Christchurch City Council

Resolution Courts Retirement Village BE 0578 EQ2

Detailed Engineering Evaluation

Quantitative Assessment Report

OPUS

Christchurch City Council

Resolution Courts Retirement Village BE 0578 EQ2

Quantitative Assessment Report

5 Resolution Place, Bryndwr, Christchurch

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Summary

Resolution Courts Retirement Village
BE 0578 EQ2

Detailed Engineering Evaluation
Quantitative Report - Summary
Final

Background
This is a summary of the quantitative report for the Resolution Court Retirement Village, 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 20 residential units on the site.

Key Damage Observed
Minor damage was observed evenly around both blocks. The damage consisted mostly of minor cracking in block masonry veneers and external blockwork as well as internal and external cracking around windows and door frames. Corrosion of exposed reinforcing was observed on the balcony of Units 10/12. There has also been damage to roof trusses.

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

Indicative Building Strength
None of the buildings on the site are considered to be earthquake prone.

Block 1 has a seismic capacity of 35%NBS and is therefore classed as a moderate risk building.

Block 2 has a seismic capacity of 34%NBS and is therefore classed as a moderate risk building.

Recommendations
- A seismic strengthening scheme should be developed to increase the seismic capacity of the buildings to at least 67%NBS.
- Cost estimates should be obtained to quantify the cost of strengthening the building.

We also recommend further detailed investigation including;

- Undertake intrusive investigation as required to determine if there is a mechanical fixing between the walls and the ceiling or roof system.

Contents

1 Introduction

Opus International Consultants Limited has been engaged by the Christchurch City Council to undertake a detailed seismic assessment of the Resolution Court Retirement Village, located at 5 Resolution Place, Bryndwr, Christchurch, following the Canterbury Earthquake Sequence which began September 2010.

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) [3] [4].

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	Improvement of Structural Performance	
					Legal Requirement	NZSEE Recommendation
Low Risk Building	A or B	Low	Above 67	Acceptable (improvement may be desirable)	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
Moderate Risk Building	B or C	Moderate	34 to 66	Acceptable legally. Improvement recommended		Not recommended. Acceptable only in exceptional circumstances
High Risk Building	D or E	High	33 or lower	Unacceptable (Improvement required under Act)	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 DBH guidance document dated 12 June 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 2 blocks with a total of 20 residential units. Block 1 consists of Units 1-5 and Block 2 Units 6-20. A site plan showing the locations of the Units is shown in Figure 2. A selection of images from the drawings have been included to provide clarity as to the construction form, these are shown in Figures 2 – 8.

In general, the buildings are constructed of reinforced concrete blockwork walls between the foundation and first floor with timber framed walls with lightweight cement cladding between first floor and roof. The partition walls between both single storey and two-storey units are reinforced concrete blockwork walls. External staircases are timber with steel stringers concrete landings. The single storey Units; 1, 18, 19 and 20 are constructed of timber framing with lightweight cement cladding. All first floors are constructed from 'unispan' prestressed concrete slab with a reinforced concrete topping. Internal partition walls are timber framed, gib-board lined walls. Timber trussed roof trusses support concrete tiles on timber purlins. External walls and ceilings are lined with 9.5mm gib-board. Foundations are reinforced concrete strip footings.

The structural engineer's drawings indicate that the buildings were designed in 1978 with an extension to Unit 18 in 1998.

Figure 2: Site plan of Resolution Court retirement village (Sourced from Google Earth)

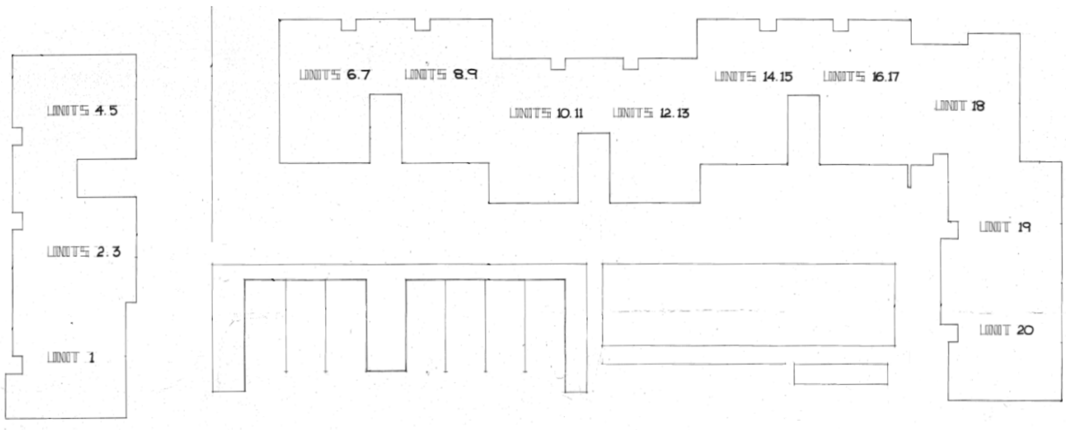


Figure 3: Site plan of Resolution Court showing Unit numbers.

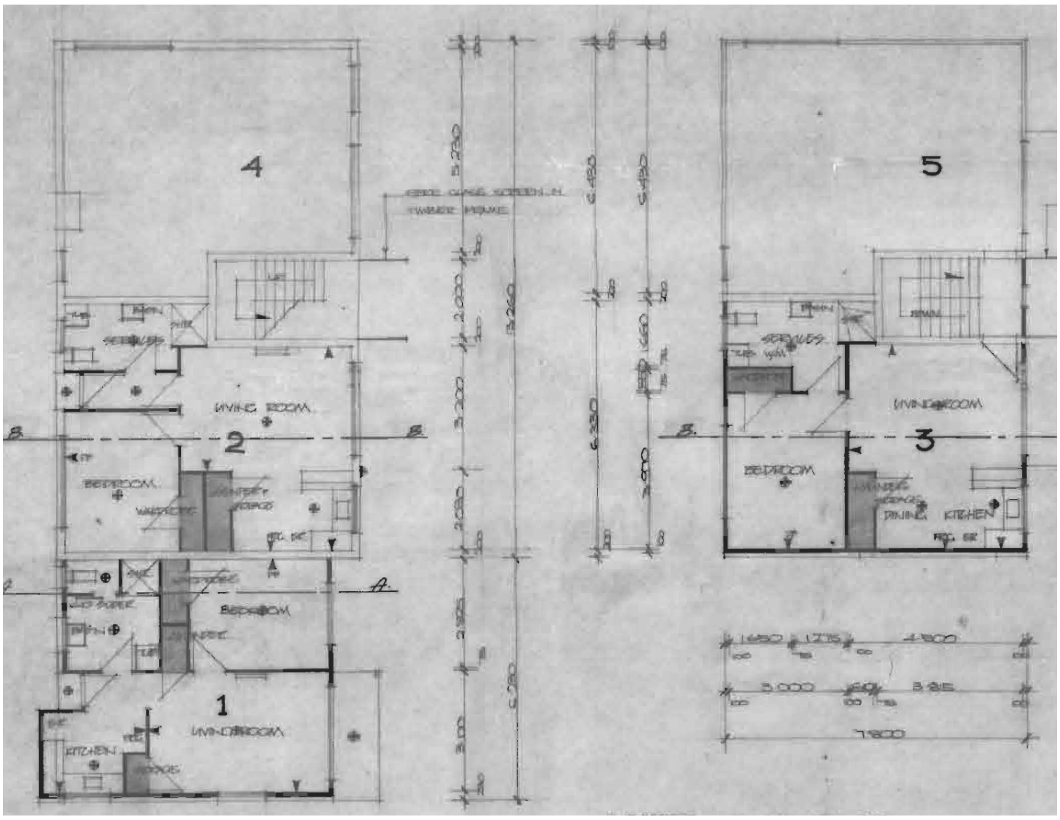


Figure 4: Floor plan of Units 1-5

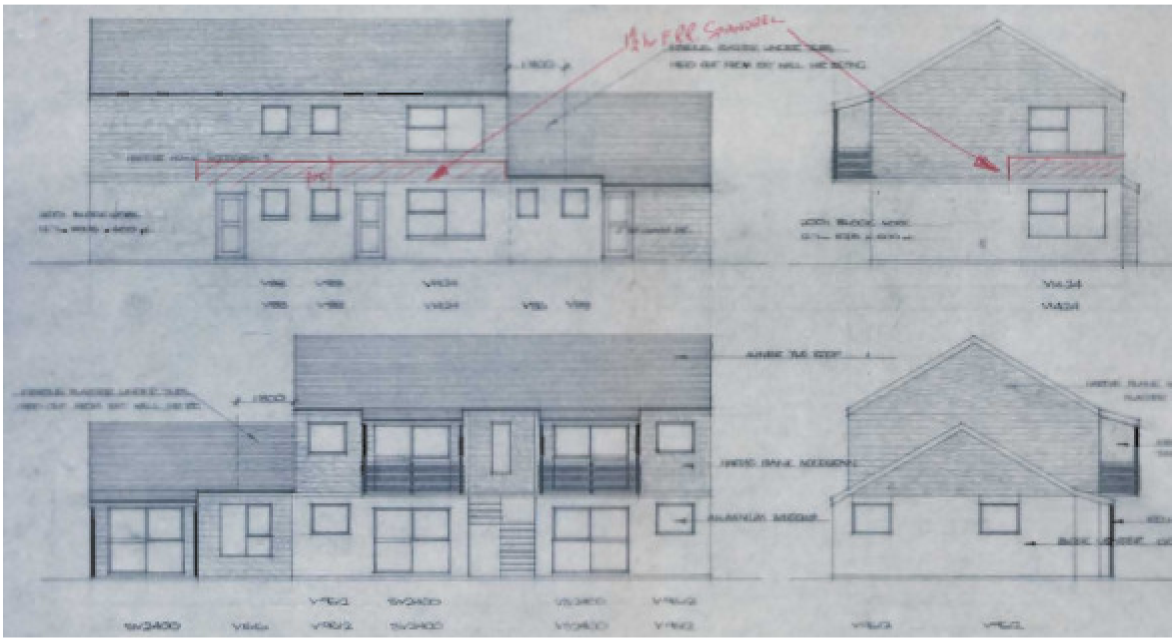


Figure 5: Elevations of Units 1-5

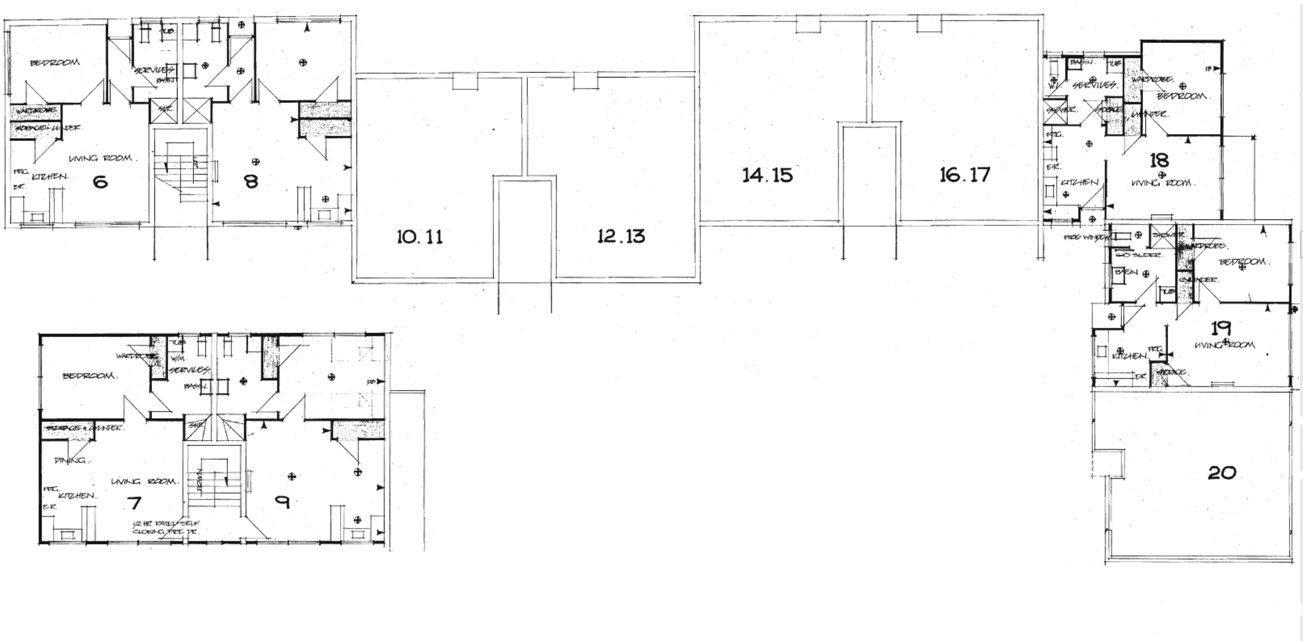


Figure 6: Floor plan of Units 6-20

Figure 7: Elevations of Units 6-20.

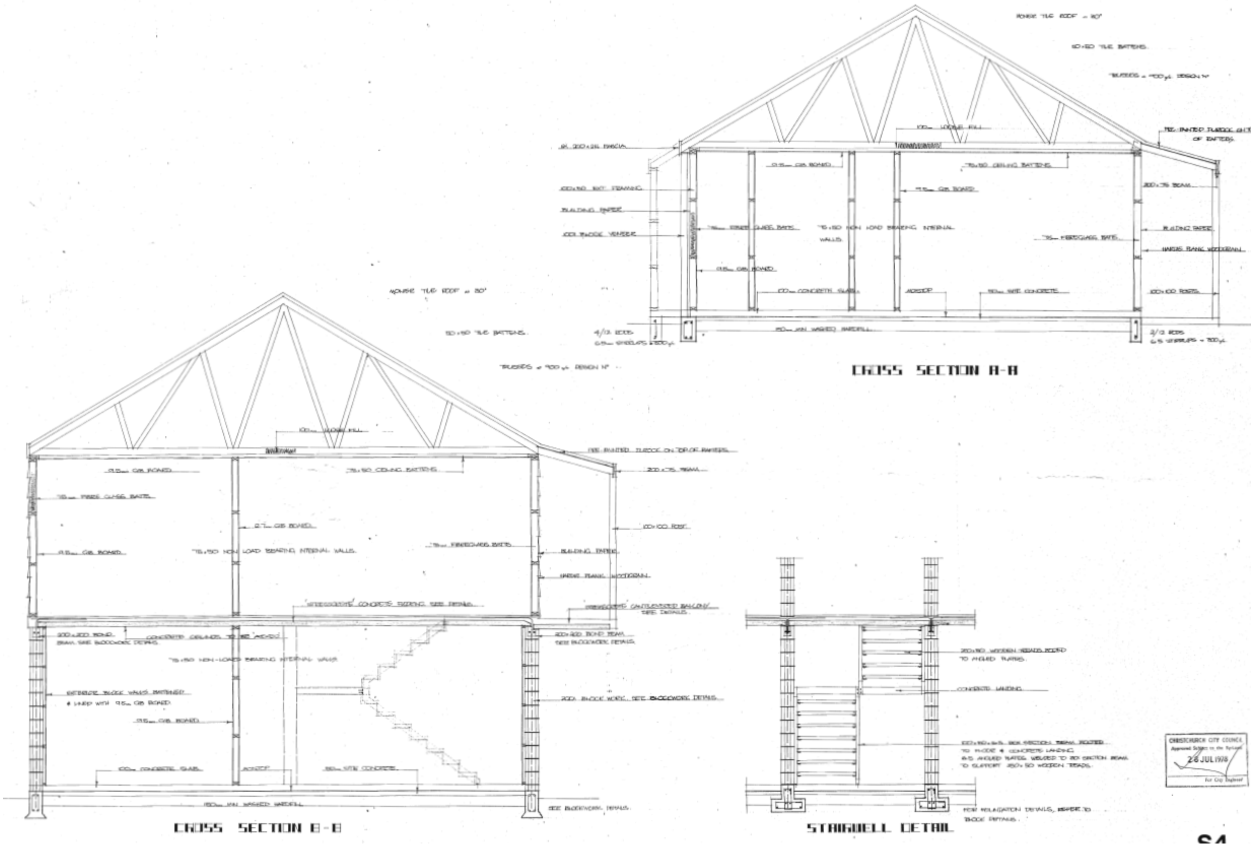


Figure 8: Cross-sections through the single-storey and two-storey units.

4.2 Survey

An initial site visit was undertaken by Opus International Consultants on 16 November 2012 with a follow up investigation on 15 February 2013. Internal and external cracking was observed as well as damage to roof trusses. A summary of the damage is provided in Section 5.

4.3 Original Documentation

Copies of the following construction drawings were provided by CCC:

- Plans, elevations, sections and details for the construction of all units by Warren R. Lewis Consulting Engineers.

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 the 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 able to be identified with only a visual inspection.

5.1 Residual Displacements

Minor permanent ground damage was observed; this appeared to be less than 10mm vertically as identified between the building foundation and concrete entranceways. There was also some evidence of ground movement as some downpipes had pulled away from the walls (refer to photos in Appendix A).

5.2 Foundations

Small cracks were observed in the concrete foundations at Units 1-5 (refer to photos 2 and 13, Appendix A).

5.3 Primary Gravity Structure

Some trusses throughout the 2 storey blocks had broken connections, the damage appeared to be in the vicinity of the stairwell between each of the upper storey units, however the damage was limited to 1 broken connection per lot, this being 2 units (refer to photos 3, 14 and 15, Appendix A).

5.4 Primary Lateral-Resistance Structure

Staircase cracking was identified in the reinforced concrete block walls along the south east elevation of Block 2; this was located at the join between each of the lots. Some cracking included breaks through the concrete block; the cracks appeared to be up to 3-5mm wide in some locations (refer to photos 18, 19 and 20, Appendix A).

5.5 Non Structural Elements

Several units suffered cracking damage to window and door frames both externally and internally. Cracks of up to 5mm were observed in the exterior block work veneer.

In addition, corrosion of reinforcing has forced cover concrete to come free from the slab on the balcony of Unit 10/12 leaving the reinforcing steel fully exposed.

Several bows and buckles were observed in the roof trusses and some members were split parallel to the grain (often due to a knot or other defect exacerbated by loading).

Refer to photos 4, 5, 16, 17, 20 and 21, Appendix A.

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.

7 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.

7.1 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 the buildings.

7.2 Quantitative Assessment Methodology

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

Hand calculations were performed to determine seismic forces from the current building codes. For the reinforced concrete blockwork walls, forces at first floor level were distributed to the ground via walls in accordance with their relative stiffness as the first floor can act as a rigid diaphragm. The first floor timber walls are considered to distribute forces from roof level to first floor level by tributary area. The capacities of the walls were calculated and used to estimate the % NBS.

7.3 Limitations and Assumptions in Results

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

7.4 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, as these effectively define the building's capacity. Other elements within the building may have significantly greater capacity when compared with the governing elements. This will be considered further when developing the strengthening options.

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 One		
Block 1 ground floor: Units 1.	Bracing capacity of gib-lined timber stud walls in transverse direction.	100%
Block 1 ground floor: Units 2, 4.	Bracing capacity of RC masonry shear walls in transverse direction.	86%
	Bracing capacity of RC masonry shear walls in longitudinal direction.	36%
Block 1 1st floor: Units 3, 5.	Bracing capacity of gib-lined timber stud walls in transverse direction.	35%
	Bracing capacity of gib-lined timber stud walls in longitudinal direction.	38%
	Bracing capacity of RC masonry shear walls in transverse direction.	100%
Block Two – Two Storey		
Block 2 ground floor: Units 6, 8, 10, 12, 14, 16.	Bracing capacity of RC masonry shear walls in transverse direction.	97%
	Bracing capacity of RC masonry shear walls in longitudinal direction.	48%

Block 2 1st floor: Units 7, 9, 11, 13, 15, 17.	Bracing capacity of gib-lined timber stud walls in transverse direction.	35%
	Bracing capacity of gib-lined timber stud walls in longitudinal direction.	38%
	Bracing capacity of RC masonry shear walls in transverse direction.	100%
Block Two – Single Storey		
Block 2 single storey: Units 18, 19, 20.	Bracing capacity of gib-lined timber stud walls in transverse direction.	34%
	Bracing capacity of gib-lined timber stud walls in longitudinal direction.	43%
All Buildings		
All buildings:	First floor fire walls between units subject to out-of-plane loading.	53%

8 Geotechnical Assessment

A geotechnical investigation report was not available at the time of writing this report. The following outlines the information available from CERA regarding the expected site performance:

The Christchurch Earthquake Recovery Authority (CERA) has rezoned the residential "green" rebuild zones into various technical categories (TC). The Resolution Courts Village is located in the Yellow-TC2 "yellow" zone, which indicates the site is likely to suffer moderate land damage from liquefaction in future significant earthquakes.

9 Conclusions

- None of the buildings on site are considered to be Earthquake Prone.
- Block 1 has a capacity of 35% NBS and is therefore deemed to be a 'moderate risk' building in a design seismic event according to NZSEE guidelines. Its level of risk is 5-10 times that of a 100% NBS building (Figure 1).
- Block 2 has a capacity of 34% NBS and is therefore deemed to be a 'moderate risk' building in a design seismic event according to NZSEE guidelines. Its level of risk is 5-10 times that of a 100% NBS building (Figure 1).

10 Recommendations

- A seismic strengthening scheme should be developed to increase the seismic capacity of the buildings to at least 67%NBS.

- Cost estimates should be obtained to quantify the cost of strengthening the building.We also recommend intrusive investigation be undertaken as required to determine if there is a mechanical fixing between the walls and the ceiling or roof system.

11 Limitations

- This report is based on an inspection of the buildings and focuses on the structural damage resulting from the Darfield and Canterbury Earthquakes and their 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 Resolution Courts. It is not intended for any other party or purpose.

12 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.

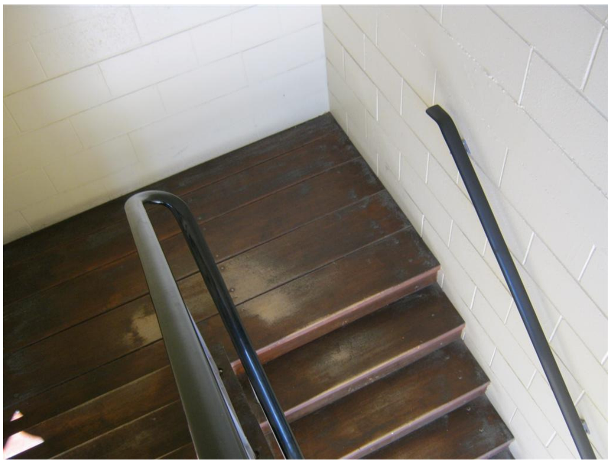
[6] DBH (2012), Guidance for engineers assessing the seismic performance of non-residential and multi-unit residential buildings in greater Christchurch, Department of Building and Housing, June 2012.

Appendix A - Photographs

Resolution Courts		
No.	Item description	Photo
Block 1 Residential Units 1-5		
1.	North Elevation	
2.	Typical Cracking at Units 1-5	
3.	Broken Connection in Roof Truss Member above Unit 2/4	

4.	Bowing, Twisting and Cracking of Roof Truss Members above Unit 2/4	
5.	Bowing, Twisting and Cracking of Roof Truss Members above Unit 2/4	
Block 2 Residential Units 6-20		
6.	East Elevation	

7.	East Elevation	
8.	South Elevation	
9.	South Elevation	

10.	Staircase (Typical to 2-storey units)	
11.	Extension to Unit 18 – Residents Lounge	
12.	Extension to Unit 18 – Residents Lounge (internal)	

13.	Evidence of Ground Movement	
14.	Broken Top Chord above Unit 10	
15.	Broken Top Chord above Unit 10	

16.	Buckling of Brace above Unit 12	
17.	Buckling in Truss Member above Unit 12	
18.	Cracking on South Side of Units 11/13	

19.	Cracking on South Side of Units 11/13	 
20.	Interior Damage to Unit 15	 
21.	Corrosion of Steel Reinforcing outside Units 10/12	

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 years)
- N(T,D) = 1.0

For the analysis of the reinforced concrete blockwork walls, a μ of 1.25 was assumed for walls subject to both in and out of plane loading while a μ of 2 was assumed for the timber stud walls subject to in-plane loading.

Analysis Procedure

For the reinforced concrete blockwork walls, capacities were based on the equivalent static method force-based approach whereby the seismic weight at first floor level was distributed to ground via the in-plane walls. The amount of force to each wall was determined in accordance with the relative stiffness of the wall due to the presence of a rigid diaphragm at first floor. Additional forces to walls arising from eccentricities of the wall layout were also considered.

For the timber framed walls, capacities were based on the NZS 3604 approach where base shears are converted to bracing units (1 kN = 20 BU's) and the bracing capacities were found by assuming a certain BU/m rating for the walls along each line. Due to the date of construction and material specified for the walls (gib-lined), the BU/m rating was taken as 60 for both internal and external walls. %NBS values were then found through the ratio of bracing demand to bracing capacity along each line; with a single %NBS value applicable for each block being reported due to the similarity of the blocks.

Additional Assumptions

Further assumptions about the seismic performance of the buildings were:

- Foundations and foundation connections had adequate capacity to resistance 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 Spreadsheet

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Resolution Court	Reviewer:	John Newall
	Unit No: Street	CPEng No:	1018146
Building Address:	Block One Units 1-5 / 5 Resolution Place, Bryndwr	Company:	Opus International Consultants
Legal Description:		Company project number:	6-QUCC2.23
		Company phone number:	03 363 5400
	Degrees Min Sec		
GPS south:		Date of submission:	3-Apr-13
GPS east:		Inspection Date:	16/11/2012
		Revision:	Final
Building Unique Identifier (CCC):	BE 0578 EQ2	Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	0
Soil type:	silty sand	Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
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):	

Building

No. of storeys above ground:	2 (single storey = 1)	Ground floor elevation (Absolute) (m):	
Ground floor split?	no	Ground floor elevation above ground (m):	0.00
Storeys below ground	0		
Foundation type:	strip footings	if Foundation type is other, describe:	
Building height (m):	7.40	height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	254		
Age of Building (years):	35	Date of design:	1976-1992
Strengthening present?	no	If so, when (year)?	
		And what load level (%g)?	
Use (ground floor):	multi-unit residential	Brief strengthening description:	
Use (upper floors):	multi-unit residential		
Use notes (if required):			
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber truss	truss depth, purlin type and cladding	Timber purlins, tile roof
Floors:	precast concrete with topping	unit type and depth (mm), topping	Stresscrete
Beams:			
Columns:			
Walls:	partially filled concrete masonry	thickness (mm)	190

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:				Partailly filled masonry
Ductility assumed, μ:	1.25			
Period along:	0.40	#N/A enter height above H31 and lateral system	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:				Partially filled masonry
Ductility assumed, μ:	1.25			
Period across:	0.40	#N/A enter height above H31 and lateral system	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:	timber	describe supports	Timber stairs with steel stringer concrete landing. Suppo
Wall cladding:	brick or tile	describe (note cavity if exists)	Block veneer lower level, light cladding upper
Roof Cladding:	Heavy tiles	describe	concrete tiles
Glazing:	aluminium frames		
Ceilings:			Plaster board
Services(list):			

Available documentation

Architectural	partial	original designer name/date	Enterprise Homes Ltd 1978
Structural	partial	original designer name/date	Hardie and Anderson, 1978
Mechanical		original designer name/date	
Electrical		original designer name/date	
Geotech report		original designer name/date	

Damage

Site: (refer DEE Table 4-2)

Site performance:		Describe damage:	
Settlement:	none observed	notes (if applicable):	
Differential settlement:	none observed	notes (if applicable):	
Liquefaction:	none apparent	notes (if applicable):	
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	none apparent	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:	

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

Recommendations

	Level of repair/strengthening required:	minor structural	Describe:	
	Building Consent required:		Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before e'quakes:	38% ##### %NBS from IEP below	If IEP not used, please detail assessment methodology:	Quantitative
	Assessed %NBS after e'quakes:	38%		
Across	Assessed %NBS before e'quakes:	35% ##### %NBS from IEP below		
	Assessed %NBS after e'quakes:	35%		

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Resolution Court
	Unit No: Street
Building Address:	Block 2 Units 18 to 20 | 5 | Resolution Place, Bryndwr
Legal Description:	
	Degrees Min Sec
GPS south:	
GPS east:	
Building Unique Identifier (CCC):	BE 0578 EQ2
Reviewer:	John Newall
CPEng No:	1018146
Company:	Opus International Consultants
Company project number:	6-QUCC2.23
Company phone number:	03 363 5400
Date of submission:	3-Apr-13
Inspection Date:	16/11/2012
Revision:	Final
Is there a full report with this summary?	yes

Site

Site slope:	flat
Soil type:	silty sand
Site Class (to NZS1170.5):	D
Proximity to waterway (m, if <100m):	
Proximity to clifftop (m, if < 100m):	
Proximity to cliff base (m,if <100m):	
Max retaining height (m):	0
Soil Profile (if available):	
If Ground improvement on site, describe:	
Approx site elevation (m):	

Building

No. of storeys above ground:	1 (single storey = 1)
Ground floor split?	no
Storeys below ground	0
Foundation type:	strip footings
Building height (m):	7.40
Floor footprint area (approx):	140
Age of Building (years):	35
Ground floor elevation (Absolute) (m):	
Ground floor elevation above ground (m):	0.00
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?	no
If so, when (year)?	
And what load level (%g)?	
Brief strengthening description:	
Use (ground floor):	multi-unit residential
Use (upper floors):	multi-unit residential
Use notes (if required):	
Importance level (to NZS1170.5):	IL2

Gravity Structure

Gravity System:	load bearing walls
Roof:	timber truss
Floors:	precast concrete with topping
Beams:	
Columns:	
Walls:	partially filled concrete masonry
truss depth, purlin type and cladding	Timber purlins, tile roof
unit type and depth (mm), topping	Stresscrete
thickness (mm)	190

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	(Partailly filled masonry)
Ductility assumed, μ:	1.25
Period along:	0.40 #N/A enter height above at H31 and lateral system — estimate or calculation? estimated
Total deflection (ULS) (mm):	estimate or calculation?
maximum interstorey deflection (ULS) (mm):	estimate or calculation?
Lateral system across:	(Partially filled masonry)
Ductility assumed, μ:	1.25
Period across:	0.40 #N/A enter height above at H31 and lateral system — 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:	other (specify) — describe: No stairs - single storey
Wall cladding:	brick or tile — describe (note cavity if exists): Block veneer lower level, light cladding upper
Roof Cladding:	Heavy tiles — describe: concrete tiles
Glazing:	aluminium frames
Ceilings:	Plaster board
Services(list):	

Available documentation

Architectural	partial	original designer name/date: Enterprise Homes Ltd 1978
Structural	partial	original designer name/date: Hardie and Anderson, 1978
Mechanical		original designer name/date:
Electrical		original designer name/date:
Geotech report		original designer name/date:

Damage

Site: (refer DEE Table 4-2)

Site performance:	
Describe damage:	
Settlement:	none observed
Differential settlement:	none observed
Liquefaction:	none apparent
Lateral Spread:	none apparent
Differential lateral spread:	none apparent
Ground cracks:	none apparent
Damage to area:	none apparent

Building:

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

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

Recommendations

Level of repair/strengthening required:	minor structural
Building Consent required:	
Interim occupancy recommendations:	full occupancy
Along — Assessed %NBS before e'quakes:	43% ##### %NBS from IEP below
Assessed %NBS after e'quakes:	43%
Across — Assessed %NBS before e'quakes:	34% ##### %NBS from IEP below
Assessed %NBS after e'quakes:	34%
If IEP not used, please detail assessment methodology:	Quantitative

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Resolution Court	Reviewer:	John Newall
	Unit No: 5 Street: Resolution Place, Bryndwr	CPEng No:	1018146
Building Address:	Block 2 - units 6 to 17	Company:	Opus International Consultants
Legal Description:		Company project number:	6-QUCC2.23
		Company phone number:	03 363 5400
GPS south:	Degrees / Min / Sec	Date of submission:	3-Apr-13
GPS east:		Inspection Date:	16/11/2012
		Revision:	Final
Building Unique Identifier (CCC):	BE 0578 EQ2	Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	0
Soil type:	silty sand	Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
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):	

Building

No. of storeys above ground:	2 (single storey = 1)	Ground floor elevation (Absolute) (m):	
Ground floor split?	no	Ground floor elevation above ground (m):	0.00
Storeys below ground	0		
Foundation type:	strip footings	if Foundation type is other, describe:	
Building height (m):	7.40	height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	608		
Age of Building (years):	35	Date of design:	1976-1992
Strengthening present?	no	If so, when (year)?	
		And what load level (%g)?	
Use (ground floor):	multi-unit residential	Brief strengthening description:	
Use (upper floors):	multi-unit residential		
Use notes (if required):			
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber truss	truss depth, purlin type and cladding	Timber purlins, tile roof
Floors:	precast concrete with topping	unit type and depth (mm), topping	Stresscrete
Beams:			
Columns:			
Walls:	partially filled concrete masonry	thickness (mm)	190

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:				Partailly filled masonry
Ductility assumed, μ:	1.25			
Period along:	0.40	#N/A	enter height above at H31 and lateral system	estimate or calculation? estimated
Total deflection (ULS) (mm):				estimate or calculation?
maximum interstorey deflection (ULS) (mm):				estimate or calculation?
Lateral system across:				Partially filled masonry
Ductility assumed, μ:	1.25			
Period across:	0.40	#N/A	enter height above at H31 and lateral system	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:	timber	describe supports	Timber stairs with steel stringer concrete landing. Suppo
Wall cladding:	brick or tile	describe (note cavity if exists)	Block veneer lower level, light cladding upper
Roof Cladding:	Heavy tiles	describe	concrete tiles
Glazing:	aluminium frames		
Ceilings:			Plaster board
Services(list):			

Available documentation

Architectural	partial	original designer name/date	Enterprise Homes Ltd 1978
Structural	partial	original designer name/date	Hardie and Anderson, 1978
Mechanical		original designer name/date	
Electrical		original designer name/date	
Geotech report		original designer name/date	

Damage

Site: (refer DEE Table 4-2)

Site performance:		Describe damage:	
Settlement:	none observed	notes (if applicable):	
Differential settlement:	none observed	notes (if applicable):	
Liquefaction:	none apparent	notes (if applicable):	
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	none apparent	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:	

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

Recommendations

	Level of repair/strengthening required:	minor structural	Describe:	
	Building Consent required:		Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before e'quakes:	38% ##### %NBS from IEP below	If IEP not used, please detail assessment methodology:	Quantitative
	Assessed %NBS after e'quakes:	38%		
Across	Assessed %NBS before e'quakes:	35% ##### %NBS from IEP below		
	Assessed %NBS after e'quakes:	35%		

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