Christchurch City Council

Customs House PRO 3640-002

Detailed Engineering Evaluation

Quantitative Assessment Report

Christchurch City Council

Customs House

Quantitative Assessment Report

1 Rue Balguerie, Akaroa

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Customs House
PRO 3640-002

Detailed Engineering Evaluation
Quantitative Report – SUMMARY
Final

1 Rue Balguerie, Akaroa

Background

This is a summary of the quantitative assessment report for the Customs House located at 1 Rue Balguerie, Akaroa, and is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011, visual inspection on 24 September 2012 and available drawings.

Key Damage Observed

- Cracking to brick chimney noted during earlier post-earthquake inspection in May and June 2011. The chimney was deconstructed down to roof level in August 2011.
- Spalling of limewash and cracking to earth infill of the timber framed mud infilled walls.
- Minor cracking to joints between ceiling plasterboards.

Other Observations

It is not conclusive if the building is fixed to the foundation or not. However, considering that the floor boards are well nailed to the joists which are bearing directly on the ground, the floor system is likely to remain intact in a design level earthquake.

Critical Structural Weakness

No CSW was observed for this building.

Indicative Building Strength (from quantitative assessment)

Based on the information available, and from undertaking a quantitative assessment, the building seismic capacity has been assessed to be 41 % NBS.

The building is not considered to be earthquake prone in accordance with the Building Act 2004.

Recommendation

a. Repair gaps/cracks within earth infill of the timber framed mud infilled walls with suitable structural filler based on consultation between engineer and conservation expert. This repair would also improve the seismic capacity of the wall albeit marginally.

b. Strengthen the building's seismic performance to as near as practicable to 100%NBS, and at least 67%.

c. During the strengthening works as recommended above, conduct intrusive investigate to check if the building is connected to the foundation. Carry out remedial works if it is not connected.

Contents

1 Introduction

Opus International Consultants Limited (Opus) has been engaged by Christchurch City Council (CCC) to undertake a detailed seismic assessment of the Customs House located at 1 Rue Balguerie, Akaroa following the M6.3 Christchurch earthquake on 22 February 2011.

This report is a Stage Two quantitative assessment of the building structure, and is based on the qualitative and quantitative procedures detailed in the Detailed Engineering Evaluation Procedure (DEEP) document (draft) issued by the Structural Engineering Society (SESOC) on 19 July 2011 [2].

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	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 Description

The Customs House, located at 1 Rue Balguerie, Akaroa, was constructed in 1858. The building is currently managed by Akaroa Museum and is used for display. It is classified as Protected under the Banks Peninsula District Plan and registered as a Category II historic place, under the provisions of the Historic Places Act, 1993.

The building is an open plan single storey rectangular timber structure with corrugated steel gable roof and small gabled entry porch. The building has a rare wall construction known as mud and stud, where earth is packed within the wall timber framing. The interior finish is lime washed and the external finish is timber weatherboard. During the restoration in 1973, the ceiling was lined with plasterboard. The overall building is approximately 5 m wide by 5.5 m long, and the height of the roof apex is 4.5 m.

Following the Canterbury earthquakes, the brick chimney was damaged and subsequently deconstructed down to the roof level in August 2011.

The Customs House entrance is predominantly east facing. For the purpose of this report, we refer to the direction parallel to Rue Balguerie as east-west (longitudinal) and the direction parallel to Rue Balguerie as east-west (transverse).

Figure 2: Akaroa Customs House Site Location

4.2 Gravity Load Resisting System

The building roof gravity loads are supported by transverse 100x60mm timber rafters at 550mm centres supported on perimeter timber framed mud infilled walls. There are also 100x50mm collar ties to the rafters at approximately mid height of the rafters.

4.3 Lateral Load Resisting System

The lateral load resisting system in both principal directions are the perimeter mud and stud walls acting as bracing walls. An overview of the key lateral resisting elements is as shown is Figure 3 below.

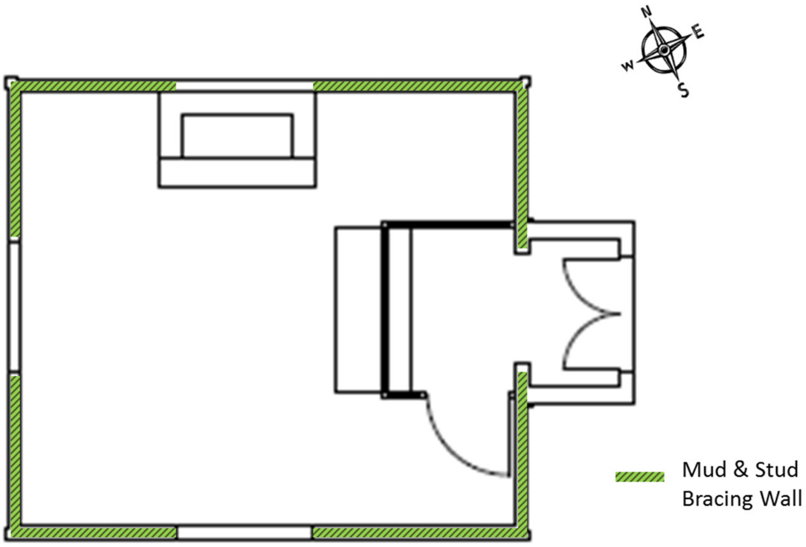


Figure 3: Building Layout and Location of Mud & Stud Bracing Wall

4.4 Foundation

The building is founded close to ground level and does not facilitate a definitive investigation of the foundation system. However, based on limited visual observation, the transverse timber floor joists appears to be bearing directly on the ground.

4.5 Original Documentation

Copies of the following drawings were provided:

- Customs House basic floor plan and elevation drawing by CCC (CAD File Ref AD154501) was provided. See Appendix 2 - Drawing.
- "Proposed Restoration to Customs House" drawing by John A. Hendry dated 3 May 1962.

4.6 Post 22 February 2011 Rapid Assessment

An engineer from Structex undertook a Level 2 assessment of the building on 21 June 2011. The assessment noted a fall hazard posed by the cracked brick chimney, which had been subsequently mitigated as discussed in Section 5.1 below.

4.7 Further Inspections

A detailed inspection was undertaken by Opus engineer on 24 September 2012 for the purpose of this detailed engineering evaluation.

5 Damage Assessment

The following damage has been noted:

5.1 Roofing & Chimney

Cracking to brick chimney was noted during post-earthquake inspections in May and June 2011. The chimney was deconstructed down to roof level in August 2011 and therefore eliminating the fall hazard. See Photo 2 in Appendix 1. Any future reinstatement of the chimney would need to consider the strengthening of the entire chimney structure, down to the ground floor.

5.2 Load Bearing Wall

Spalling of limewash and cracking to earth infill at stud and batten edges, which was due to the movement of the timber framing caused by earthquake shaking. See Photo 3 in Appendix 1.

5.3 Flooring

No observed earthquake related damage. There is an area of dipping in the timber flooring near the northwest corner of the building. This is likely to be due to deterioration over time of the timber subfloor. See Photo 4 in Appendix 1.

5.4 Foundation

The foundation appears to have performed satisfactory with no observed earthquake damage.

5.5 Non Structural

Minor cracking to joints between ceiling plasterboards. See Photo 5 in Appendix 1.

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.

6.1 Critical Structural Weaknesses

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

No critical structural weaknesses were observed for this building.

6.2 Quantitative Assessment Methodology

The equivalent static load method was used to analyse the forces in the key components of the building's lateral load resisting system. The parameters used for the detailed analyses are as follows:

6.2.1 Seismic coefficient parameters

The seismic design parameters based on current design requirements from NZS1170.5:2004 [1] and the NZBC clause B1 for this building are:

- Site soil class C, clause 3.1.3 NZS 1170:2002
- 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 [1] with a 50 year design life and based on an Importance Level 2).

6.2.2 Expected ductility factor

Based on our assessment of the building structure and using guidance from the earth buildings standard NZS 4297:1998 [7], our estimate for the expected structural ductility factor is 1.0 for the structure in both orthogonal directions.

6.3 Limitations and Assumptions in Results

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

6.4 Quantitative Analysis Methodology

The seismic force arising from the roof mass is assumed to be distributed to the perimeter timber framed mud infilled walls based on their respective tributary area. This is a reasonable assumption considering the flexible horizontal diaphragm created by the ceiling plasterboard and roof framing.

6.5 Quantitative Assessment Results

Based on the criteria as listed above, the estimated structural performance of the respective primary structural load resisting elements are shown in Table 2 as follows.

Table 2: Structural Performance

Structural Element / System	Failure mode or description of limiting criteria based on elastic capacity of critical element	% NBS (based on calculated capacity)
North-South Direction		
Perimeter mud & stud bracing wall along the east elevation where entrance porch is located.	Mud & stud bracing wall resisting lateral load in north-south direction. The failure mode is likely to be degradation of the earth infill and diminishing bracing strength due to cyclical seismic loading.	41%
East - West Direction		
Perimeter mud & stud bracing wall along the north elevation where brick chimney is located.	Mud & stud bracing wall resisting lateral load in north-south direction. The failure mode is likely to be degradation of the earth infill and diminishing bracing strength due to cyclical seismic loading.	50%

7 Discussion of Results

Based on the analysis, the building has a minimum seismic capacity of approximately 41% NBS. This is limited by the seismic capacity of the perimeter mud & stud wall along the east elevation resisting lateral loads in the north - south direction. The degradation of the earth infill due to earthquake damage has also been factored into the assessment of the wall lateral resisting capacity. The seismic demand along this elevation is higher due to the additional lateral load induced by the entrance porch.

It is not conclusive if the building is fixed to the foundation or not. However, considering that the floor boards are well nailed to the joists which are bearing directly on the ground, the floor system is likely to remain intact in a design level earthquake. It would be unlikely that the substructure would collapse even if the building is not connected to the foundation. Furthermore, the internal finish floor level is only approximately 100mm above external ground level.

This building is not considered to be earthquake prone in accordance with the Building Act 2004.

8 Summary of Geotechnical Appraisal

8.1 Regional Geology

The published geological map of the area, (Geology of the Christchurch Area 1:250,000, Forsyth, Barrell and Jongens, 2008) indicates the site is located on grey river alluvium beneath plains or low-level terraces.

8.2 Peak Ground Acceleration

Interpolation of United States Geological Survey (USGS) Shakemap: South Island of New Zealand (22 Feb, 2011) indicates that this location has likely experienced a Horizontal Peak Ground Acceleration (PGA) of approximately 0.05g to 0.1 g during the 22nd February 2011 Earthquake. Estimated PGA's have been cross checked with Geonets' Modified Mercalli intensity scale observations.

8.3 Expected Ground Conditions

Two ECan borehole logs are located within 100m north - west of the Akaroa Museum which indicates well graded, tightly packed Gravel with some silt to a depth of 4.90m. Refer to ECan borehole log's in Appendix 3. The ground conditions at the site are expected to be of a similar alluvium deposit.

8.4 Site Observation

The building was inspected by an Opus Structural Engineer on the 24th September 2012. The following observations were made from photographs taken during the site visit.

- This building is located on a flat site surrounded by paved surfaces.
- The Akaroa Harbour is located approximately 30m west of the building, opposite the boat loading ramp.
- It appears that the buildings joists are bearing directly onto the underlying soil.
- The floor boards located in the north - west corner of the building appear to be dipping.
- There does not appear to be any liquefaction induced heaving or subsidence nor any evidence suggesting lateral spreading.

8.5 Geotechnical Discussion

The soil underlying the Akaroa Customs House building appear to have performed satisfactorily in the recent seismic events. No ground damage has been observed on site. Due to the likely presence of silty gravels at shallow depths, the risk of lateral spreading and liquefaction induced settlement is considered to be low. No further geotechnical testing is recommended at this location.

No as-built drawings of the foundations have been made available for review. Based on site photos obtained, it appears the floor joists are bearing directly on the ground. Further inspection of the foundations are recommended to determine if foundation remediation works are required as part of structural strengthening. Remedial works may include connecting the building to piled foundations.

9 Conclusions

The building has seismic capacity of 41% NBS and is therefore not considered to be earthquake prone in accordance to the Building Act 2004.

10 Recommendations

a. Repair gaps/cracks within earth infill of the timber framed mud infilled walls with suitable structural filler based on consultation between engineer and conservation expert. This repair would also improve the seismic capacity of the wall albeit marginally.

b. Strengthen the building's seismic performance to as near as practicable to 100%NBS, and at least 67%.

c. During the strengthening works as recommended above, conduct intrusive investigate to check if the building is connected to the foundation. Carry out remedial works if it is not connected,

11 Limitations

a. This report is based on an inspection of the structure of the building and focuses on the structural damage resulting from the Canterbury Earthquakes and aftershocks only. Some non-structural damage is described but this is not intended to be a complete list of damage to non-structural items.
b. Our inspections have been visual and non-intrusive, and no linings or finishes were removed to expose structural elements.
c. 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.
d. This report is prepared for CCC to assist with assessing the remedial works required for their 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 (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

[7] NZS 4297:1998, *Engineering Design of Earth Buildings*, Standards New Zealand.

Appendix 1 - Photographs

<table>
<tr><th>No.</th><th>Item description</th><th>Photo</th></tr>
<tr><td>1.</td><td>General building elevations

South west elevation

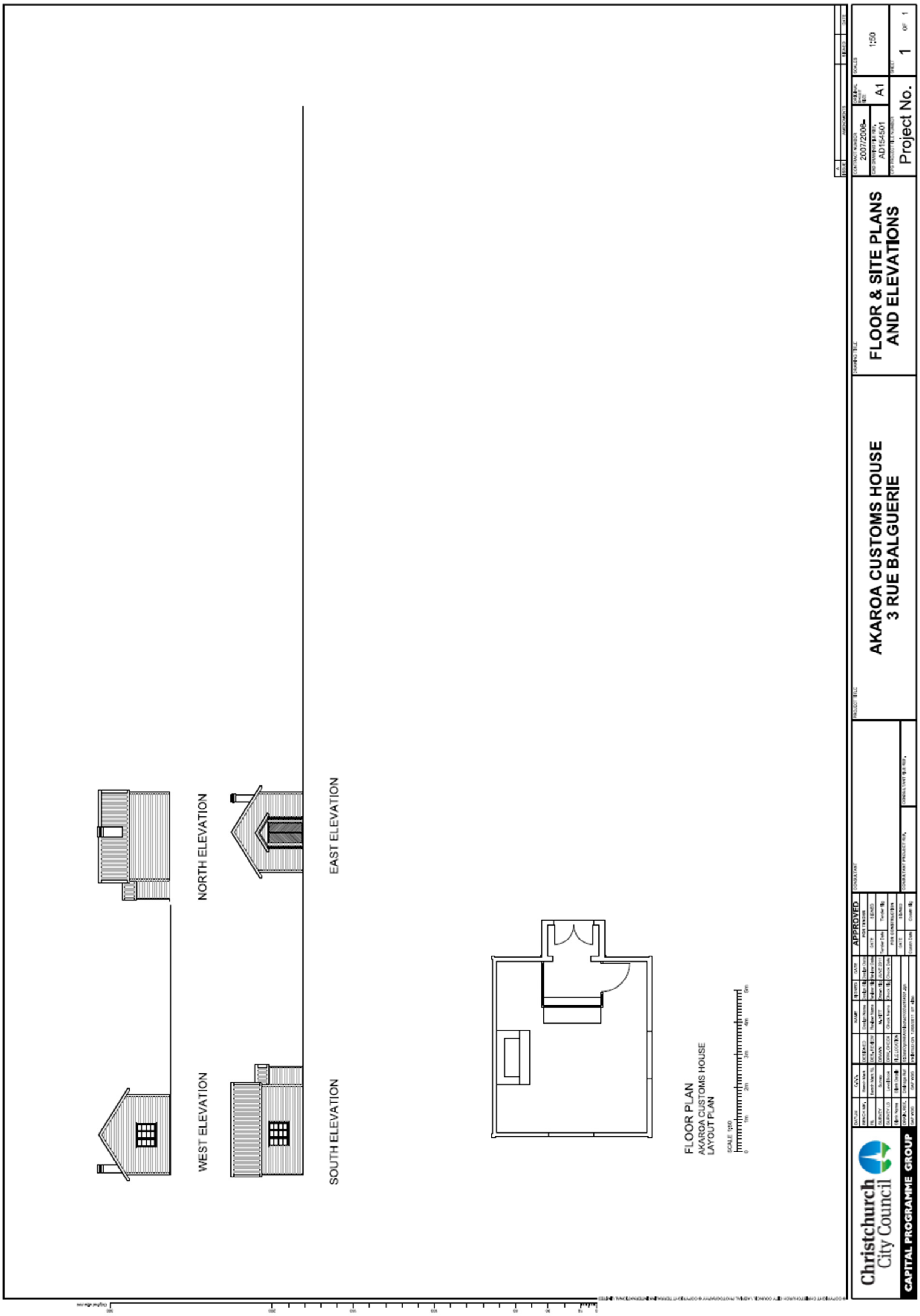
North east elevation</td><td>
</td></tr>
<tr><td>2.</td><td>Brick chimney deconstructed down to roof level.

Photo showing before chimney deconstruction to roof level.</td><td></td></tr>
</table>

	Photo after chimney removed and temporarily water proofed.	
3.	Spalling of limewash and cracking to infill earth	
4.	Localised dipping of timber flooring	

5.	Minor cracking to joints between ceiling plasterboards.	

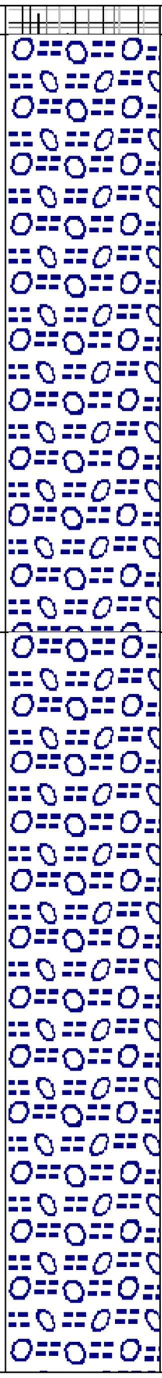
Appendix 2 - Drawing


WEST ELEVATION
NORTH ELEVATION
SOUTH ELEVATION
EAST ELEVATION
FLOOR PLAN
AKAROA CUSTOMS HOUSE
LAYOUT PLAN
APPROVED
Christchurch City Council
CAPITAL PROGRAMME GROUP
AKAROA CUSTOMS HOUSE
3 RUE BALGUERIE
FLOOR & SITE PLANS
AND ELEVATIONS
A1
1:50
Project No.

Appendix 3 - Environment Canterbury Borehole Logs

Borelog for well N36/0065

Gridref: N36:07450-11490 Accuracy : 3 (1=best, 4=worst)
Driller : CW Drilling and Investigation
Drill Method : Unknown
Drill Depth : -4.8m Drill Date : 16/05/2002



Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
		-0.10m	Asphalt	
		-2.20m	Silty gravel light brown well graded tightly packed dry Gravel fine to large subrounded	
		-4.80m	Gravel with some silt light brown well graded tightly packed damp to wet at 2.4m below ground level Gravel fine to large subrounded	

Borelog for well N36/0066

Gridref: N36:07448-11480 Accuracy : 2 (1=best, 4=worst)
Driller : CW Drilling and Investigation
Drill Method : Unknown
Drill Depth : -4.9m Drill Date : 17/05/2002

Environment Canterbury
Your regional council

Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
		-0.10m	Asphalt	
		-2.40m	Silty gravel light brown well graded tightly packed dry Gravel fine to large subrounded	
		-4.90m	Gravel with some silt light brown well graded tightly packed damp to wet at 2.6m below ground level Gravel fine to large subrounded	

Appendix 4 – CERA DEE Data Sheet

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Akaroa Customs House	Reviewer:	Jan Stanway
	Unit: No: Street	CPEng No:	222291
Building Address:	1 Rue Balguerie Akaroa	Company:	Opus International Consultants Ltd
Legal Description:		Company project number:	6-QUCCC.98
		Company phone number:	03-3635400
	Degrees Min Sec		
GPS south:		Date of submission:	Mar-14
GPS east:		Inspection Date:	24-Sep-12
		Revision:	Final
Building Unique Identifier (CCC):	PRO 3640-002	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):	C		
Proximity to waterway (m, if <100m):	20	If Ground improvement on site, describe:	
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	0.00

Building

No. of storeys above ground:	1 (single storey = 1)	Ground floor elevation (Absolute) (m):	2.70
Ground floor split?	no	Ground floor elevation above ground (m):	0.10
Storeys below ground	0		
Foundation type:	strip footings	if Foundation type is other, describe:	
Building height (m):	4.50	height from ground to level of uppermost seismic mass (for IEP only) (m):	4
Floor footprint area (approx):	28		
Age of Building (years):	154	Date of design:	Pre 1935
Strengthening present?	no	If so, when (year)?	
		And what load level (%g)?	
Use (ground floor):	public	Brief strengthening description:	
Use (upper floors):			
Use notes (if required):	museum gallery		
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber framed	rafter type, purlin type and cladding	Corr. Metal roof on sarking on timber rafters
Floors:	timber	joist depth and spacing (mm)	
Beams:	timber	type	
Columns:			
Walls:			

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	other (note)		describe system	timber framed mud infilled
Ductility assumed, μ:	1.00			
Period along:	0.12	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	other (note)		describe system	timber framed mud infilled
Ductility assumed, μ:	1.00			
Period across:	0.12	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	

Separations:

leave blank if not relevant

north (mm):	
east (mm):	0
south (mm):	0
west (mm):	

Non-structural elements

Stairs:			
Wall cladding:	other light	describe	weatherboard
Roof Cladding:	Metal	describe	corrugated
Glazing:	timber frames		
Ceilings:	strapped or direct fixed		plasterboard
Services(list):			

Available documentation

Architectural	partial	original designer name/date	CCC / June 2011
Structural	none	original designer name/date	
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	partial	original designer name/date	Opus / Nov 12

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:			
Along	Damage ratio:	9%	Describe how damage ratio arrived at:	Visual observation of cracking to earth infill
	Describe (summary):			
Across	Damage ratio:	9%		
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	minor joint cracking to ceiling diaphragm
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	no	Describe:	spalled limewash

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

Recommendations

Level of repair/strengthening required:		Describe:	
Building Consent required:		Describe:	
Interim occupancy recommendations:	full occupancy	Describe:	

Along	Assessed %NBS before:	55%	##### %NBS from IEP below
	Assessed %NBS after:	50%	
Across	Assessed %NBS before:	45%	##### %NBS from IEP below
	Assessed %NBS after:	41%	