Christchurch City Council

Margaret Murray Courts
BE 0208 EQ2

Detailed Engineering Evaluation

Quantitative Assessment Report

Christchurch City Council

Margaret Murray Courts

BE 0208 EQ2

Quantitative Assessment Report

Prepared By

Michael Moran
Structural Engineer

Reviewed By

John Newall
Structural Engineer
CPEng 1018146

Approved for Release By

Mary Ann Halliday
Structural Engineer
CPEng 67073

Opus International Consultants Ltd
Christchurch Office
20 Moorhouse Avenue
PO Box 1482, Christchurch Mail Centre, Christchurch 8140
New Zealand

Telephone: +64 3 363 5400
Facsimile: +64 3 365 7858

Date: March 2013
Reference: 6-QUCC2.22
Status: Final

Summary

Margaret Murray Courts
BE 0208 EQ2

Detailed Engineering Evaluation
Quantitative Report - Summary
Final

Background
This is a summary of the quantitative report for Margaret Murray Courts located at 193 Withells Road, Avonhead, Christchurch and is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011.

Key Damage Observed
No major damage was observed

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

Indicative Building Strength
All blocks at Margaret Murray Courts are rated at 52%NBS and are considered not to be earthquake prone and are considered to be moderate risk in accordance with NZSEE guidelines.

Recommendations
It is recommended that the buildings are strengthened to increase their seismic capacity to at least 67%NBS.

Contents

1 Introduction

Opus International Consultants Limited has been engaged by the Christchurch City Council to undertake a detailed earthquake assessment of Margaret Murray Courts, residential housing, located at 193 Withells Road, Avonhead, Christchurch, following the Canterbury Earthquake Sequence which began September 2010.

The purpose of the assessment is to determine if the buildings on the site 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	Improvement of Structural Performance: 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

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

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.

4 Background Information

4.1 Building Descriptions

Margaret Murray Courts comprises of three buildings, namely Blocks A, B & C (refer Figure 2). The three blocks are partly single storey and partly two storey and were constructed c.1989 to a design by the Waimairi District Council.

Block A contains units 1 to 7; units 1,2,5,6 & 7 are situated at ground floor level and units 4 & 5 are situated at first floor level.

Block B contains units 8 to 11; units 8, 9 & 11 are situated at ground floor level and unit 10 is situated at first floor level.

Block C contains units 12 to 19 (there is no unit 13); units 12, 14, 15, 18 & 19 are situated at ground floor level and units 16 & 17 are situated at first floor level.

Common walls between the units of all three blocks are formed with reinforced concrete masonry (RCM). An in-situ 140mm thick reinforced concrete slab at first floor bounds the walls supporting the first floor portion of the three blocks.

The roof structure of the three blocks is formed with timber trussed rafters with timber purlins between supporting a light weight corrugated iron roof deck over.

The foundations of the three blocks comprise of reinforced concrete foundation walls generally. A reinforced concrete ground bearing slab provides the ground level floor to all three blocks.

Figure 2: Site location plan of Margaret Murray Courts, Blocks A, B & C.

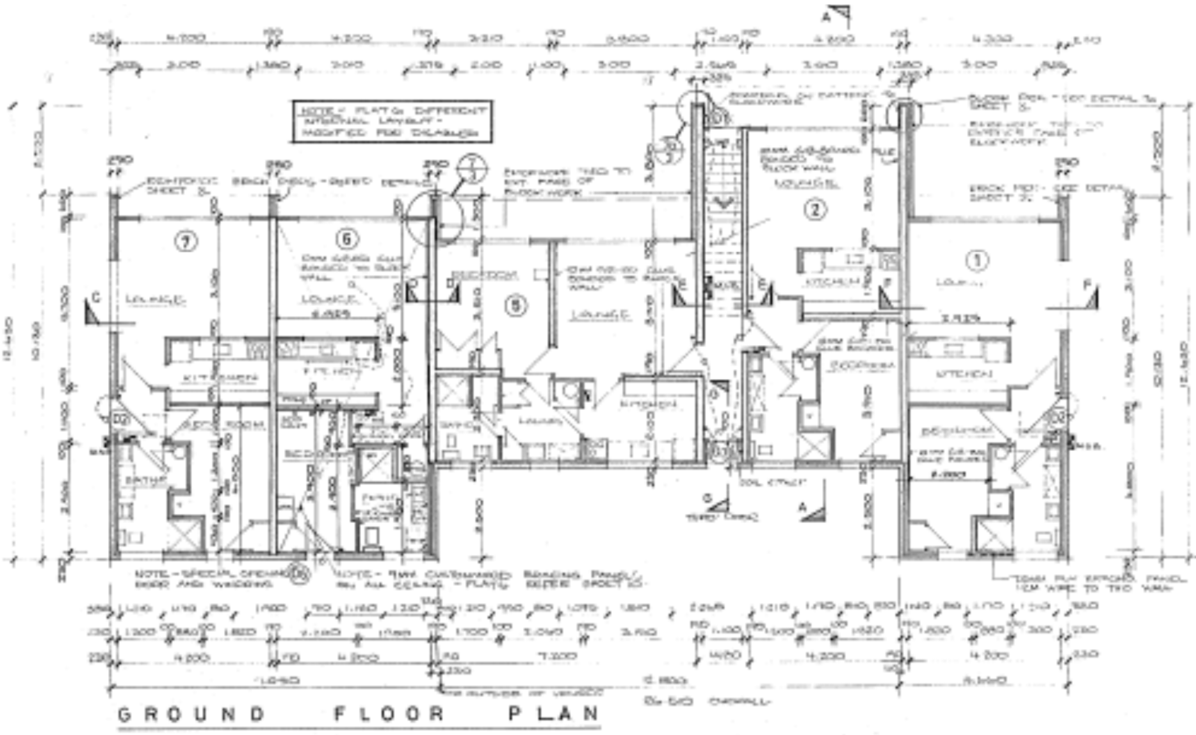

Figure 3: Ground floor plan of Block A

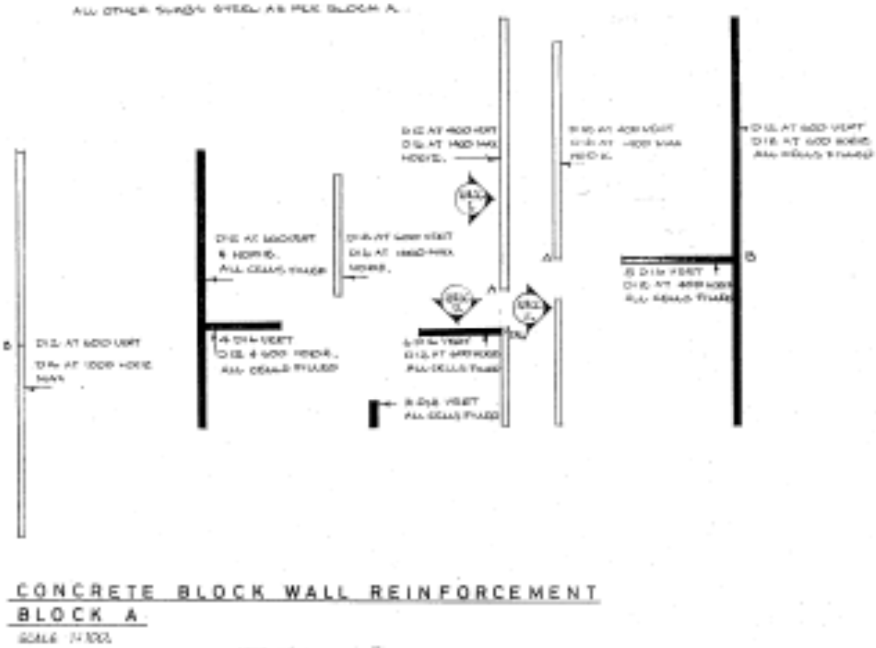

Figure 4: Block A RCM walls

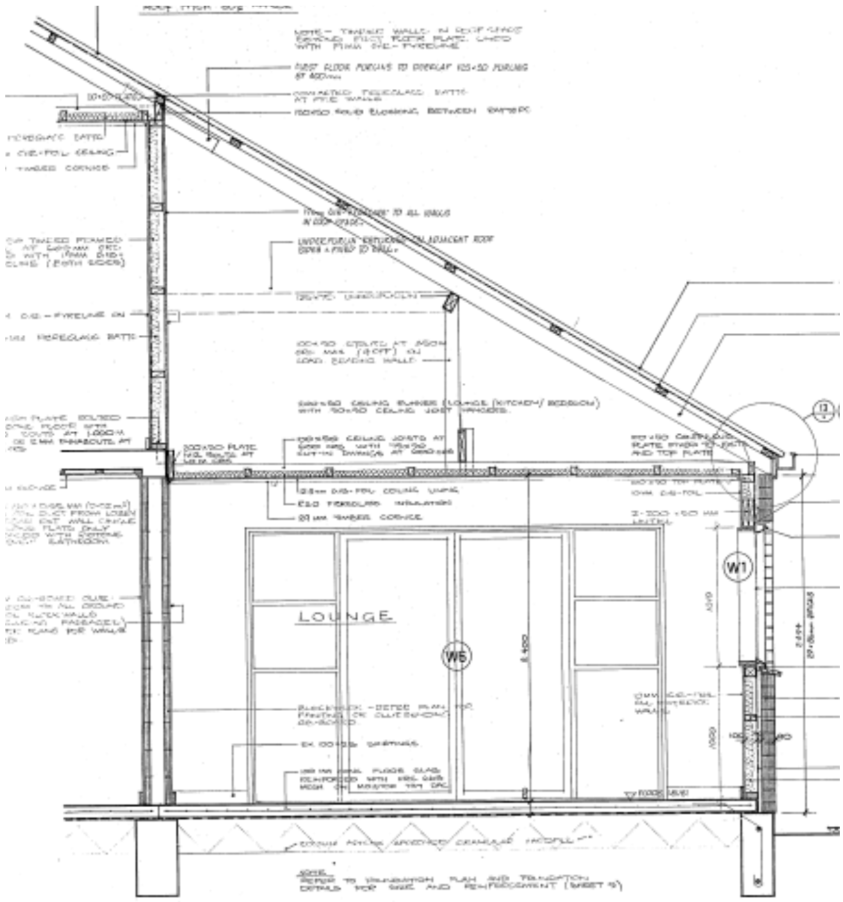

Figure 5: Typical section showing junction between single and two storey building portions.

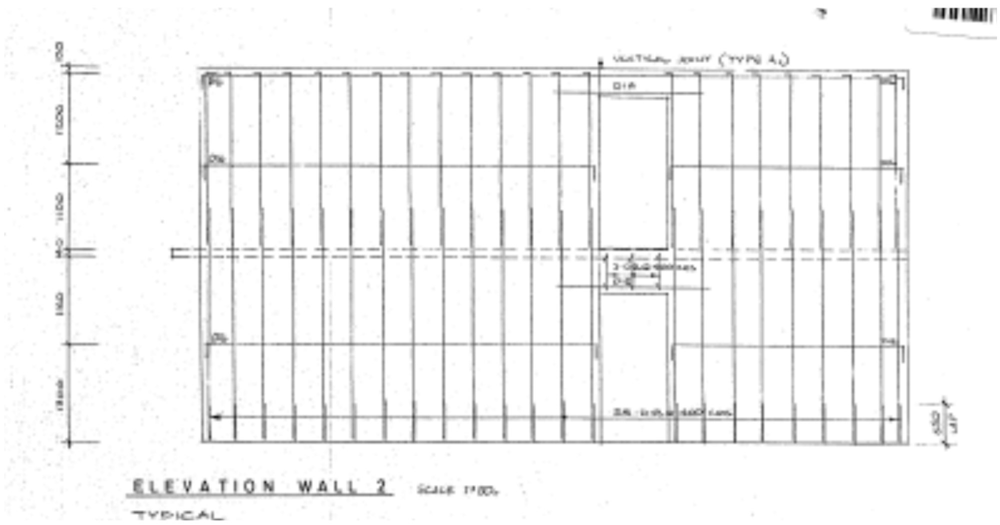

Figure 6: Elevation on typical two storey RCM wall

4.2 Survey

4.2.1 Post 22 February 2011 Rapid Assessment

A structural (Level 1) assessment of Unit 4 was undertaken on 11th March 2011 by Opus International Consultants. Minor/none damage was observed throughout.

4.2.2 Further Inspections

A further inspection was undertaken by Opus International Consultants on 18 January 2013. Minor damage was observed. A summary of the damage is provided in Section 5.

4.3 Original Documentation

Copies of the following construction drawings were provided by CCC:

- Original Waimairi District Council architectural and structural drawings.

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 able to be identified from a visual inspection.

5.1 Residual Displacements

The site showed evidence of settlement in various locations, especially around entrances to the various flats, causing ponding of water during rain.

5.2 Foundations

No noticeable damage to the foundations of the buildings was observed.

5.3 Primary Gravity Structure

No noticeable damage to the gravity structure of the buildings was observed.

5.4 Primary Lateral-Resistance Structure

No noticeable damage to the lateral-resistance structure was observed.

5.5 Non Structural Elements

Some minor damage was noted such as cracking in brick veneer grout and cracking to block work at the base of the Unit 3/4 interior staircase and 1st floor level.

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.

As the majority of the residential units (all but Units 1 and 2) have the same floor plan, the analysis was simplified by conducting the analysis of each multi-unit block once for each cladding type (brick veneer or block veneer).

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. During the initial qualitative stage of the assessment the following potential CSW's were identified for each of the buildings and have been considered in the quantitative analysis.

No critical structural weaknesses were identified in the buildings.

6.2 Quantitative Assessment Methodology

The assessment assumptions and methodology have been included in Appendix 2. 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 or relative rigidity for walls connected by rigid diaphragms. The capacities of the walls were calculated and used to estimate the % NBS.

6.3 Limitations and Assumptions in Results

Our analysis and assessment is based on an assessment of the building in its undamaged state. 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.

6.4 Gravity Load Resisting System

Reinforced concrete masonry (RCM) walls support a 140mm thick reinforced concrete slab at first floor level in the vicinity of the first floor units and support the timber trussed rafter roof areas at eaves levels. The upper level floor slab had two layers of reinforcing steel providing a more robust load path for lateral loads.

The RCM walls are supported off reinforced concrete foundation walls which are in turn anchored into the ground floor slab.

6.5 Seismic Load Resisting System

6.5.1 Longitudinal

Where the ground floor walls are contained by the first floor reinforced concrete slab, which acts as a rigid diaphragm, lateral forces are resisted by the RCM walls through in-plane shear resistance with forces being distributed by the diaphragm according to the in-plane stiffness of the walls.

The timber frame walls of the single storey units and first floor walls of the first floor units act as lines of bracing resistance for the roof structure to span between. In these areas ceiling linings provide a diaphragm between timber frame walls.

6.5.2 Transverse

Where the ground floor walls are contained by the first floor reinforced concrete slab, which acts as a rigid diaphragm, lateral forces are resisted by the RCM walls through in-plane shear resistance with forces being distributed by the diaphragm according to the in-plane stiffness of the walls.

The timber frame walls of the single storey units and first floor walls of the first floor units act as lines of bracing resistance for the roof structure to span between. In these areas ceiling linings provide a diaphragm between timber frame walls.

6.6 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.
Blocks A & C		
Longitudinal		
Ground floor RCM walls	In-plane, shear	82%
1st floor timber stud walls	In-plane, bracing	71%
Single storey flank units, timber stud walls	In-plane, bracing	52%
Ground & 1st floor RCM walls	Out-of-plane, flexure	>100%
Transverse		
Ground floor RCM walls	In-plane, shear	82%
1st floor timber stud walls	In-plane, shear	>100%
Single storey flank units, timber stud walls	In-plane, bracing	>100%
Ground floor RCM walls	Out-of-plane, flexure	>100%
Block B		
Longitudinal		
Ground floor RCM walls	In-plane, shear	82%
1st floor timber stud walls	In-plane, bracing	71%
Single storey flank units, timber stud walls	In-plane, bracing	52%
Ground & 1st floor RCM walls	Out-of-plane, flexure	>100%
Transverse		
Ground floor RCM walls	In-plane, shear	>100%

1st floor timber stud walls	In-plane, bracing	>100%
Single storey flank units, timber stud walls	In-plane, bracing	>100%
Ground floor RCM walls	Out-of-plane, flexure	>100%

6.7 Discussion of results

The ground floor RCM walls are rated at 82%NBS. The satisfactory result is primarily due to the regular spacing and total length of RCM walls available to resist seismic forces.

There are no first floor RCM walls within Block B, as a result, the ground floor RCM walls are subject to a lower force level and are rated at >100%NBS.

The timber bracing walls of the single storey flank units perform satisfactorily due to the sufficient lengths of bracing available, and more generally, regular spacing of the bracing lines in each orthogonal direction; the walls are rated at 52%NBS for Blocks A & C and >100%NBS for Block B.

7 Geotechnical Appraisal

Due to a lack of observed ground damage, no geotechnical assessment has been carried out at the site. The site is surrounded by TC1 category land.

8 Conclusions

Margaret Murray Courts have been assessed to have the following ratings:

- Blocks A & C have a rating of 52%NBS and are therefore deemed to be "Moderate Risk" buildings in a design seismic event according to NZSEE guidelines. It should be noted that their rating is limited to 52%NBS by the single storey flank units only; the remainder of the two structures are rated above 67%NBS.
- Block B has a rating of 52%NBS and is therefore deemed to be a "Moderate Risk" building in a design seismic event according to NZSEE guidelines.

9 Recommendations

It is recommended that Blocks A, B and C are strengthened to increase the seismic capacity to at least 67%NBS.

10 Limitations

- This report is based on an inspection of the buildings and focuses on the structural damage resulting from the Canterbury Earthquake Sequence which began September 2010 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 Concord Place retirement village. 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] 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 1 - Photographs

Margaret Murray Courts		
No.	Item description	Photo
1	View on North elevation, Block A	
2	View on South elevation, Block A	

3	View on North East elevation, Blocks A & B	
4	View on North elevation, Block C	

5	Cracking of inter-tenancy blockwork wall. Block A stairwell, unit 3/4	
6	Cracking of inter-tenancy blockwork wall. Block A facade, unit 3/4	

Appendix 2 - 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 1.25 was utilised for the in-plane shear response of the reinforced concrete masonry shear walls while a μ of 2.0 was utilised for the in-plane bracing capacity of the timber stud, Gib Board lined walls.

Analysis Procedure

Storey forces where calculated using ESM.

The single storey flank units to all three blocks were analysed in each orthogonal direction based on the tributary area of weight associated with each bracing/ wall line due to the limited strength and stiffness of the ceiling level Gib Board diaphragms. Transversely, the ceiling level diagrams distributed force to the reinforced concrete masonry shear walls positioned on the common walls lines. Longitudinally, the ceiling level diaphragms distributed force into regularly spaced, timber stud walls lined with Gib Board.

The first floor slabs of the three blocks act as a rigid diaphragm and therefore the force at this level is distributed to the reinforced concrete masonry walls according to their combined flexural and shear stiffness for each orthogonal direction.

Timber stud wall 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.

Additional Assumptions

Further assumptions about the seismic performance of the buildings were:

- 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 3 – CERA DEE Spreadsheets

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Margaret Murray Court, Blocks A & C	Reviewer:	John Newall
	Unit / No: 193 / Street: Withells Road	CPEng No:	1018146
Building Address:	193 Withells Road, Avonhead	Company:	Opus International Consultants Ltd
Legal Description:		Company project number:	6-QUCC2.22 R01
		Company phone number:	+64 3 363 5400
GPS south:	Degrees 43, Min 30, Sec 44.18	Date of submission:	18/03/2013
GPS east:	Degrees 172, Min 33, Sec 18.17	Inspection Date:	15-Feb-13
		Revision:	Final
Building Unique Identifier (CCC):	BE 0208 EQ2	Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	gravel	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):	20.00

Building

No. of storeys above ground:	2 (single storey = 1)	Ground floor elevation (Absolute) (m):	20.00
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):	7.00	height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	300		
Age of Building (years):	23	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 framed	rafter type, purlin type and cladding	Timber trussed rafters with Cor. Iron Deck
Floors:	concrete flat slab	slab thickness (mm)	140mm thick in-situ RC slab
Beams:	none	overall depth x width (mm x mm)	
Columns:	other (note)	typical dimensions (mm x mm)	none
Walls:	partially filled concrete masonry	thickness (mm)	

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	partially filled CMU	note total length of wall at ground (m):	10
Ductility assumed, μ:	1.25	wall thickness (m):	0.29
Period along:	0.40 ##### enter height above at H31	estimate or calculation?	estimated
Total deflection (ULS) (mm):		estimate or calculation?	
maximum interstorey deflection (ULS) (mm):		estimate or calculation?	
Lateral system across:	partially filled CMU	note total length of wall at ground (m):	32
Ductility assumed, μ:	1.25	wall thickness (m):	0.29
Period across:	0.40 ##### enter height above at H31	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:	other (specify)	describe	
Wall cladding:	brick or tile	describe (note cavity if exists)	Brick veneer generally and weather board
Roof Cladding:	Metal	describe	Cor. Iron roof deck
Glazing:	timber frames		
Ceilings:	plaster, fixed		
Services(list):			

Available documentation

Architectural	none	original designer name/date	
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:	Good	Describe damage:	None observed
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):	No apparent structural damage		
Across	Damage ratio:	0%		
	Describe (summary):	No apparent structural damage		
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	no	Describe:	

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

Recommendations

Level of repair/strengthening required:	none	Describe:	
Building Consent required:	no	Describe:	
Interim occupancy recommendations:	full occupancy	Describe:	

Along	Assessed %NBS before:	52%	27% %NBS from IEP below
	Assessed %NBS after:	52%	
Across	Assessed %NBS before:	82%	27% %NBS from IEP below
	Assessed %NBS after:	82%	

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name: Margaret Murray Court, Block B
No: 193 Street: Withells Road
Building Address: 193 Withells Road, Avonhead
Legal Description:

	Degrees	Min	Sec
GPS south:	43	30	44.18
GPS east:	172	33	18.17

Building Unique Identifier (CCC): BE 0208 EQ2

Reviewer: John Newall
CPEng No: 1018146
Company: Opus International Consultants Ltd
Company project number: 6-QUCC2.22 R01
Company phone number: +64 3 363 5400
Date of submission: 18/03/2013
Inspection Date: 15-Feb-13
Revision: Final
Is there a full report with this summary? yes

Site

Site slope: flat
Soil type: gravel
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):
Soil Profile (if available):
If Ground improvement on site, describe:
Approx site elevation (m): 20.00

Building

No. of storeys above ground: 2 — single storey = 1
Ground floor split? no
Storeys below ground: 0
Foundation type: strip footings
Building height (m): 7.00
Floor footprint area (approx): 200
Age of Building (years): 23

Ground floor elevation (Absolute) (m): 20.00
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 framed — rafter type, purlin type and cladding: Timber trussed rafters with Cor. Iron Deck
Floors: concrete flat slab — slab thickness (mm): 140mm thick in-situ RC slab
Beams: none — overall depth x width (mm x mm):
Columns: other (note) — typical dimensions (mm x mm): none
Walls: partially filled concrete masonry — thickness (mm):

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along: partially filled CMU — note total length of wall at ground (m): 6
Ductility assumed, μ: 1.25 — wall thickness (m): 0.29
Period along: 0.40 ##### enter height above at H31 — estimate or calculation? estimated
Total deflection (ULS) (mm): — estimate or calculation?
maximum interstorey deflection (ULS) (mm): — estimate or calculation?

Lateral system across: partially filled CMU — note total length of wall at ground (m): 28
Ductility assumed, μ: 1.25 — wall thickness (m): 0.29
Period across: 0.40 ##### enter height above at H31 — 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: other (specify) — describe
Wall cladding: brick or tile — describe (note cavity if exists): Brick veneer generally and weather board
Roof Cladding: Metal — describe: Cor. Iron roof deck
Glazing: timber frames
Ceilings: plaster, fixed
Services(list):

Available documentation

Architectural: none — original designer name/date
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: Good — Describe damage: None observed

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): No apparent structural damage

Across — Damage ratio: 0%
Describe (summary): No apparent structural damage

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

Diaphragms — Damage?: no — Describe:
CSWs: — Damage?: no — Describe:
Pounding: — Damage?: no — Describe:
Non-structural: — Damage?: no — Describe:

Recommendations

Level of repair/strengthening required: none — Describe:
Building Consent required: no — Describe:
Interim occupancy recommendations: full occupancy — Describe:

Along — Assessed %NBS before: 52% — 27% %NBS from IEP below
Assessed %NBS after: 52%

Across — Assessed %NBS before: 100% — 27% %NBS from IEP below
Assessed %NBS after: 100%

Opus International Consultants Ltd
20 Moorhouse Avenue
PO Box 1482, Christchurch Mail Centre,
Christchurch 8140
New Zealand

t: +64 3 363 5400
f: +64 3 365 7858
w: www.opus.co.nz