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Halswell Quarry Old Crusher Building

Qualitative Engineering Evaluation

Functional Location ID: PRK 1887 BLDG 003

Address: Halswell Quarry, Kennedys Bush Road

Reference: 228886

Prepared for:

Christchurch City Council

Revision: 2

Date: 24 June 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 Old Crusher 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 Old Crusher Building			
Building Location ID	PRK 1887 BLDG 003			**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**	1912
Foot Print (m²)	200	**Stories above ground**	1	**Stories below ground**	0
Type of Construction	Light roof, light timber framed walls, concrete slab on grade floor.				
Qualitative L4 Report Results Summary					
Building Occupied	N	The Halswell Quarry Old Crusher Building is cordoned off.			
Suitable for Continued Occupancy	N	The Halswell Quarry Old Crusher Building is not suitable for occupation.			
Key Damage Summary	Y	Refer to summary of building damage section 3.1 of report.			
Critical Structural Weaknesses (CSW)	Y	A number of critical structural weaknesses were noted. Refer to section 4.2 of report.			
Levels Survey Results	N	Levels surveys not required due to the lack of settlement related damage observed.			
Building %NBS From Analysis	35%	Based on an analysis of the bracing capacity and demand of the building superstructure. The wall to the northwest of the building is dangerous.			
Qualitative L4 Report Recommendations					
Geotechnical Survey Required	N	Geotechnical survey not required			
Proceed to L5 Quantitative DEE	N	Complete or partial demolition recommended. Refer to section 6.0 of report.			
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 Old Crusher Building 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 Old Crusher Building 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

Built in 1912 the Halswell Quarry Old Crusher Building is a single story one room building with an extension built onto its eastern side. Originally built to house quarry processing machinery, this building forms part of the Halswell Quarry station and is classified as a category 2 historic building by the Christchurch City Council plan.

The main building has a light weight corrugated iron roof. The walls are timber framed with a vertical board and batten external cladding. There is an internal concrete floor slab. The foundations are assumed to consist of concrete strip footings. A portion of the building overhangs a 4m high retaining wall and is supported off timber struts to the base of the retaining wall. The floor of the overhanging section is constructed of timber. The retaining wall also forms part of the foundations for the northern edge of the building.

The extension has a light weight corrugated iron roof. The walls are timber framed with a vertically orientated corrugated iron cladding on two sides with an open south elevation; it shears its west wall with the original Crusher Building. The floor is a combination of dirt and timber. The timber section of the floor is supported on timber bearers on concrete strip footings or concrete foundation piers where the floor elevated above the ground.

The approximate floor area of the building is 200 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

Halswell Quarry Old Crusher Building is a simple structure. Its light weight iron roof is supported on timber rafters on trusses that transfer loads to the external load bearing walls. Load bearing walls are supported on timber bearers on the concrete perimeter foundation. Lateral loads are resisted by lined timber framed external walls with diagonal timber bracing in each direction. External walls are either clad with board and batten or corrugated iron. No plans were available for this structure.

2.3 Reference Building Type

The Halswell Quarry Old Crusher Building is a basic industrial shed typical of its age and style. It was not subject to specific engineering design; rather it was constructed to a reliable formula known to achieve the performance and aesthetic objectives of the time it was built. Halswell Quarry Old Crusher Building does however suffer from deferred maintenance issues and a significant amount of age related damage was observed.

2.4 Building Foundation System and Soil Conditions

Halswell Quarry Old Crusher Building has, as discussed above, a variety of different foundation types. The land and surrounds of Halswell Quarry Old Crusher Building 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 Halswell Quarry Old Crusher Building of liquefaction bulges, boils or subsidence however rock fall may be a potential hazard in some locations.

2.5 Available Structural Documentation and Inspection Priorities

No architectural or structural drawings were available for the Halswell Quarry Old Crusher Building. Inspection priorities related to a review of potential damage to foundations and consideration of wall bracing adequacy. The generic building type for the Halswell Quarry Old Crusher Building is a basic industrial timber shed and this type of structure has performed fairly well during the Canterbury Earthquakes.

2.6 Available Survey Information

No levels or verticality survey information was available at the time of this report and obtaining these is not considered necessary due to the style of construction and intended use of the structure.

3 Structural Investigation

3.1 Summary of Building Damage

The Halswell Quarry Old Crusher Building was not in use at the time the damage assessment was carried out.

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

- The large free standing mass concrete wall to the north of the Halswell Quarry Old Crusher Building has a significant horizontal crack running the length of the wall.
- Cracking in the concrete retaining wall bellow the northern elevation of the building especially at the eastern end of the wall.
- Cracking in the concrete foundation piers supporting the northern elevation of the extension, especially in the north-eastern corner. These cracks are up to 5mm wide.
- Increased crack widths and gaps in the concrete floor slab of the main building.

Aside from the seismic damage the building has suffered significant damage due to deferred maintenance summarised as follows:

- The west wall of the main building is has deteriorated to the point of imminent collapse.
- A portion of the roofing is missing at the west end of the building

3.2 Record of Intrusive Investigation

An intrusive investigation was not required for Halswell Quarry Old Crusher Building as the above ground structure is fully exposed.

3.3 Damage Discussion

The large free standing mass concrete wall to the north of the Halswell Quarry Old Crusher Building presents a serious hazard in its current state as the top portion of the wall is loose and unstable.

The most significant seismic related damage observed to Halswell Quarry Old Crusher Building was to the concrete retaining wall supporting the northern elevation of the main building and the concrete foundation piers supporting the northern elevation of the extension. The concrete foundation piers and the concrete retaining wall have partially failed and further failure would result in the collapse of the crusher building. That they are damaged is not surprising as they are made from very poor quality concrete and are likely to be unreinforced. While some of the damage is possibly related to the age of the structure the earthquake has clearly worsened the damage.

4 Building Review Summary

4.1 Building Review Statement

As noted above no intrusive investigations were carried out for the Halswell Quarry Old Crusher Building. Because of the generic nature of the building and the lack of linings all above ground structural elements could be inspected.

4.2 Critical Structural Weaknesses

The following critical structural weaknesses were identified as part of the building qualitative assessment.

- The poor quality of concrete and the lack of reinforcing in the concrete retaining wall results in an undesirable brittle failure mode.
- The poor quality of concrete and the lack of reinforcing in the concrete foundation piers result in an undesirable brittle failure mode.
- There is a significant lateral eccentricity in the building due to the deterioration of the west wall of the main building which causes torsional effects.

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

5.1 General

The Halswell Quarry Old Crusher Building is, as discussed above, a typical example of an early industrial shed built from timber. The super structure of the Halswell Quarry Old Crusher Building, in general has performed well however it has suffered damage particularly to its concrete foundations as noted above.

5.2 Initial %NBS Assessment

The Halswell Quarry Old Crusher Building 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. Nevertheless an estimate of lateral load capacity can be made by adopting assumed values for strengths of existing materials and calculating the capacity of existing walls.

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	1.00	NZS 1170.5:2004, Table 3.5
Ductility Factor in Transverse Direction, μ	3.00	Timber sheathing on timber framed walls
Ductility Factor in Longitudinal Direction, μ	3.00	Timber sheathing on timber framed walls

The seismic demand for the Halswell Quarry Old Crusher Building has been calculated based on the current code requirements. The capacity of the existing walls in the building has been calculated from assumed strengths of existing materials and the number and length of walls present for both the north – south and east – west directions. The seismic demand was then compared with the building capacity in both directions. The building was found to have a capacity in the north – south direction to achieve a capacity of 35% NBS in its current state. The capacity of the building has been reduced significantly due to the deterioration of the west end of the building.

5.3 Results Discussion

Analysis shows that the Halswell Quarry Old Crusher Building superstructure is capable of achieving 35% NBS in its current state. The ability of the building to resist seismic actions has been significantly reduced by the deterioration of the west end of the building.

The retaining wall supporting the northern wall of the Halswell Quarry Old Crusher Building has partially failed and its residual capacity is likely to be very low given the style of construction.

The free standing mass concrete wall to the north of the Halswell Quarry Old Crusher Building appears to have partially failed as there is a horizontal crack running the length of the wall. Preliminary analysis shows that this wall is less than 33% NBS and poses a significant hazard.

6 Conclusions and Recommendations

The Halswell Quarry Old Crusher Building superstructure requires significant repair work to restore the western end of the building.

The retaining wall that forms part of the foundations for the northern elevation of the building has partially failed and requires replacement. This would involve a significant amount of invasive works and may be uneconomical in which case demolition of the old crusher building and replacement of the retaining wall or return of the ground to a natural slope may be the preferred option.

The cracked concrete foundation piers supporting the northern elevation of the addition should be replaced as the size of cracks which measure up to approximately 5mm and the type of construction make them unrepairable.

The free standing mass concrete block wall to the north of the Halswell Quarry Old Crusher Building requires demolition as it currently poses a significant hazard and repair of this structure is not feasible given the type of construction.

As the building is listed as a category 2 historic building any repairs or alterations or demolition 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.

The land below the Halswell Quarry Old Crusher Building 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 has not been recommended for this site**.

As there is clear evidence of damage to the retaining wall structure it is **recommended that a geotechnical investigation is carried out** to enable design of a replacement retaining wall to suit the ground conditions present.

The building is currently unoccupied and in our opinion the Halswell Quarry Old Crusher Building **is not considered suitable for occupation** due to the collapse hazard presented by the damaged retaining wall.

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 Old Crusher Building site photographs

General view of the Halswell Quarry site.	
Aerial photograph of the Old Crusher Building.	
Building northern elevation.	

Building southern elevation.	
Building internal view.	
Increased crack widths and gaps in the concrete floor slab.	
Cracking in concrete floor slab.	

Cracking in the concrete foundation piers supporting the northern elevation of the extension.	
Cracking in the concrete foundation piers supporting the northern elevation of the extension.	
Cracking in the concrete retaining wall bellow the northern elevation of the building.	

Cracking in the concrete retaining wall bellow the northern elevation of the building.	
Horizontal cracking in the large free standing mass concrete wall to the north of the Halswell Quarry Old Crusher Building.	

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"
- 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	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	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 Crusher Bldg	Reviewer:	Simon Manning
	Unit / No: / Street	CPEng No:	132053
Building Address:	Halswell Quarry / Kennedys Bush Rd	Company:	Aurecon
Legal Description:		Company project number:	228886
		Company phone number:	03 366 0821
	Degrees / Min / Sec		
GPS south:	43 / 36 / 0.04	Date of submission:	26/06/2013
GPS east:	172 / 34 / 39.69	Inspection Date:	2/04/2012
		Revision:	2
Building Unique Identifier (CCC):	PRK 1887 BLDG 003	Is there a full report with this summary?	yes

Site

Site slope:	slope >1 in 5	Max retaining height (m):	5
Soil type:	mixed	Soil Profile (if available):	
Site Class (to NZS1170.5):	C		
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):	35.00

Building

No. of storeys above ground:	1 (single storey = 1)	Ground floor elevation (Absolute) (m):	35.00
Ground floor split?	no	Ground floor elevation above ground (m):	0.00
Storeys below ground	0		
Foundation type:	other (describe)	if Foundation type is other, describe:	Combination of Concrete and timber bearers, some isolate
Building height (m):	5.00	height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	200		
Age of Building (years):	100	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):	Plant nursery and storage		
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	frame system		
Roof:	timber framed	rafter type, purlin type and cladding	
Floors:	concrete flat slab	slab thickness (mm)	Unknown, Timber floor in some places
Beams:	timber	type	
Columns:	timber	typical dimensions (mm x mm)	
Walls:	non-load bearing	0	

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	lightweight timber framed walls		note typical wall length (m)	20
Ductility assumed, μ:	3.00			
Period along:	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
Lateral system across:	lightweight timber framed walls		note typical wall length (m)	10
Ductility assumed, μ:	3.00			
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:

north (mm):		leave blank if not relevant
east (mm):		
south (mm):		
west (mm):		

Non-structural elements

Stairs:			
Wall cladding:	exposed structure	describe	exposed interior, board and batten exterior
Roof Cladding:	Metal	describe	corrugated iron
Glazing:	other (specify)		None
Ceilings:	none		
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?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	no	Describe:	

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

Recommendations

	Level of repair/strengthening required:	none	Describe:	
	Building Consent required:	yes	Describe:	
	Interim occupancy recommendations:	do not occupy	Describe:	
Along	Assessed %NBS before:	35%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology:
	Assessed %NBS after:	35%		
Across	Assessed %NBS before:	35%	##### %NBS from IEP below	
	Assessed %NBS after:	35%		

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

Near Fault scaling factor, from NZS1170.5, cl 3.1.6: 1.00

	along	across
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

	along	across
2.7 Baseline %NBS, $(NBS\%)_b = (\%NBS)_{nom}$ x A x B x C x D x E — **$\%NBS_b$:**	**#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 $\leq$ 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

	along	across
3.7. Overall Performance Achievement ratio (PAR)	**0.00**	**0.00**
4.3 PAR x $(\%NBS)_b$: — PAR x Baselline %NBS:	**#DIV/0!**	**#DIV/0!**
4.4 Percentage New Building Standard (%NBS), (before)		**#DIV/0!**

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