Halswell Quarry Park - Old Quarryman's Information Centre (Single Man's Quarter)

Qualitative Engineering Evaluation

Functional Location ID: PRK 1887 BLDG 004

Address: Halswell Quarry, Kennedys Bush Road

Reference: 228887

Prepared for:

Christchurch City Council

Revision: 2

Date: 2 September 2013

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Approval			
Author Signature		Approver Signature	
Name	Hugh Burnett	Name	Simon Manning
Title	Structural Engineer	Title	Senior Structural Engineer

Contents

Appendices

Executive Summary

This is a summary of the Qualitative Engineering Evaluation for the Halswell Quarry Park - Old Quarryman's Information Centre (Single Man's Quarter) building and is based on the Detailed Engineering Evaluation Procedure document issued by the Engineering Advisory Group on 19 July 2011, visual inspections, available structural documentation and summary calculations as appropriate.

Building Details	**Name**	Halswell Quarry Park - Old Quarryman's Information Centre (Single Man's Quarter)			
Building Location ID	**PRK 1887 BLDG 004**			**Multiple Building Site**	Y
Building Address	Halswell Quarry, Kennedys Bush Road			**No. of residential units**	0
Soil Technical Category	NA	**Importance Level**	2	**Approximate Year Built**	1922
Foot Print (m^2)	125	**Stories above ground**	1	**Stories below ground**	0
Type of Construction	Lightweight roof, stone masonry walls, concrete floor.				
Qualitative L4 Report Results Summary					
Building Occupied	N	The Halswell Quarry Park - Old Quarryman's Information Centre (Single Man's Quarter) is currently cordoned off.			
Suitable for Continued Occupancy	N	The Halswell Quarry Park - Old Quarryman's Information Centre (Single Man's Quarter) not suitable for continued occupation.			
Key Damage Summary	Y	Refer to summary of building damage section 3.1 report body.			
Critical Structural Weaknesses (CSW)	Y	There were critical structural weaknesses found.			
Levels Survey Results	N/A	A levels survey is not required due to the lack of settlement related damage.			
Building %NBS From Analysis	<33%	Limited by wall to diaphragm connection.			
Qualitative L4 Report Recommendations					
Geotechnical Survey Required	N	Geotechnical survey not required due to lack of observed ground damage on site.			
Proceed to L5 Quantitative DEE	Y	Quantitative DEE required to determine strengthening requirements.			
Approval					
Author Signature		**Approver Signature**			
Name	Hugh Burnett	**Name**	Simon Manning		
Title	Structural Engineer	**Title**	Senior Structural Engineer		

1 Introduction

1.1 General

On 2 April 2012 Aurecon engineers visited the Halswell Quarry Park - Old Quarryman's Information Centre (Single Man's Quarter) to carry out a qualitative building damage assessment on behalf of Christchurch City Council. Detailed visual inspections were carried out to assess the damage caused by the earthquakes on 4 September 2010, 22 February 2011, 13 June 2011, 23 December and related aftershocks.

The scope of work included:

- Assessment of the nature and extent of the building damage.
- Visual assessment of the building strength particularly with respect to safety of occupants if the building is currently occupied.
- Assessment of requirements for detailed engineering evaluation including geotechnical investigation, level survey and any areas where linings and floor coverings need removal to expose structural damage.

This report outlines the results of our Qualitative Assessment of damage to the Halswell Quarry Park - Old Quarryman's Information Centre (Single Man's Quarter) and is based on the Detailed Engineering Evaluation Procedure document issued by the Structural Advisory Group on 19 July 2011, visual inspections, available structural documentation and summary calculations as appropriate.

2 Description of the Building

2.1 Building Age and Configuration

The Old Stone House was built in 1922. It is a single story building constructed using stone from the nearby stone quarry. It was originally used as workers accommodation for the quarry. This building is listed as the workmen's quarters and classified as a category 2 historic building by the Christchurch City Council.

The building has a light weight corrugated iron roof supported on timber sarking supported by timber framing. The ceiling sarking consists of tongue and groove timber boards supported on timber beams. The exterior walls consist of two leaves of stone masonry with an unreinforced concrete core; the interior walls are cast in situ concrete and assumed to be unreinforced. The floor is concrete slab. The foundation system is unknown however it is thought to be unreinforced concrete based on the age and style of construction.

The approximate floor area of the building is 125 square metres. It is an importance level 2 structure in accordance with NZS 1170 Part 0:2002.

2.2 Building Structural Systems Vertical and Horizontal

The Old Stone House is a very simple structure. Its light weight iron roof is supported on timber framing that transfers loads to the load bearing walls. Lateral loads are resisted by the stone masonry walls and concrete walls with out-of-plane wall loads transferred to the in-plane-walls via the tongue and groove ceiling sarking.

2.3 Reference Building Type

The Old Stone House was not subject to specific engineering design; rather it was constructed to a reliable formula known to achieve the performance objectives of the time it was built. Many of these old stone buildings have suffered earthquake damage and this is also the case for the Old Stone House.

2.4 Building Foundation System and Soil Conditions

The foundations for the Old Stone House are thought to consist of unreinforced concrete as discussed above. The land and surrounds of Halswell Quarry are zoned as Port Hills and Banks Peninsula and are unlikely to be susceptible to liquefaction and differential settlement. Additionally there are no signs in the vicinity of the Old Stone House of liquefaction bulges, boils or subsidence

2.5 Available Structural Documentation and Inspection Priorities

No structural or architectural drawings were available for the Halswell Quarry Park - Old Quarryman's Information Centre (Single Man's Quarter). Inspection priorities related to a review of potential damage to foundations and consideration of wall capacity both in-plane and out-of-plane and roof diaphragm capacity.

2.6 Available Survey Information

No levels or verticality survey information was available at the time of this report. These are not considered to be necessary for this building given the lack of settlement related damage.

3 Structural Investigation

3.1 Summary of Building Damage

The Old Stone House was unoccupied at the time the damage assessment was carried out.

The main areas of seismic damage that were noted are summarized as follows:

- Horizontal cracking in the stone walls.
- Vertical cracking in the stone walls.
- Step cracking in the stone walls.
- Displacement of the stone blocks in the north-western and south-eastern corners of the building.
- Displaced stone blocks in the top few rows of blocks and movement between the roof and walls.
- Movement of the diaphragm indicating failure of the wall to diaphragm connection.
- Vertical cracking in end of a wall perpendicular to the northern elevation
- Spalling of the interior plaster covering the stone walls indicating significant movement of the stone blocks.
- Gaps of up to 10mm have opened up between the external walls and perpendicular internal walls.
- The unreinforced masonry brick chimney has suffered significant damage.

3.2 Record of Intrusive Investigation

No intrusive investigation was carried out for the Old Stone House as the above ground structure is fully exposed.

3.3 Damage Discussion

The vertical cracks in the external stone walls are the result insufficient connection strength between the internal and external walls. This has resulted in large gaps of up to 10mm opening between the external walls and perpendicular internal walls.

The horizontal and step cracking in the external stone walls may be the result of either out-of-plane bending and rocking of the stone or insufficient bond between the stones and the mortar to transfer the shear forces generated by the earthquakes.

The damage to the north-western and south-eastern corners of the building is due to the concentration of the in-plane and out-of-plane forces on the walls in the stiffer corners of the building.

The displaced stone blocks in the top few rows of blocks and movement between the roof and walls is due to insufficient shear strength in the connection between the roof diaphragm and the walls to transfer the seismic action on the roof and out-of –plane walls into the in-plane stone walls. This also results in a lower out-of-plane capacity of the stone walls since the roof diaphragm will be unable to transfer the out-of-plane loads on the walls to the in-plane walls.

4 Building Review Summary

4.1 Building Review Statement

As noted above no intrusive investigations were carried out for the Old Stone House. Because of the lack of linings a significant amount of information can be inferred from an external and internal visual inspection.

4.2 Critical Structural Weaknesses

The connection between the roof diaphragm and the walls has been identified as a critical structural weakness for this building. The gaps observed between the stone walls and parts of the timber diaphragm indicate that this connection has failed under recent seismic loading.

5 Building Strength (Refer to Appendix C for background information)

5.1 General

The Halswell Quarry Park - Old Quarryman's Information Centre (Single Man's Quarter) is a typical example of a single story building constructed from stone masonry and unreinforced concrete. It is of a type of building that, due to its heavy construction has typically sustained some damage. In general the Old Stone House has performed reasonably well however it has suffered damage as noted above.

5.2 Initial %NBS Assessment

The Halswell Quarry Park - Old Quarryman's Information Centre (Single Man's Quarter) has not been subject to specific engineering design and the initial evaluation procedure or IEP is not an appropriate method of assessment for this building. Instead a more detailed assessment has been carried out for the Old Stone House based on the Assessment and Improvement of Unreinforced Masonry Buildings for Earthquake Resistance document published by the New Zealand Society For Earthquake Engineering in February 2011.

Selected assessment seismic parameters are tabulated in the Table below.

Table 1: Parameters used in the Seismic Assessment

Seismic Parameter	Quantity	Comment/Reference
Site Soil Class	D	NZS 1170.5:2004, Clause 3.1.3, Deep or Soft Soil
Site Hazard Factor, Z	0.30	DBH Info Sheet on Seismicity Changes (Effective 19 May 2011)
Return period Factor, R_u	1	NZS 1170.5:2004, Table 3.5
Ductility Factor in Transverse Direction, μ	1	Stone masonry and unreinforced concrete walls
Ductility Factor in Longitudinal Direction, μ	1	Stone masonry and unreinforced concrete walls
Damping Ratio	15%	Based on NZSEE (2006) Guidelines

The wall to ceiling diaphragm connection is below 33% NBS. There are signs of movement between the diaphragm and the stone blocks indicating that this connection has failed in the recent earthquakes. The connection relies on friction to transfer shear forces and is currently limiting the strength of the building as a whole to less than 33% NBS

5.3 Results Discussion

Analysis shows that the wall to ceiling diaphragm connection in the Halswell Quarry Park - Old Quarryman's Information Centre (Single Man's Quarter) is a critical structural weakness which is limiting its seismic capacity to less than 33% NBS. As the buildings seismic capacity is below 33% NBS the building is considered to be a high risk building.

6 Conclusions and Recommendations

6.1.1 Building Occupation

A cordon has been placed around the building and it is currently unoccupied. In our opinion the Halswell Quarry Park - Old Quarryman's Information Centre (Single Man's Quarter) **is not currently suitable for occupation and the cordon should remain in place until repairs and strengthening work can be carried out**.

6.1.2 Further Investigations

The land below the Halswell Quarry is zoned as Port Hills and Banks peninsula and is unlikely to suffer from liquefaction and differential settlement. Additionally there is no local evidence of settlement and liquefaction in the surrounding land. Accordingly **a levels survey or geotechnical investigation has not been recommended for this site**.

A Quantitative DEE is required for this structure in order to determine the requirements for strengthening the building.

6.1.3 Repair

As the building is listed as a category 2 historic building any repairs or alterations must take into account the heritage nature of the building and will need to be done in consultation with and subject to the approval of the historic places trust (HPT).

The horizontal, vertical and step cracking in the stonework should be injected with grout. Some repointing may be necessary depending on the desired finish.

The displaced blocks in the south-eastern and north-western corners of the building should be removed and re-laid.

Spalling of interior plaster should be made good to match original finish.

The gaps between the external stone walls and internal concrete walls should be filled using grout.

The damaged unreinforced masonry chimney should be fully removed and the floor and ceiling made good. A suitable replacement may be required by the HPT.

6.1.4 Strengthening

We recommend that all structural elements within the building be strengthened to a minimum of 67%NBS or where easily achievable up to 100%NBS. Strengthening of the understrength elements may include:

- Strengthening of the diaphragm, this may be achieved by adding additional cross bracing in the roof space. Alternately plywood may be added to the diaphragm in order to increase its strength and stiffness.
- Strengthening of the wall to diaphragm connection for the stone walls, this may be achieved by bolting through the diaphragm and into the top of the stone walls. Strengthening of the connection of the diaphragm to the concrete internal walls may be achieved by attaching a steel angle to the concrete wall and the diaphragm.

Strengthening of elements continued:

- Strengthening of the connection between the internal concrete walls and the external stone walls to reduce the potential for pounding damage. This may be achieved in a number of ways. Steel rods could be inserted through the stone walls and into the concrete walls, these rods would be epoxied into the concrete walls and have pattress plates attached externally which would be visible on the exterior of the building. Alternatively steel angle could be bolted to the stone and concrete walls.

7 Explanatory Statement

The inspections of the building discussed in this report have been undertaken to assess structural earthquake damage. No analysis has been undertaken to assess the strength of the building or to determine whether or not it complies with the relevant building codes, except to the extent that Aurecon expressly indicates otherwise in the report. Aurecon has not made any assessment of structural stability or building safety in connection with future aftershocks or earthquakes – which have the potential to damage the building and to jeopardise the safety of those either inside or adjacent to the building, except to the extent that Aurecon expressly indicates otherwise in the report.

This report is necessarily limited by the restricted ability to carry out inspections due to potential structural instabilities/safety considerations, and the time available to carry out such inspections. The report does not address defects that are not reasonably discoverable on visual inspection, including defects in inaccessible places and latent defects. Where site inspections were made, they were restricted to external inspections and, where practicable, limited internal visual inspections.

To carry out the structural review, existing building drawings were obtained from the Christchurch City Council records. We have assumed that the building has been constructed in accordance with the drawings.

While this report may assist the client in assessing whether the building should be strengthened, that decision is the sole responsibility of the client.

This review has been prepared by Aurecon at the request of its client and is exclusively for the client's use. It is not possible to make a proper assessment of this review without a clear understanding of the terms of engagement under which it has been prepared, including the scope of the instructions and directions given to and the assumptions made by Aurecon. The report will not address issues which would need to be considered for another party if that party's particular circumstances, requirements and experience were known and, further, may make assumptions about matters of which a third party is not aware. No responsibility or liability to any third party is accepted for any loss or damage whatsoever arising out of the use of or reliance on this report by any third party.

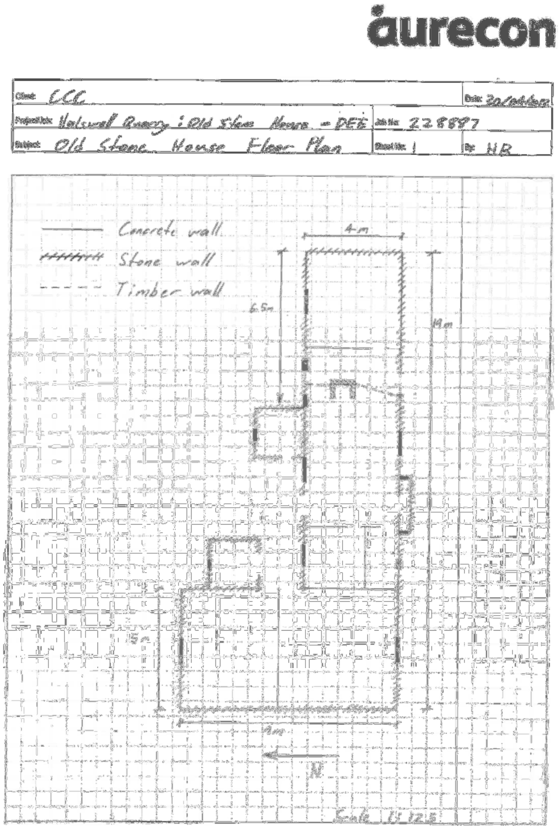
Without limiting any of the above, Aurecon's liability, whether under the law of contract, tort, statute, equity or otherwise, is limited as set out in the terms of the engagement with the client.

Appendices

Appendix A
Site Map and Photos

2 April 2012 – Halswell Quarry Park - Old Quarryman's Information Centre (Single Man's Quarter) site photographs

Aerial photograph of the Halswell Quarry site.	
Aerial photograph of the Halswell Quarry Park - Old Quarryman's Information Centre (Single Man's Quarter).	

Floor plan of the Halswell Quarry Park - Old Quarryman's Information Centre (Single Man's Quarter).	
Building northern elevation.	
Building southern elevation	

Building western elevation.	
Horizontal cracking in the stone wall.	
Vertical cracking in the stone wall.	
Step cracking in the stone wall.	

Displacement of stone blocks in the south-eastern corner of the building.	
Displacement of stone blocks in the south-eastern corner of the building.	
Displaced stone blocks in the top few rows of blocks.	

Vertical cracking in the end of a wall perpendicular to the northern elevation.	
Spalling of the interior plaster covering the stone walls indicating significant movement between stone blocks.	

Gaps of up to 10mm have between the external walls and perpendicular internal walls.	
Gaps of up to 10mm have between the external walls and perpendicular internal walls.	
Movement of the diaphragm indicating failure of the wall to diaphragm connection.	

Significant damage to the brick chimney.	

Appendix B
References

- Standards New Zealand, "AS/NZS 1170 Parts 0,1 and 5 and commentaries"
- Standards New Zealand, "NZS 3604:2011: Timber Framed Structures"
- Standards New Zealand, "NZS 4229:1999, Concrete Masonry Buildings Not Requiring Specific Design"
- Standards New Zealand, "NZS 3404:1997, Steel Structures Standard"
- Standards New Zealand, "NZS 3101:2006, Concrete Structures Standard"
- New Zealand Society for Earthquake Engineering (NZSEE), "Assessment and Improvement of the Structural Performance of Buildings in Earthquakes June 2006 and its 2011 supplement"
- Engineering Advisory Group, "Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-Residential Buildings in Canterbury. Part 2 Evaluation Procedure. Revision 5, 19 July 2011"

Appendix C
Strength Assessment Explanation

New building standard (NBS)

New building standard (NBS) is the term used with reference to the earthquake standard that would apply to a new building of similar type and use if the building was designed to meet the latest design Codes of Practice. If the strength of a building is less than this level, then its strength is expressed as a percentage of NBS.

Earthquake Prone Buildings

A building can be considered to be earthquake prone if its strength is less than one third of the strength to which an equivalent new building would be designed, that is, less than 33%NBS (as defined by the New Zealand Building Act). If the building strength exceeds 33%NBS but is less than 67%NBS the building is considered at risk.

Christchurch City Council Earthquake Prone Building Policy 2010

The Christchurch City Council (CCC) already had in place an Earthquake Prone Building Policy (EPB Policy) requiring all earthquake-prone buildings to be strengthened within a timeframe varying from 15 to 30 years. The level to which the buildings were required to be strengthened was 33%NBS.

As a result of the 4 September 2010 Canterbury earthquake the CCC raised the level that a building was required to be strengthened to from 33% to 67% NBS but qualified this as a target level and noted that the actual strengthening level for each building will be determined in conjunction with the owners on a building-by-building basis. Factors that will be taken into account by the Council in determining the strengthening level include the cost of strengthening, the use to which the building is put, the level of danger posed by the building, and the extent of damage and repair involved.

Irrespective of strengthening level, the threshold level that triggers a requirement to strengthen is 33%NBS.

As part of any building consent application fire and disabled access provisions will need to be assessed.

Christchurch Seismicity

The level of seismicity within the current New Zealand loading code (AS/NZS 1170) is related to the seismic zone factor. The zone factor varies depending on the location of the building within NZ. Prior to the 22nd February 2011 earthquake the zone factor for Christchurch was 0.22. Following the earthquake the seismic zone factor (level of seismicity) in the Christchurch and surrounding areas has been increased to 0.3. This is a 36% increase.

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 new building standard load requirements have been determined in accordance with the current earthquake loading standard (NZS 1170.5:2004 Structural design actions - Earthquake actions - New Zealand).

The likely capacity of this building has been derived in accordance with the New Zealand Society for Earthquake Engineering (NZSEE) guidelines 'Assessment and Improvement of the Structural Performance of Buildings in Earthquakes' (AISPBE), 2006. These guidelines provide an Initial Evaluation Procedure that assesses a buildings capacity based on a comparison of loading codes from when the building was designed and currently. It is a quick high-level procedure that can be used when undertaking a Qualitative analysis of a building. The guidelines also provide guidance on calculating a modified Ultimate Limit State capacity of the building which is much more accurate and can be used when undertaking a Quantitative analysis.

The New Zealand Society for Earthquake Engineering has proposed a way for classifying earthquake risk for existing buildings in terms of %NBS and this is shown in Figure C1 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	Unacceptable	Unacceptable

Figure C1: NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE Guidelines

Table C1 below compares the percentage NBS to the relative risk of the building failing in a seismic event with a 10% probability of exceedance in 50 years (i.e. 0.2% in the next year). It is noted that the current seismic risk in Christchurch results in a 6% probability of exceedance in the next year.

Table C1: Relative Risk of Building Failure In A

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

Appendix D
Background and Legal Framework

Background

Aurecon has been engaged by the Christchurch City Council (CCC) to undertake a detailed engineering evaluation of the building

This report is a Qualitative Assessment of the building structure, and is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011.

A qualitative assessment involves inspections of the building and a desktop review of existing structural and geotechnical information, including existing drawings and calculations, if available.

The purpose of the assessment is to determine the likely building performance and damage patterns, to identify any potential critical structural weaknesses or collapse hazards, and to make an initial assessment of the likely building strength in terms of percentage of new building standard (%NBS).

At the time of this report, no intrusive site investigation, detailed analysis, or modelling of the building structure had been carried out. Construction drawings were made available, and these have been considered in our evaluation of the building. The building description below is based on a review of the drawings and our visual inspections.

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.

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 carry out a full structural survey before the building is re-occupied.

We understand that CERA will 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). It is anticipated that CERA will adopt the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011. This document sets out a methodology for both qualitative and quantitative assessments.

The qualitative assessment is a desk-top and site inspection assessment. It is based on a thorough visual inspection of the building coupled with a review of available documentation such as drawings and specifications.

The quantitative assessment involves analytical calculation of the buildings strength and may require non-destructive or destructive material testing, geotechnical testing and intrusive investigation.

It is anticipated that factors determining the extent of evaluation and strengthening level required will include:

- The importance level and occupancy of the building
- The placard status and amount of damage
- The age and structural type of the building
- Consideration of any critical structural weaknesses
- The extent of any earthquake damage

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 any alteration. This effectively means that a building cannot be weakened as a result of an alteration (including partial demolition).

Section 115 – Change of Use

This section requires that the territorial authority (in this case Christchurch City Council (CCC)) be satisfied that the building with a new use complies with the relevant sections of the Building Code 'as near as is reasonably practicable'. Regarding seismic capacity 'as near as reasonably practicable' has previously been interpreted by CCC as achieving a minimum of 67%NBS however where practical achieving 100%NBS is desirable. The New Zealand Society for Earthquake Engineering (NZSEE) recommend a minimum of 67%NBS.

Section 121 – Dangerous Buildings

The definition of dangerous building in the Act was extended by the Canterbury Earthquake (Building Act) Order 2010, and it now defines a building as dangerous if:

- 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
- 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
- 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
- there is a risk that that other property could collapse or otherwise cause injury or death; or
- 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 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 ground shaking 33% of the shaking 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.

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 of the 4th September 2010.

The 2010 amendment includes the following:

- A process for identifying, categorising and prioritising Earthquake Prone Buildings, commencing on 1 July 2012;
- A strengthening target level of 67% of a new building for buildings that are Earthquake Prone;
- A timeframe of 15-30 years for Earthquake Prone Buildings to be strengthened; and,
- 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.

We anticipate that any building with a capacity of less than 33%NBS (including consideration of critical structural weaknesses) will need to be strengthened to a target of 67%NBS of new building standard as recommended by the Policy.

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.

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.

After the February Earthquake, on 19 May 2011, Compliance Document B1: Structure was amended to include increased seismic design requirements for Canterbury as follows:

- Hazard Factor increased from 0.22 to 0.3 (36% increase in the basic seismic design load)
- Serviceability Return Period Factor increased from 0.25 to 0.33 (80% increase in the serviceability design loads when combined with the Hazard Factor increase)

The increase in the above factors has resulted in a reduction in the level of compliance of an existing building relative to a new building despite the capacity of the existing building not changing.

Appendix E
Standard Reporting Spread Sheet

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Old Quarryman's Information Centre (Single Man's Quarter)	Reviewer:	Simon Manning
	Unit / No: / Street	CPEng No:	132053
Building Address:	Halswell Quarry Park / Kennedys Bush Rd	Company:	Aurecon
Legal Description:		Company project number:	228887
		Company phone number:	03 375 0761
	Degrees / Min / Sec		
GPS south:	43 / 35 / 59.08	Date of submission:	2/09/2013
GPS east:	172 / 34 / 33.00	Inspection Date:	2/04/2012
		Revision:	2
Building Unique Identifier (CCC):	PRK 1887 BLDG 004	Is there a full report with this summary?	yes

Site

Site slope:	slope < 1in 5	Max retaining height (m):	1.5
Soil type:	mixed	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:	1 (single storey = 1)	Ground floor elevation (Absolute) (m):	20.00
Ground floor split?	no	Ground floor elevation above ground (m):	21.00
Storeys below ground	0		
Foundation type:	mat slab	if Foundation type is other, describe:	concrete slab floor
Building height (m):	4.00	height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	125		
Age of Building (years):	90	Date of design:	Pre 1935
Strengthening present?	no	If so, when (year)?	
		And what load level (%g)?	
Use (ground floor):	other (specify)	Brief strengthening description:	
Use (upper floors):			
Use notes (if required):	Heritage		
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber framed	rafter type, purlin type and cladding	Combination of stone and concrete walls
Floors:	concrete flat slab	slab thickness (mm)	Unknown
Beams:	timber	type	
Columns:	load bearing walls	typical dimensions (mm x mm)	110mm thick
Walls:	load bearing stone	#N/A	

Lateral load resisting structure

Lateral system along:	unreinforced masonry bearing wall - stone	note wall thickness and cavity	300 thick no cavity
Ductility assumed, μ:	1.00	**Note: Define along and across in detailed report!**	
Period along:	0.40 (0.40 from parameters in sheet)	estimate or calculation?	estimated
Total deflection (ULS) (mm):		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):		estimate or calculation?	estimated
Lateral system across:	unreinforced masonry bearing wall - stone	note wall thickness and cavity	300 thick no cavity
Ductility assumed, μ:	1.00		
Period across:	0.40 (0.00)	estimate or calculation?	estimated
Total deflection (ULS) (mm):		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):		estimate or calculation?	estimated

Separations: (leave blank if not relevant)

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

Non-structural elements

Stairs:			
Wall cladding:	other heavy	describe	Concrete walls, Plastered over stone walls
Roof Cladding:	Metal	describe	corrugated iron
Glazing:	timber frames		
Ceilings:	strapped or direct fixed		Timber boards
Services(list):	None		

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:			
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):			
Across	Damage ratio:	0%		
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	yes	Describe:	Wall to diaphragm connection
Pounding:	Damage?:	yes	Describe:	Internal walls against external walls
Non-structural:	Damage?:	no	Describe:	

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

Recommendations

	Level of repair/strengthening required:	significant structural and strengthening	Describe:	
	Building Consent required:	yes	Describe:	
	Interim occupancy recommendations:	do not occupy	Describe:	
Along	Assessed %NBS before:	15% ##### %NBS from IEP below	If IEP not used, please detail assessment methodology:	Evaluation of Capacity and Demand
	Assessed %NBS after:	15%		
Across	Assessed %NBS before:	15% ##### %NBS from IEP below		
	Assessed %NBS after:	15%		

IEP **Use of this method is not mandatory - more detailed analysis may give a different answer, which would take precedence. Do not fill in fields if not using IEP.**

Period of design of building (from above): Pre 1935 — h_n from above: m

Seismic Zone, if designed between 1965 and 1992: — not required for this age of building / not required for this age of building

	along	across
Period (from above):	0.4	0.4
(%NBS)nom from Fig 3.3:		
Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0	1.00	
Note 2: for RC buildings designed between 1976-1984, use 1.2	1.0	
Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0)	1.0	

along across

	Final $(\%NBS)_{nom}$:	0%	0%

2.2 Near Fault Scaling Factor

		along	across
	Near Fault scaling factor, from NZS1170.5, cl 3.1.6:		1.00
	Near Fault scaling factor (1/N(T,D), **Factor A**:	1	1

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3:	
Z_{1992}, from NZS4203:1992	
Hazard scaling factor, **Factor B:**	#DIV/0!

2.4 Return Period Scaling Factor

Building Importance level (from above):	2
Return Period Scaling factor from Table 3.1, **Factor C**:	

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	1.00	1.00
Ductility scaling factor: =1 from 1976 onwards; or =kμ, if pre-1976, fromTable 3.3:		
Ductiity Scaling Factor, **Factor D**:	0.00	0.00

2.6 Structural Performance Scaling Factor:

	along	across
Sp:	1.000	1.000
Structural Performance Scaling Factor **Factor E**:	1	1

2.7 Baseline %NBS, $(NBS\%)_b = (\%NBS)_{nom}$ x A x B x C x D x E

	along	across
$\%NBS_b$:	#DIV/0!	#DIV/0!

Global Critical Structural Weaknesses: (refer to NZSEE IEP Table 3.4)

3.1. Plan Irregularity, factor A: 1

3.2. Vertical irregularity, Factor B: 1

3.3. Short columns, Factor C: 1

3.4. Pounding potential

Pounding effect D1, from Table to right 1.0

Height Difference effect D2, from Table to right 1.0

Therefore, Factor D: 1

3.5. Site Characteristics 1

Table for selection of D1	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
Alignment of floors within 20% of H	**0.7**	**0.8**	**1**
Alignment of floors not within 20% of H	**0.4**	**0.7**	**0.8**

Table for Selection of D2	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
Height difference > 4 storeys	0.4	0.7	1
Height difference 2 to 4 storeys	0.7	0.9	1
Height difference < 2 storeys	1	1	1

3.6. Other factors, Factor F

	Along	Across
For ≤ 3 storeys, max value =2.5, otherwise max valule =1.5, no minimum		
Rationale for choice of F factor, if not 1		

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)

List any: Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

3.7. Overall Performance Achievement ratio (PAR)

	along	across
PAR	**0.00**	**0.00**

4.3 PAR x (%NBS)b:

	along	across
PAR x Baselline %NBS:	**#DIV/0!**	**#DIV/0!**

4.4 Percentage New Building Standard (%NBS), (before) **#DIV/0!**

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