and site inspections.
- The normal variation in material properties which change from batch to batch.
- Approximations made in the assessment of the capacity of each element, especially when considering the post-yield behaviour.
- Construction is consistent with normal practise of the era in which constructed.

6.4 Assessment

A summary of the structural performance of the buildings is shown in the following table. Note that the values given represent the worst performing elements in the building, where these effectively define the building's capacity. Other elements within the building may have significantly greater capacity when compared with the governing elements.

Table 2: Summary of Seismic Performance

Structural Element/System	Failure Mode, or description of limiting criteria based on displacement capacity of critical element.	% NBS based on calculated capacity.
Block A	Bracing capacity of walls - across	54%
	Bracing capacity of walls - along	100%
Block B	Bracing capacity of walls - across	43%
	Bracing capacity of walls - along	100%
Block C	Bracing capacity of walls - across	43%
	Bracing capacity of walls - along	100%
Block D	Bracing capacity of walls - across	43%
	Bracing capacity of walls - along	100%
Block E	Bracing capacity of walls - across	43%
	Bracing capacity of walls - along	97%
Block F	Bracing capacity of walls - across	54%
	Bracing capacity of walls - along	100%

7 Geotechnical Summary

7.1.1 Geotechnical Survey/ Appraisal

CERA indicates that Bridgewater Courts Housing Complex is located in a TC2 zone (as shown in Figure 7). This classification suggests future significant earthquakes will cause minor to moderate land damage due to liquefaction and settlement.

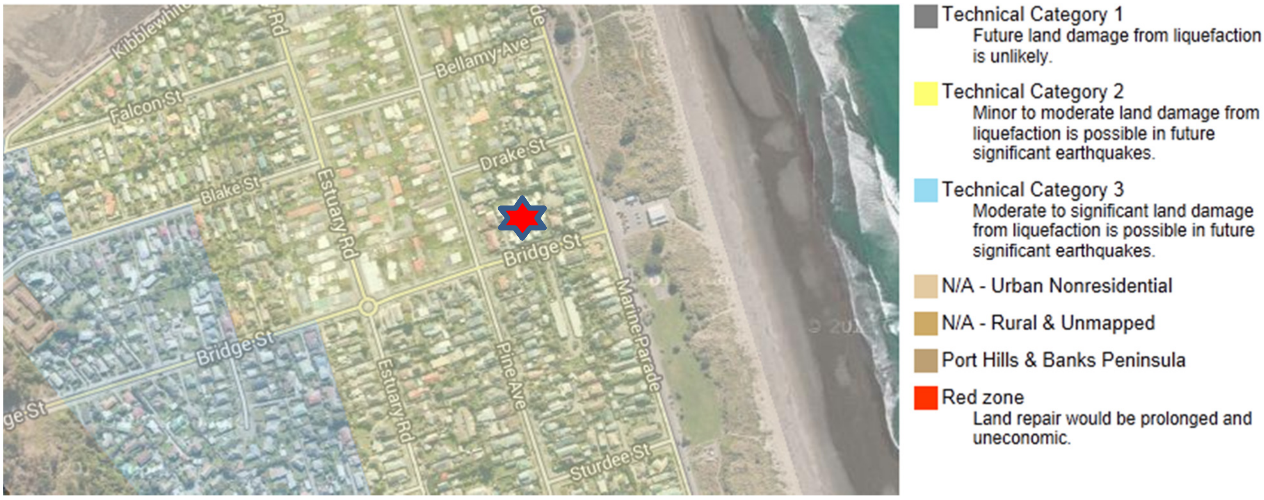


Figure 7: CERA Technical Categories map (loc. starred)

There is no evidence to suggest that further geotechnical investigation is warranted for this site.

8 Conclusions

- None of the buildings on site are considered to be Earthquake Prone.
- Blocks A, B, C, D, E, and F have capacities ranging from 43% - 54% NBS, as limited by the in-plane bracing capacity of timber framed walls. They are therefore deemed to be 'Moderate risk' buildings in a design seismic event according to NZSEE guidelines. Their level of risk is 5-10 times that of a 100% NBS building (Figure 1).

9 Recommendations

We make the following recommendations:

- A strengthening works scheme be developed to increase the seismic capacity of all blocks to at least 67% NBS. This may also need to consider compliance with accessibility and fire requirements.
- Undertake remedial repair works to wall cracks and opened wall joints.
- Remove dislodged blocks from roof apex area.
- Undertake a veneer tie investigation especially in areas where the veneer appears to have pulled out.
- A geotechnical site investigation be carried out to determine the liquefaction potential of the site and the shallow bearing capacities of the soils if this information is required for future construction on the site.

10 Limitations

- This report is based on an inspection of the buildings and focuses on the structural damage resulting from the 22^{nd} February Canterbury Earthquake and its subsequent aftershocks only. Some non-structural damage may be described but this is not intended to be a complete list of damage to non-structural items.

- Our professional services are performed using a degree of care and skill normally exercised, under similar circumstances, by reputable consultants practicing in this field at this time.

- This report is prepared for the Christchurch City Council to assist in the assessment of any remedial works required for the Bridgewater Courts Housing Complex. It is not intended for any other party or purpose.

11 References

[1] NZS 1170.5: 2004, Structural design actions, Part 5 Earthquake actions, Standards New Zealand.

[2] NZSEE (2006), Assessment and improvement of the structural performance of buildings in earthquakes, New Zealand Society for Earthquake Engineering.

[3] Engineering Advisory Group, Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury, Part 2 Evaluation Procedure, Draft Prepared by the Engineering Advisory Group, Revision 5, 19 July 2011.

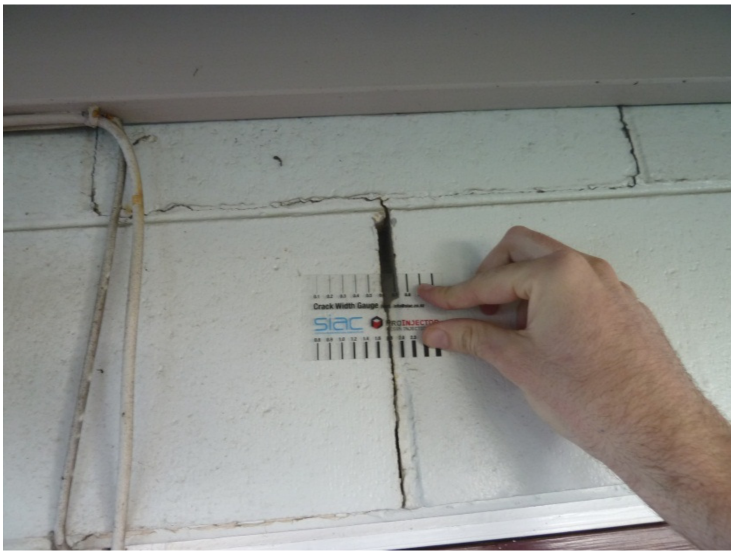
[4] Engineering Advisory Group, *Guidance on Detailed Engineering Evaluation of Non-residential buildings, Part 3 Technical Guidance*, Draft Prepared by the Engineering Advisory Group, 13 December 2011.

[5] SESOC (2011), Practice Note – Design of Conventional Structural Systems Following Canterbury Earthquakes, Structural Engineering Society of New Zealand, 21 December 2011.

[6] MBIE (2012), Repairing and rebuilding houses affected by the Canterbury earthquakes, Ministry of Building, Innovation and Employment, December 2012.

Appendix A - Photographs

Bridgewater Courts Housing Complex		
No.	Item description	Photo
Residential units		
1	Typical unit entry porch	
2	Typical end elevation of unit *(bathroom/ bedroom windows shown)*	
3	Typical roof cavity shown timber trusses	

4	Typical roof connection between trusses and wall	
5	Typical cracking along block veneer mortar joint and actual block	
6	Typical cracking located above entry door opening	

7	Typical stepped cracking along block veneer mortar joint. Located around wall opening	
8	Typical stepped cracking to blockwork veneer	
9	Cracking along blockwork veneer mortar joint	

10	Cracking of horizontal mortar joint	
11	Separation occurs between the blockwork veneer and window opening	
12	Typical cracking observed along vertical mortar junction where units connect to one another	

13	Typical cracking observed along vertical mortar junction where units connect to one another	
14	Dislodged apex blockwork veneer. Units 11-12 and 13-14	
15	Typical dislodged blockwork units 20-23	

16	Typical dislodged blockwork units 20-23	
17	Typical cracking GIB wall lining	
18	Typical wall lining cracking located around window opening	

Appendix B - Methodology and Assumptions

Seismic Parameters

As per NZS 1170.5:

- T < 0.4s (assumed)
- Soil: Category D
- Z = 0.3
- R = 1.0 (IL2, 50 year)
- N(T,D) = 1.0

For the analyses, a μ of 2 was assumed for the residential units.

Analysis Procedure

As the units are small and have a number of closely spaced walls in both directions, the ceilings are assumed to be capable of transferring loads to all walls. It was therefore assumed that a global method could be used to distribute the seismic inertia forces to timber and masonry walls in each direction.

Bracing capacities of timber walls were found by assuming a certain kN/m rating for the walls along each line. Due to the relatively unknown nature of the walls, the kN/m rating was taken as 3 kN/m for all timber walls with an aspect ratio (height: length) of less than 2:1. This was scaled down to zero kN/m at an aspect ratio of 3.5:1 as per NZSEE guidelines.

Bracing capacities of block walls were found by reinforced concrete theory utilising a masonry compression strength of 8MPa as for the old masonry code level for Grade B masonry.

%NBS values were then found through the ratio of bracing demand to bracing capacity for all walls in each direction.

Additional Assumptions

Further assumptions about the seismic performance of the buildings were:

- Foundations and foundation connections had adequate capacity to resist and transfer earthquake loads.
- Connections between all elements of the lateral load resisting systems are detailed to adequately transfer their loads sufficiently and are strong enough so as to not fail before the lateral load resisting elements.

Appendix C – CERA DEE Spreadsheets

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Bridgewater Court Housing Complex	Reviewer:	Mary Ann Halliday
Unit / No: / Street		CPEng No:	67073
Building Address:	Block A / 14 / Bridge Street	Company:	OPUS International Consultants Ltd
Legal Description:		Company project number:	6-QC318.00
		Company phone number:	6433635400
GPS south (Degrees / Min / Sec):	-43.52221246	Date of submission:	Oct-13
GPS east:	172.7349351	Inspection Date:	12-Jul-13
		Revision:	Final
Building Unique Identifier (CCC):	PRO 1347	Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:		Soil Profile (if available):	
Site Class (to NZS1170.5):			
Proximity to waterway (m, if <100m):		If Ground improvement on site, describe:	
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	1.00

Building

No. of storeys above ground:	1 (single storey = 1)	Ground floor elevation (Absolute) (m):	
Ground floor split?	no	Ground floor elevation above ground (m):	
Storeys below ground	0		
Foundation type:	mat slab	if Foundation type is other, describe:	
Building height (m):		height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):			
Age of Building (years):	36	Date of design:	1976-1992
Strengthening present?		If so, when (year)?	
		And what load level (%g)?	
Use (ground floor):	multi-unit residential	Brief strengthening description:	
Use (upper floors):			
Use notes (if required):			
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	frame system		
Roof:	timber truss	truss depth, purlin type and cladding	
Floors:	concrete flat slab	slab thickness (mm)	
Beams:	timber	type	
Columns:	timber	typical dimensions (mm x mm)	
Walls:			

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	lightweight timber framed walls		note typical wall length (m)	
Ductility assumed, μ:	2.00		estimate or calculation?	estimated
Period along:	0.10	0.00	estimate or calculation?	
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):				
Lateral system across:	lightweight timber framed walls		note typical wall length (m)	
Ductility assumed, μ:	2.00		estimate or calculation?	estimated
Period across:	0.10	0.00	estimate or calculation?	
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):				

Separations:

leave blank if not relevant

north (mm):	
east (mm):	
south (mm):	
west (mm):	

Non-structural elements

Stairs:			
Wall cladding:	brick or tile	describe (note cavity if exists)	
Roof Cladding:	Metal	describe	light weight
Glazing:	aluminium frames		
Ceilings:	strapped or direct fixed		
Services(list):			

Available documentation

Architectural	full	original designer name/date	1976
Structural	none	original designer name/date	
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

Damage

Site:
(refer DEE Table 4-2)

Site performance:		Describe damage:	
Settlement:		notes (if applicable):	
Differential settlement:		notes (if applicable):	
Liquefaction:		notes (if applicable):	
Lateral Spread:		notes (if applicable):	
Differential lateral spread:		notes (if applicable):	
Ground cracks:		notes (if applicable):	
Damage to area:		notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):			
Across	Damage ratio:	0%		
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	yes	Describe:	stepped cracking to exterior veneers

$$Damage\_Ratio = \frac{(\%NBS\,(before) - \%NBS\,(after))}{\%NBS\,(before)}$$

Recommendations

	Level of repair/strengthening required:	minor non-structural		Describe:	
	Building Consent required:	no		Describe:	
	Interim occupancy recommendations:	full occupancy		Describe:	
Along	Assessed %NBS before e'quakes:	100%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology:	equivalent static
	Assessed %NBS after e'quakes:	100%			
Across	Assessed %NBS before e'quakes:	54%	##### %NBS from IEP below		
	Assessed %NBS after e'quakes:	54%			

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Bridgewater Court Housing Complex	Reviewer:	Mary Ann Halliday
Building Address:	Blocks B-D; Unit No: 14; Street: Bridge Street	CPEng No:	67073
Legal Description:		Company:	OPUS International Consultants Ltd
		Company project number:	6-QC318.00
		Company phone number:	6433635400
GPS south (Degrees):	-43.52221246	Date of submission:	Oct-13
GPS east (Degrees):	172.7349351	Inspection Date:	12-Jul-13
		Revision:	Final
Building Unique Identifier (CCC):	PRO 1347	Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:		Soil Profile (if available):	
Site Class (to NZS1170.5):			
Proximity to waterway (m, if <100m):		If Ground improvement on site, describe:	
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	1.00

Building

No. of storeys above ground:	1 (single storey = 1)	Ground floor elevation (Absolute) (m):	
Ground floor split?	no	Ground floor elevation above ground (m):	
Storeys below ground	0		
Foundation type:	mat slab	if Foundation type is other, describe:	
Building height (m):		height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):			
Age of Building (years):	36	Date of design:	1976-1992
Strengthening present?		If so, when (year)?	
		And what load level (%g)?	
Use (ground floor):	multi-unit residential	Brief strengthening description:	
Use (upper floors):			
Use notes (if required):			
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	frame system		
Roof:	timber truss	truss depth, purlin type and cladding	
Floors:	concrete flat slab	slab thickness (mm)	
Beams:	timber	type	
Columns:	timber	typical dimensions (mm x mm)	
Walls:			

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	lightweight timber framed walls		
Ductility assumed, μ:	2.00	note typical wall length (m)	
Period along:	0.10 (0.00)	estimate or calculation?	estimated
Total deflection (ULS) (mm):		estimate or calculation?	
maximum interstorey deflection (ULS) (mm):		estimate or calculation?	
Lateral system across:	lightweight timber framed walls		
Ductility assumed, μ:	2.00	note typical wall length (m)	
Period across:	0.10 (0.00)	estimate or calculation?	estimated
Total deflection (ULS) (mm):		estimate or calculation?	
maximum interstorey deflection (ULS) (mm):		estimate or calculation?	

Separations: (leave blank if not relevant)

north (mm):	
east (mm):	
south (mm):	
west (mm):	

Non-structural elements

Stairs:			
Wall cladding:	brick or tile	describe (note cavity if exists)	
Roof Cladding:	Metal	describe	light weight
Glazing:	aluminium frames		
Ceilings:	strapped or direct fixed		
Services(list):			

Available documentation

Architectural	full	original designer name/date	1976
Structural	none	original designer name/date	
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

Damage

Site: (refer DEE Table 4-2)

Site performance:		Describe damage:	
Settlement:		notes (if applicable):	
Differential settlement:		notes (if applicable):	
Liquefaction:		notes (if applicable):	
Lateral Spread:		notes (if applicable):	
Differential lateral spread:		notes (if applicable):	
Ground cracks:		notes (if applicable):	
Damage to area:		notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):			
Across	Damage ratio:	0%		
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	yes	Describe:	stepped cracking to exterior veneers

$$Damage\_Ratio = \frac{(\%NBS(before) - \%NBS(after))}{\%NBS(before)}$$

Recommendations

	Level of repair/strengthening required:	minor non-structural	Describe:	
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before e'quakes:	100% (##### %NBS from IEP below)	If IEP not used, please detail assessment methodology:	equivalent static
	Assessed %NBS after e'quakes:	100%		
Across	Assessed %NBS before e'quakes:	43% (##### %NBS from IEP below)		
	Assessed %NBS after e'quakes:	43%		

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Bridgewater Court Housing Complex	Reviewer:	Mary Ann Halliday
	Unit / No: / Street	CPEng No:	67073
Building Address:	Block E / 14 / Bridge Street	Company:	OPUS International Consultants Ltd
Legal Description:		Company project number:	6-QC318.00
		Company phone number:	6433635400
	Degrees / Min / Sec		
GPS south:	-43.52221246	Date of submission:	Oct-13
GPS east:	172.7349351	Inspection Date:	12-Jul-13
		Revision:	Final
Building Unique Identifier (CCC):	PRO 1347	Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:		Soil Profile (if available):	
Site Class (to NZS1170.5):			
Proximity to waterway (m, if <100m):		If Ground improvement on site, describe:	
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	1.00

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m):
Ground floor split?	no		Ground floor elevation above ground (m):
Storeys below ground	0		
Foundation type:	mat slab		if Foundation type is other, describe:
Building height (m):			height from ground to level of uppermost seismic mass (for IEP only) (m):
Floor footprint area (approx):			
Age of Building (years):	36	Date of design:	1976-1992
Strengthening present?		If so, when (year)?	
		And what load level (%g)?	
Use (ground floor):	multi-unit residential	Brief strengthening description:	
Use (upper floors):			
Use notes (if required):			
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	frame system		
Roof:	timber truss	truss depth, purlin type and cladding	
Floors:	concrete flat slab	slab thickness (mm)	
Beams:	timber	type	
Columns:	timber	typical dimensions (mm x mm)	
Walls:			

Lateral load resisting structure

Lateral system along:	lightweight timber framed walls	**Note: Define along and across in detailed report!**		
Ductility assumed, μ:	2.00		note typical wall length (m)	
Period along:	0.10	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	lightweight timber framed walls			
Ductility assumed, μ:	2.00		note typical wall length (m)	
Period across:	0.10	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	

Separations:

north (mm):		leave blank if not relevant
east (mm):		
south (mm):		
west (mm):		

Non-structural elements

Stairs:			
Wall cladding:	brick or tile	describe (note cavity if exists)	
Roof Cladding:	Metal	describe	light weight
Glazing:	aluminium frames		
Ceilings:	strapped or direct fixed		
Services(list):			

Available documentation

Architectural	full	original designer name/date	1976
Structural	none	original designer name/date	
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

Damage

Site: (refer DEE Table 4-2)

Site performance:		Describe damage:	
Settlement:		notes (if applicable):	
Differential settlement:		notes (if applicable):	
Liquefaction:		notes (if applicable):	
Lateral Spread:		notes (if applicable):	
Differential lateral spread:		notes (if applicable):	
Ground cracks:		notes (if applicable):	
Damage to area:		notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):			
Across	Damage ratio:	0%		
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	yes	Describe:	stepped cracking to exterior veneers

$$Damage\_Ratio = \frac{(\%NBS\,(before) - \%NBS\,(after))}{\%NBS\,(before)}$$

Recommendations

	Level of repair/strengthening required:	minor non-structural	Describe:	
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before e'quakes:	97%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology: equivalent static
	Assessed %NBS after e'quakes:	97%		
Across	Assessed %NBS before e'quakes:	43%	##### %NBS from IEP below	
	Assessed %NBS after e'quakes:	43%		

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Bridgewater Court Housing Complex
Building Address:	Block F — Unit No: 14 — Street: Bridge Street
Legal Description:	
GPS south (Degrees / Min / Sec):	-43.52221246
GPS east (Degrees / Min / Sec):	172.7349351
Building Unique Identifier (CCC):	PRO 1347

Reviewer:	Mary Ann Halliday
CPEng No:	67073
Company:	OPUS International Consultants Ltd
Company project number:	6-QC318.00
Company phone number:	6433635400
Date of submission:	Oct-13
Inspection Date:	12-Jul-13
Revision:	Final
Is there a full report with this summary?	yes

Site

Site slope:	flat
Soil type:	
Site Class (to NZS1170.5):	
Proximity to waterway (m, if <100m):	
Proximity to clifftop (m, if < 100m):	
Proximity to cliff base (m,if <100m):	
Max retaining height (m):	
Soil Profile (if available):	
If Ground improvement on site, describe:	
Approx site elevation (m):	1.00

Building

No. of storeys above ground:	1 (single storey = 1)
Ground floor split?	no
Storeys below ground	0
Foundation type:	mat slab
Building height (m):	
Floor footprint area (approx):	
Age of Building (years):	36
Ground floor elevation (Absolute) (m):	
Ground floor elevation above ground (m):	
if Foundation type is other, describe:	
height from ground to level of uppermost seismic mass (for IEP only) (m):	
Date of design:	1976-1992
Strengthening present?	
If so, when (year)?	
And what load level (%g)?	
Brief strengthening description:	
Use (ground floor):	multi-unit residential
Use (upper floors):	
Use notes (if required):	
Importance level (to NZS1170.5):	IL2

Gravity Structure

Gravity System:	frame system		
Roof:	timber truss	truss depth, purlin type and cladding	
Floors:	concrete flat slab	slab thickness (mm)	
Beams:	timber	type	
Columns:	timber	typical dimensions (mm x mm)	
Walls:			

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	lightweight timber framed walls			
Ductility assumed, μ:	2.00		note typical wall length (m)	
Period along:	0.10	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	lightweight timber framed walls			
Ductility assumed, μ:	2.00		note typical wall length (m)	
Period across:	0.10	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	

Separations:

leave blank if not relevant

north (mm):	
east (mm):	
south (mm):	
west (mm):	

Non-structural elements

Stairs:			
Wall cladding:	brick or tile	describe (note cavity if exists)	
Roof Cladding:	Metal	describe	light weight
Glazing:	aluminium frames		
Ceilings:	strapped or direct fixed		
Services(list):			

Available documentation

Architectural	full	original designer name/date	1976
Structural	none	original designer name/date	
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

Damage

Site:
(refer DEE Table 4-2)

Site performance:		Describe damage:	
Settlement:		notes (if applicable):	
Differential settlement:		notes (if applicable):	
Liquefaction:		notes (if applicable):	
Lateral Spread:		notes (if applicable):	
Differential lateral spread:		notes (if applicable):	
Ground cracks:		notes (if applicable):	
Damage to area:		notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):			
Across	Damage ratio:	0%		
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	yes	Describe:	stepped cracking to exterior veneers

$$Damage\_Ratio = \frac{(\%NBS\,(before) - \%NBS\,(after))}{\%NBS\,(before)}$$

Recommendations

	Level of repair/strengthening required:	minor non-structural		Describe:	
	Building Consent required:	no		Describe:	
	Interim occupancy recommendations:	full occupancy		Describe:	
Along	Assessed %NBS before e'quakes:	100%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology:	equivalent static
	Assessed %NBS after e'quakes:	100%			
Across	Assessed %NBS before e'quakes:	54%	##### %NBS from IEP below		
	Assessed %NBS after e'quakes:	54%			

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