Christchurch City Council

Mona Vale Toilets
PRK 0555 BLDG 003

Detailed Engineering Evaluation

Quantitative Assessment Report

Christchurch City Council

Mona Vale Toilets

Quantitative Assessment Report

63 Fendalton Road

Prepared By

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Reference: 6-QUCC1.15
Status: Final V2

Summary

Mona Vale Toilets
PRK 0555 BLDG 003

Detailed Engineering Evaluation
Quantitative Report - SUMMARY
Final V2

Background
This is a summary of the quantitative report for the Mona Vale Toilets building, and is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011, visual inspections on 16 August 2012, measured-up sketch drawings and calculations and updated construction information provided January 2014.

Key Damage Observed
No major damage was identified.

Critical Structural Weaknesses
No critical structural weaknesses identified.

Indicative Building Strength
Based on the information available, and from undertaking a quantitative assessment, the building's seismic capacity has been assessed to be greater than 34%NBS and it is therefore classed as not earthquake prone under the NZSEE classification. The building has been calculated to be 50%NBS as limited by the out of plane response of the wing walls and is therefore classified as moderate risk in accordance with NZSEE guidelines [2].

Recommendations
It is recommended that the wing walls are strengthened to at least 67%NBS.

Contents

1 Introduction

Opus International Consultants Limited has been engaged by Christchurch City Council (CCC) to undertake a detailed seismic assessment of the Mona Vale Toilets, located in Mona Vale, 63 Fendalton Road, following the Canterbury Earthquake Sequence since September 2010.

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

The seismic assessment and reporting have been undertaken based on the quantitative procedures detailed in the Detailed Engineering Evaluation Procedure (DEEP) document (draft) issued by the Structural Engineering Society (SESOC) on 19 July 2011.

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 2006. This policy was amended immediately following the Darfield Earthquake on 4 September 2010.

The 2010 amendment includes the following:

1. A process for identifying, categorising and prioritising Earthquake Prone Buildings, commencing on 1 July 2012;

2. A strengthening target level of 67% of a new building for buildings that are Earthquake Prone;

3. A timeframe of 15-30 years for Earthquake Prone Buildings to be strengthened; and,

4. 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 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 Building Description

4.1 General

The Mona Vale Toilets building is a single storey brick veneer clad, braced timber frame building with a heavy clay tile roof and high pitched timber roof trusses. The ground floor is a slab on grade and although no drawings were available it is likely the foundations are shallow strip footings.

The building is approximately 8m long in the longitudinal direction and 4m wide in the transverse direction. The apex of the roof is approximately 4.5m from the ground and the stud height is approximately 2.4m. The building is split into a male and female toilet with a timber dividing wall.

Recently provided construction information has confirmed the building was constructed in 1992. The style is similar to the Mona Vale homestead.

4.2 Gravity Load Resisting System

The roof consists of heavy clay tiles on timber truss and rafters at approximately 450mm centres. The roof has a steep 45 degree pitch with window gables at each end. The roof is supported by the walls which are lined inside with gib material.

4.3 Seismic Load Resisting System

Seismic loads are resisted by the timber ceiling cladding and truss onto the timber framed and braced walls spanning in the transverse and longitudinal direction.

There are external wingwalls that provide privacy screens to the male and female entrances. The construction information indicates reinforcement starters extending into the wingwalls however there is no confirmation on the wall construction itself. They have been treated as double thickness brick walls for the assessment.

5 Survey

The building currently does not have a placard.

Copies of the following drawings were referred to as part of the assessment:

- Measured-up sketches of the building completed by Opus International Consultants, titled "Mona Vale Toilets, Existing Plan and Section".

No copies of the design calculations or structural drawings have been obtained for this building. Two construction progress photos were made available and are included in Appendix A.

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

6 Damage Assessment

The building structure does not appear to have suffered major damage as a result of the recent earthquake events. It is noted that the Mona Vale Homestead suffered significant damage and has been closed for use, and the surrounding area adjacent to the Avon River has undergone some slumping towards the river, although the toilet building itself was not affected.

7 General Observations

Overall the building has performed well under seismic conditions which would be expected for a single storey structure in good condition. However the damage to the adjacent land and buildings indicate the area may undergo foundation settlement or damage in future larger earthquake events.

8 Detailed Seismic Assessment

8.1 Critical Structural Weaknesses

As outlined in the Critical Structural Weakness and Collapse Hazards draft briefing document, issued by the Structural Engineering Society (SESOC) on 7 May 2011, 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 the building.

No CSW's have been identified on this building.

8.2 Seismic Coefficient Parameters

The seismic design parameters based on current design requirements from NZS1170.5:2004 and the NZBC clause B1 for this building are:

- Site soil class D, clause 3.1.3 NZS 1170.5:2004;
- Site hazard factor, Z=0.3, B1/VM1 clause 2.2.14B;
- Return period factor R_u = 1.0 from Table 3.5, NZS 1170.5:2004, for an Importance Level 2 structure with a 50 year design life;
- μ_{max} = 3 for wall bracing elements

8.3 Detailed Seismic Assessment Results

A summary of the structural performance of the building is shown in the following table.

Table 2: Summary of Seismic Performance

Structural Element/System	Description/Discussion	% NBS based on calculated capacity
Walls in the longitudinal directions	In plane capacity	100%
Walls in the transverse directions	In plane capacity	90%
Wing walls	out of plane response	50%

8.4 Discussion of Results

The building has a calculated capacity greater than 34%NBS and is classified as not earthquake prone under the Building Act 2004. The privacy wingwalls have a rating of 50%NBS based on their out of plane response where they act as cantilever walls with edge restraint. The wing walls do not support the building roof.

8.5 Limitations and Assumptions in Results

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.

9 Geotechnical Summary

As no ground damage in the region immediately around the toilets were observed no geotechnical assessment was carried out. If specific geotechnical information is required this may be able to be obtained through any works carried out as part of the Mona Vale Homestead remedial works.

10 Conclusions and Recommendations

The building has a seismic capacity greater than 34%NBS and is classed as not earthquake prone in accordance with the Building Act 2004. The privacy wingwalls have a rating of 50%NBS based on their out of plane response where they act as cantilever walls with edge restraint. The building is classified as moderate risk in accordance with NZSEE guidelines [2]. The wing walls do not support the building roof.
It is recommended that the wing walls are strengthened to at least 67%NBS.

11 Limitations

(a) This report is based on an inspection of the structure with a focus on the damage sustained from the 22 February 2011 Canterbury Earthquake and aftershocks only. Some non-structural damage is mentioned but this is not intended to be a comprehensive list of non-structural items.

(b) 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 the time.

(c) This report is prepared for the CCC to assist with assessing remedial works required for council buildings and facilities. 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, *Practice Note – Design of Conventional Structural Systems Following Canterbury Earthquakes*, Structural Engineering Society of New Zealand, 21 December 2011.

Appendix A – Photographs

Photo 1: External View from Rear

Photo 2: External View from Front

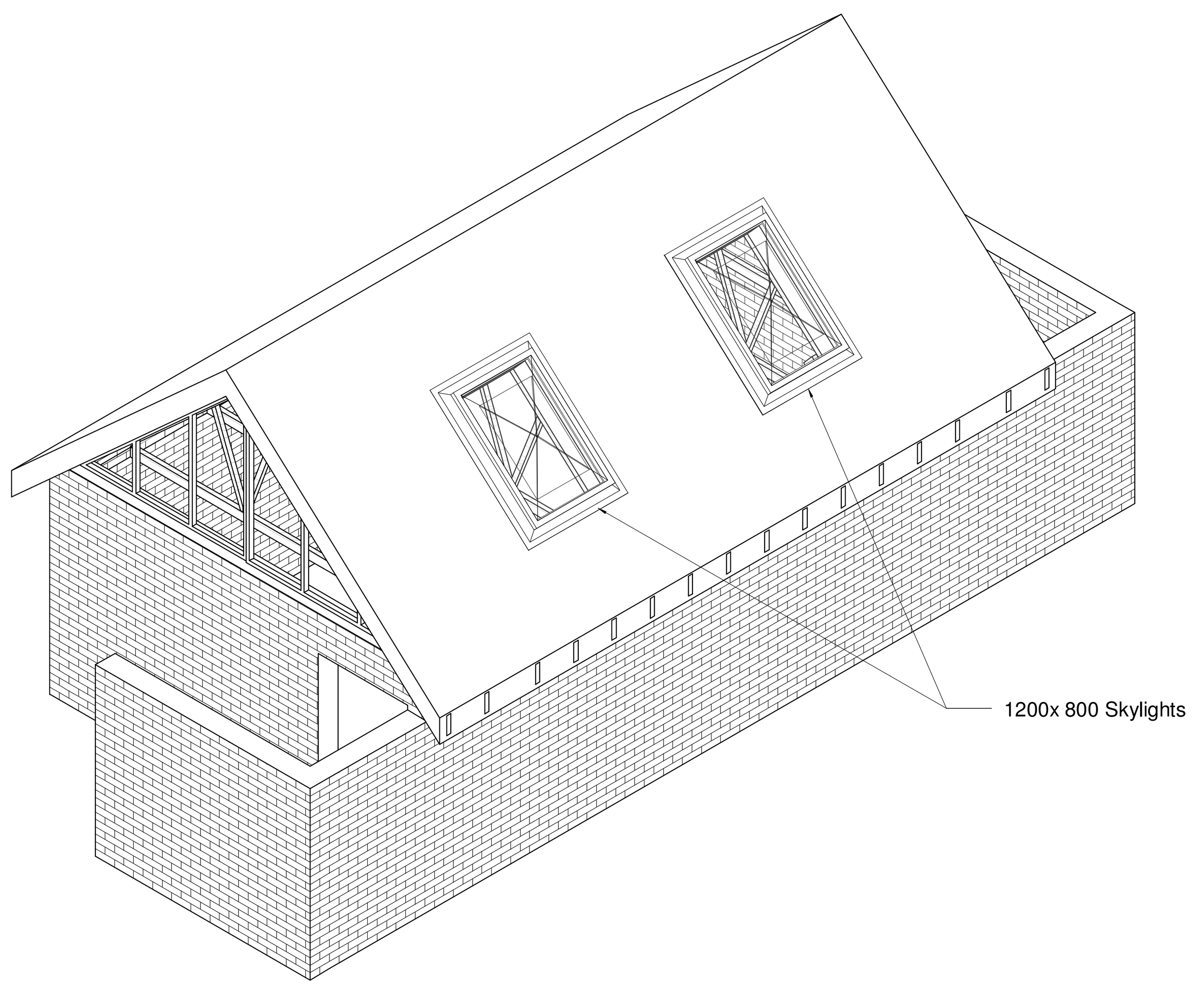
Photo 3: Internal View

Photo 4: Construction Progress, 1992

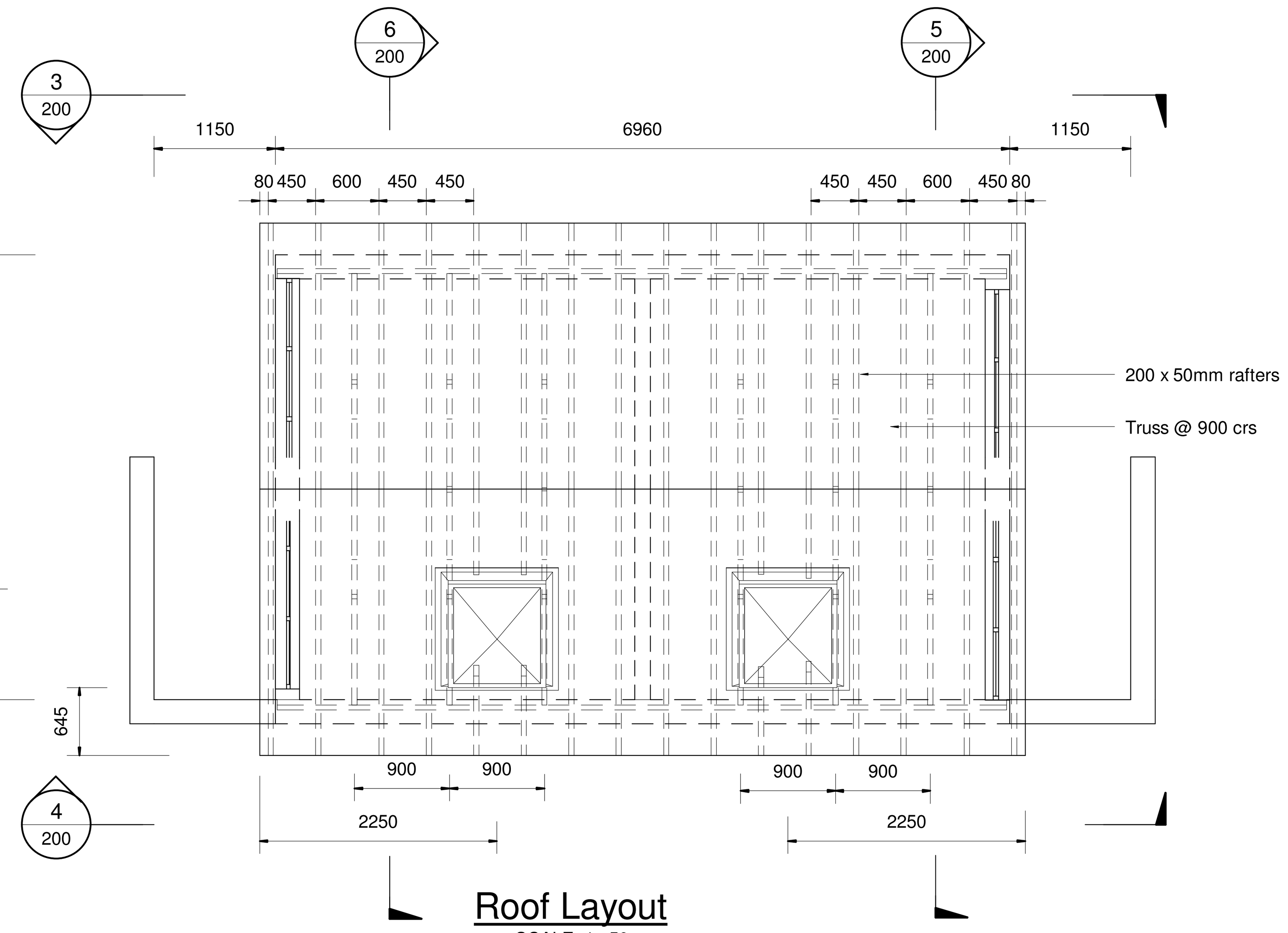
Photo 5: Construction Progress, 1992

Appendix B – Drawing

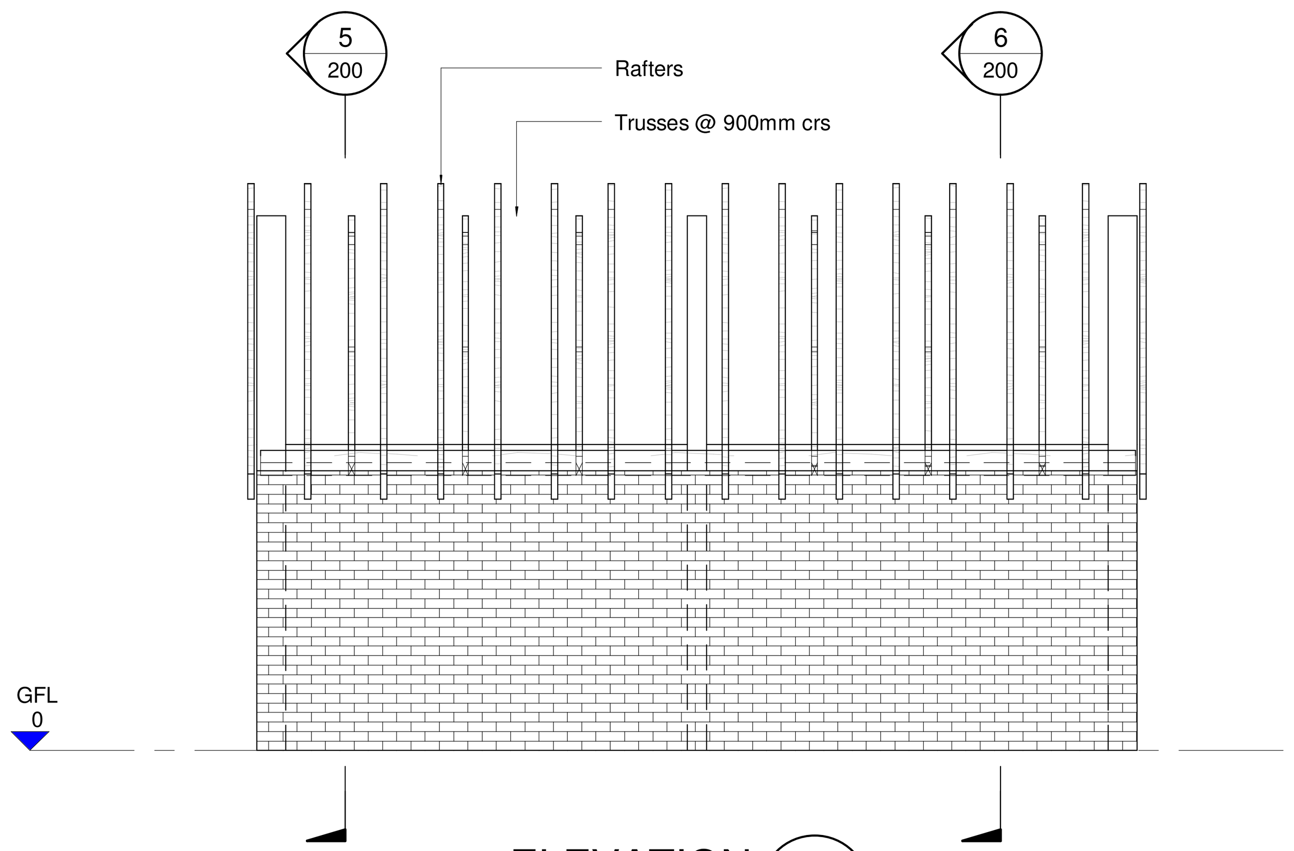
300mm
200mm
100
50
10mm
0



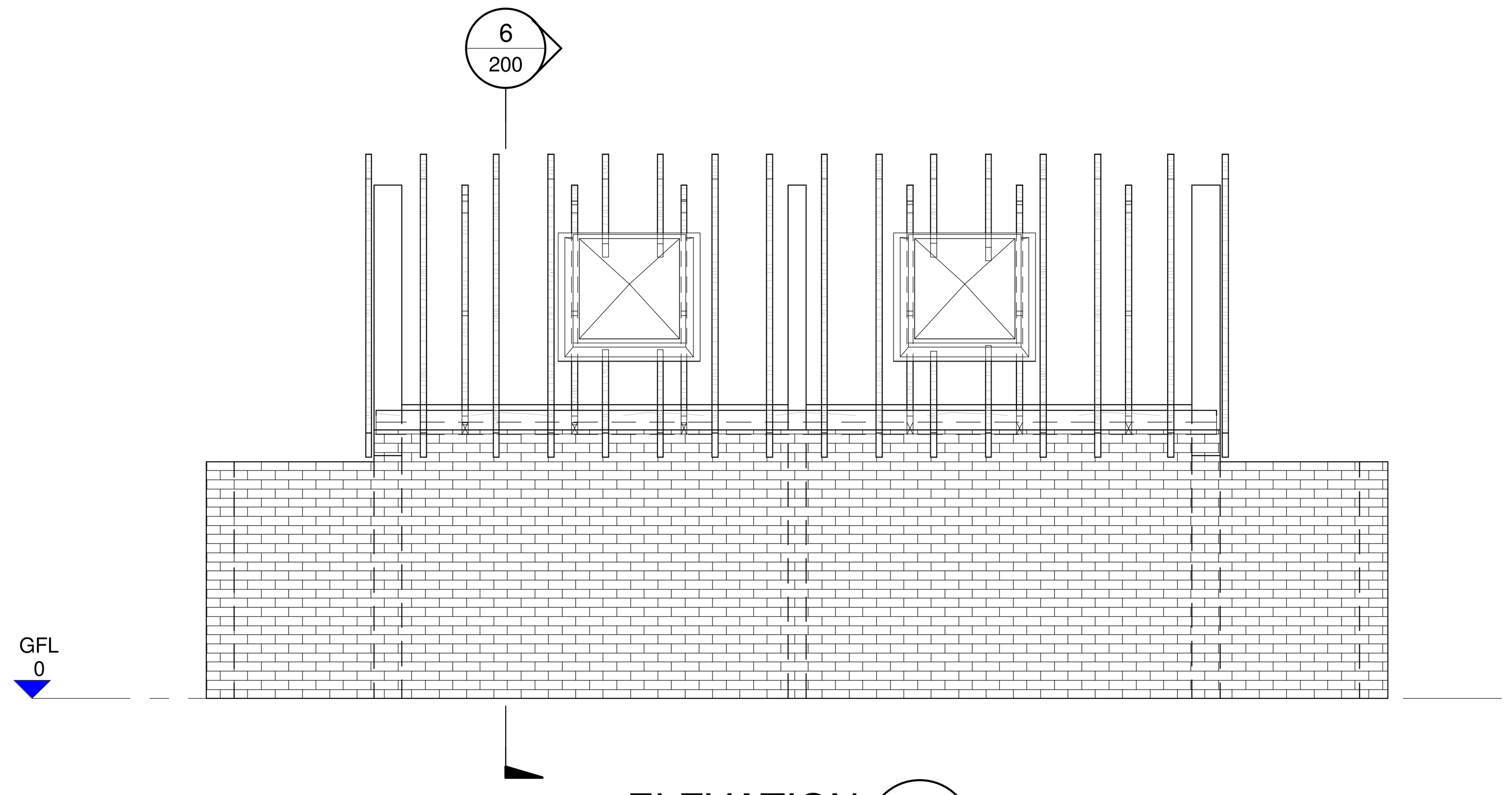
3D View



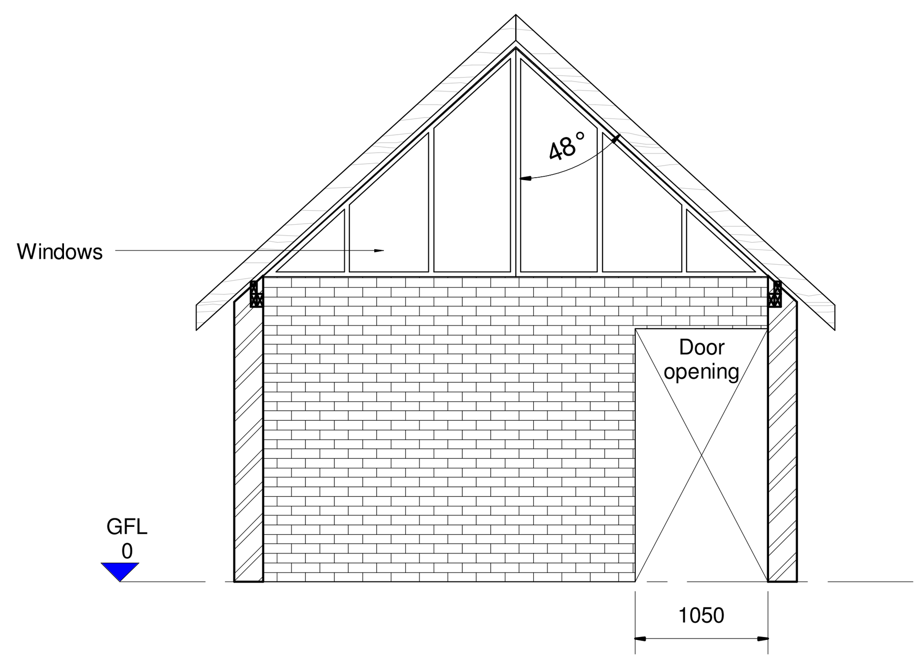
Roof Layout
SCALE 1 : 50



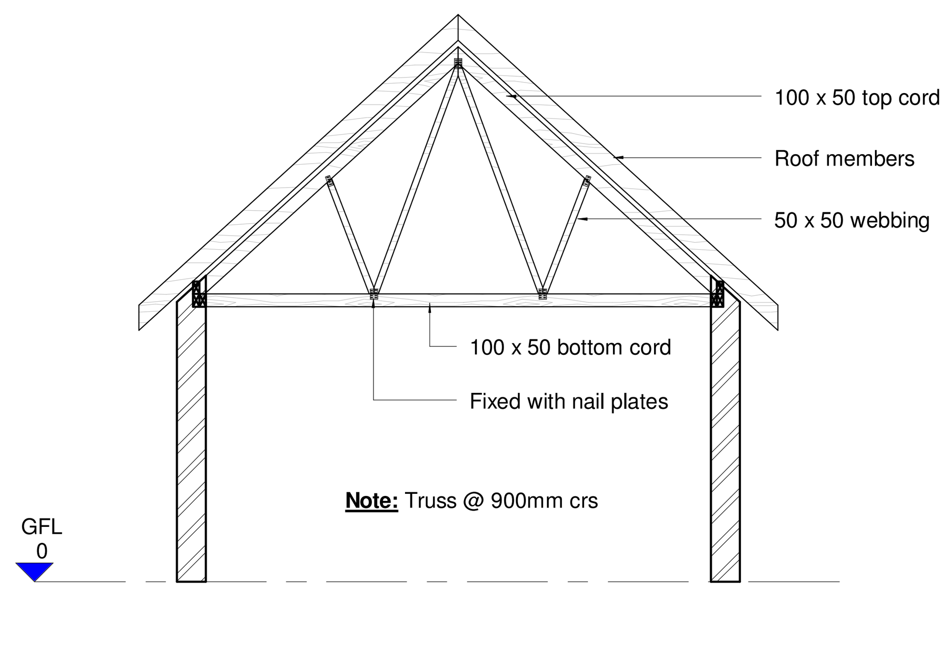
ELEVATION 3/200
SCALE 1 : 50



ELEVATION 4/200
SCALE 1 : 50



SECTION 5/200
SCALE 1 : 50



SECTION 6/200
SCALE 1 : 50

Northwest corner

View of Truss Layout

Truss Wall Connection

CONSTRUCTION DETAILS

Revision	Amendment	Approved	Revision Date

CHRISTCHURCH
CITY COUNCIL · YOUR PEOPLE · YOUR CITY

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Project
Christchurch City Council
63 Fendalton Road, Riccarton 8011
Mona Vale

Title
Toilet Block

Drawn	Designed	Approved	Revision Date
J.R.W			25.09.2012

Project No.	Scale	Drawing No.	Sheet No.	Revision
6-QUCC1.15	1 : 50	6/1366/293/ 8602	200	R0

Original sheet size A1 (841x594) Plot date: 25/09/2012 11:58:40 a.m. P:\Projects\6-QUAKE.01\CCC_Parks Buildings\Mona Vale\Toilets\Drawings\Toilet_Block.rvt

Appendix C – CERA DEE Data Sheet

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Mona Vale - Toilets	Reviewer:	Dave Morrison
	Unit / No: / Street	CPEng No:	229087
Building Address:	63 Mona Vale Avenue, Fendalton / PRK 0555-BLDG-003-EQ2	Company:	Opus International Consultants Ltd
Legal Description:		Company project number:	6-QUCC1.15
		Company phone number:	03 3635400
	Degrees / Min / Sec		
GPS south:	43 / 31 / 25.51	Date of submission:	24/02/2014
GPS east:	172 / 36 / 30.95	Inspection Date:	16/08/2012
		Revision:	Final V2
Building Unique Identifier (CCC):	PRK_0555_BLDG_003	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):	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):	7.00

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:	other (describe)		if Foundation type is other, describe:	shallow strip footing (assumed, no drwg information)
Building height (m):	4.50		height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	32			
Age of Building (years):	20		Date of design:	1992-2004
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	public		Brief strengthening description:	
Use (upper floors):	other (specify)			
Use notes (if required):	toilets			
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber framed	rafter type, purlin type and cladding	Truss
Floors:	concrete flat slab	slab thickness (mm)	not available
Beams:	none	overall depth x width (mm x mm)	na
Columns:	other (note)	typical dimensions (mm x mm)	na
Walls:	non-load bearing	0	

Lateral load resisting structure

Lateral system along:	lightweight timber framed walls	**Note: Define along and across in detailed report!**	note typical wall length (m)	4
Ductility assumed, μ:	1.00			
Period along:	0.40	0.00	estimate or calculation?	
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	lightweight timber framed walls		note typical wall length (m)	4m
Ductility assumed, μ:	1.00			
Period across:	0.40	0.00	estimate or calculation?	
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	none
Wall cladding:	brick or tile	describe (note cavity if exists)	Brick
Roof Cladding:	Heavy tiles	describe	Roof tile
Glazing:	timber frames		
Ceilings:	none		
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:		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:	No damage
	Describe (summary):			
Across	Damage ratio:	0%		
	Describe (summary):			
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:	minor non-structural	Describe:	Privacy wingwalls - top restraint
	Building Consent required:	no	Describe:	Confirm with CCC if minor works
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before:	100%	54% %NBS from IEP below	If IEP not used, please detail assessment methodology: Quantitative
	Assessed %NBS after:	100%		
Across	Assessed %NBS before:	50%	54% %NBS from IEP below	
	Assessed %NBS after:	50%		

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