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Awa-iti Domain Shed 005

PRK 3746 BLDG 005

Detailed Engineering Evaluation

Quantitative Report

Version FINAL

4313 Christchurch Akaroa Road,
Little River.

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Awa-iti Domain Shed 005
PRK 3746 BLDG 005

Detailed Engineering Evaluation
Quantitative Report
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4313 Christchurch Akaroa Road,
Little River

Christchurch City Council

Prepared By
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Reviewed By
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Date
26/9/13

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Awa-iti Domain Shed 005

PRK 3746 BLDG 005

Detailed Engineering Evaluation

Quantitative Report - SUMMARY

Version FINAL

4313 Christchurch Akaroa Road, Little River

Background

This is a summary of the Quantitative report for the building structure, and is based in general on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011 and visual inspections on 26th June 2013 only.

Brief Description

The Awa-iti Domain Shed is located at 4313 Christchurch Akaroa Road, Little River. The site consists of the several buildings of various use, a car park and various sports facilities. The age of the building is unknown.

The building is a single storey timber framed structure on concrete slab with perimeter thickening. The roof is pitched up to a central longitudinal ridge and consists of lightweight metal cladding fixed to timber purlins. The purlins are fixed to the timber trusses which are supported by load bearing timber framed walls. All internal surfaces of walls are lined internally with particleboard and exterior cladding is provided by a profiled metal cladding system.

Key Damage Observed

Key damage observed includes:-

- Minor cracking to perimeter strip footing.
- Minor damage to ceiling linings.

Building Capacity Assessment

Based on the Quantitative Analysis carried out on the structure using NZS 3604:2011 for Timber-Framed buildings and referencing the New Zealand Society for Earthquake Engineering (NZSEE) guidelines, the building has been assessed to be 93% NBS along the building and 34% NBS across. Based on this, the overall %NBS for the building is 34%.

Recommendations

The building has been assessed to have a seismic capacity of 34% NBS. As the building's capacity is assessed to be greater than 34% NBS, it is not considered to be either an Earthquake Prone building. It is however, considered to be a potentially Earthquake Risk building as it has achieved less than 67% NBS.

Although the building has achieved greater than 34% NBS, GHD recommend that strengthening of the building be carried out to increase the % NBS of the building to a minimum of 67% NBS in accordance with the NZSEE guidelines.

Furthermore, repair work should be carried out on all cracking observed in the perimeter foundations of the building.

As are no immediate collapse hazards, or Critical Structural Weaknesses associated with the structure, therefore general occupancy of the building is permitted.

1. Background

GHD has been engaged by the Christchurch City Council (CCC) to undertake a detailed engineering evaluation of Awa-iti Domain Shed 005.

This report is a Quantitative Assessment of the building structure, and is based in general on NZS 3604:2011 Timber Framed buildings and the New Zealand Society for Earthquake Engineering (NZSEE) guidelines.

A Quantitative Assessment involves a full site measure of the building which is used to determine bracing capacity in accordance with manufacturers' guidelines where available. When the manufacturers' guidelines are not available, values for material strengths are taken from Table 11.1 of the NZSEE guidelines for the Assessment and Improvement of the Structural Performance of Buildings in Earthquakes. The demand for the building is determined in accordance with NZS 3604:2011 and the percentage of New Building Standard (%NBS) is assessed.

At the time of this report, no modelling of the building structure had been carried out. The detailed analysis for the report consisted of an analysis of the bracing capacity of the structure. No further analysis or calculations other than those set out within this report were carried out.

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 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

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 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.

2.2.1 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.

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 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.

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.

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.

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 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 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	Unacceptable	Unacceptable

Figure 1 NZSEE Risk Classifications Extracted from Table 2.2 of the NZSEE 2006 AISPBE

Table 1 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). It is noted that the current seismic risk in Christchurch results in a 6% risk of exceedance in the next year.

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

Table 1 %NBS compared to relative risk of failure

4. Building Description

4.1 General

The Awa-iti Domain Shed is located at 4313 Christchurch Akaroa Road, Little River. The site consists of the several buildings of various use, a car park and various sports facilities. The age of the building is unknown.

The building is a single storey timber framed structure on concrete slab with perimeter thickening. The roof is pitched up to a central longitudinal ridge and consists of lightweight metal cladding fixed to timber purlins. The purlins are fixed to the timber trusses which are supported by load bearing timber framed walls. All internal surfaces of walls are lined internally with particleboard and exterior cladding is provided by a profiled metal cladding system.

The building dimensions are approximately 17 m long by 5.5 m wide with an approximate total floor area of 93.5 m^2. The overall height of the building is 4.4 m with wall stud heights of 2.5 m.

The nearest building is approximately 1 m from the shed building whilst the nearest waterway to the property is the Hukahuka Turoa Stream, located approximately 60 m to the east of the property.

A plan layout of the building is shown in Figure 2.

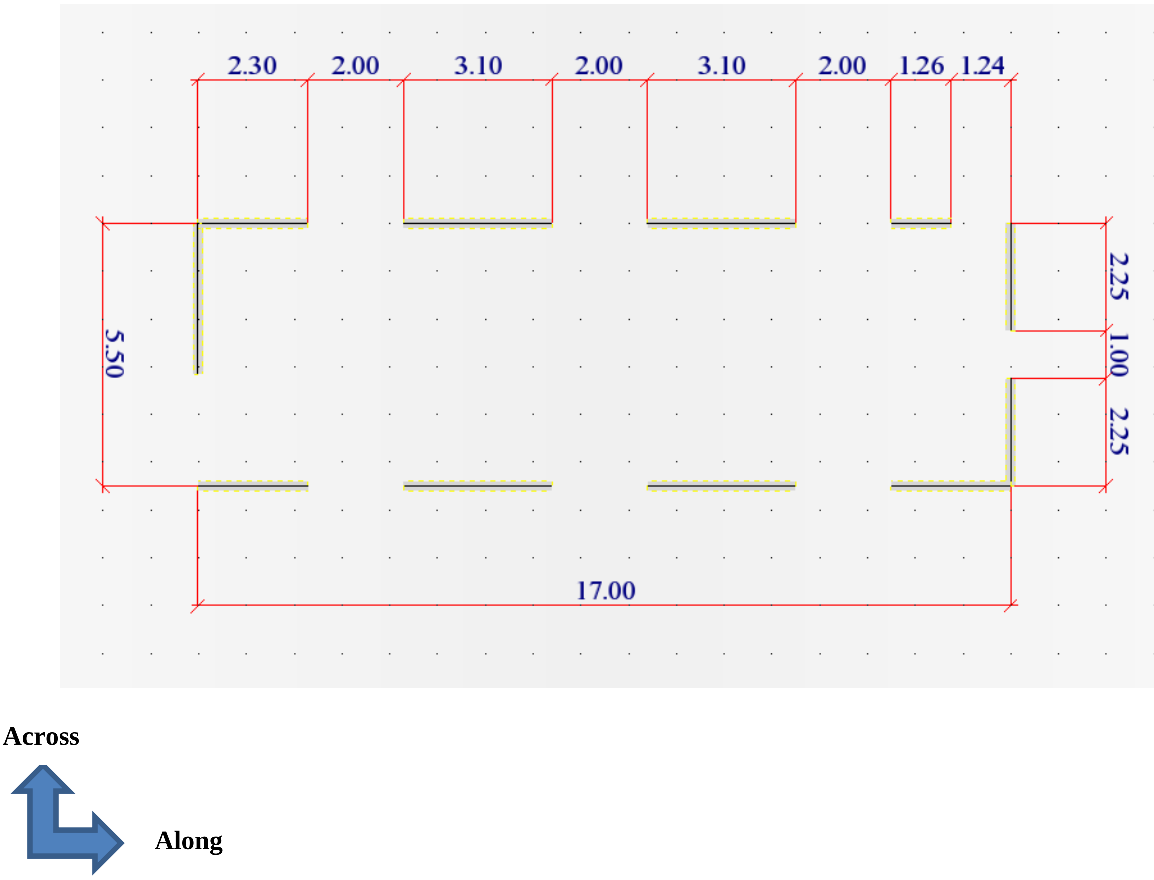

Figure 2 Plan sketch showing key structural elements

4.2 Gravity Load Resisting System

Gravity loads from the roof cladding are supported by timber purlins. These loads are then transferred from the purlins to the timber roof trusses. Gravity loads from the trusses are then transferred to the load bearing timber framed external walls and then to the concrete perimeter foundation walls. Internal gravity loads are transferred through the concrete floor slab back to the perimeter foundations and the soil below.

4.3 Lateral Load Resisting System

Lateral loads acting on the structure in both the long and short directions of the building are resisted by timber framed, particleboard lined walls. Lateral forces acting on the roof structure are distributed to the walls through diaphragm action of the lined ceiling. The walls are distributed around the perimeter of the building in both the long and short directions. The walls then transfer the lateral loads to the perimeter foundations.

5. Damage Assessment

An inspection of the building was undertaken on the 26th of June 2013. Both the interior and exterior of the building was inspected. No inspection of the foundations of the structure was able to be undertaken.

The inspection consisted of observing the building to determine the structural systems and likely behaviour of the building during an earthquake. The site was assessed for damage, including observing the ground conditions, checking for damage in areas where damage would be expected for the structure type observed and noting general damage observed throughout the building in both structural and non-structural elements.

5.1 Surrounding Buildings

No apparent damage was noted to the surrounding buildings or the adjoining properties.

5.2 Residual Displacements and General Observations

Cracking was noted at several locations on the building's perimeter foundation. Several of the cracks penetrate through the concrete foundation.

5.3 Ground Damage

There was no evidence of ground damage on the site.

6. Survey

No floor level survey or intrusive investigations have been carried out for the building.

7. Geotechnical Consideration

7.1 Site Description

The site is situated in Little River on Banks Peninsula. It is situated in the bottom on a valley at approximately 20 m above mean sea level. It is approximately 40 m west of the Hukahuka Turoa Stream, 2.5 km northeast of Lake Forsyth, and 14 km west of Akaroa.

7.2 Published Information on Ground Conditions

7.2.1 Published Geology

Forsyth *et. al* 2008[1] describes the site geology as:

- Grey river alluvium beneath plains or low-level terraces (Q1a), Holocene in age;

7.2.2 Environment Canterbury Logs

Information from Environment Canterbury (ECan) indicates that four boreholes with lithographic logs are located within 500 m of the site, the borehole logs for these wells are summarised in Table 2.

These indicate the area is underlain by loess colluvium and alluvium with occasional volcanic boulders to ~20 m bgl, underlain by volcanic rock to ~60 m bgl.

Groundwater was recorded between 1.85 m and 3.7 m bgl in the borehole logs.

Table 2 ECan Borehole Summary

Bore Name	Log Depth	Groundwater	From Site	Log Summary	
N36/0003	10.6 m	N/A	90 m E	0.0 – 7.6	Not logged
				7.6 – 9.1	Rock
				9.1 – 10.6	Blue clay
N36/0082	41.5 m	3.6 m bgl	400 m W	0.0 – 3.0	Sand and gravels
				3.0 – 7.0	Clay
				7.0 – 8.0	Clayey volcanic rock
				8.0 – 8.5	Volcanic rock
				8.5 – 24.0	Clay, silt and volcanics
				24.0 – 41.5	Hard volcanics
N36/0131	60.0 m	3.7 m bgl	465 m SW	0.0 – 0.5	Soil
				0.5 – 6.0	Sandy clay with gravels
				6.0 – 10.0	Volcanic gravels

[1] Forsyth, P.J., Barrell, D.J.A., Jongens, R. (2008) (compilers), Geology of the Christchurch Area, Institute of Geological and Nuclear Sciences 1:250 000 geological map 16. 1 sheet. Lower Hutt, New Zealand. GNS Science. ISBN 987-0-478-19649-8

Bore Name	Log Depth	Groundwater	From Site	Log Summary	
				10.0 – 13.0	Peaty silt/clay
				13.0 – 17.0	Gravelly clay
				17.0 – 24.0	Rock
				24.0 – 34.0	Rock and clay
				34.0 – 60.0	Rock
N36/0250	10.9 m	1.85 m bgl	475 m SW	0.0 – 0.3	Silty soils
				0.3 – 0.7	Silty clay
				0.7 – 3.0	Clay
				3.0 – 4.5	Rock and clay
				4.5 – 7.0	Clay and gravels
				7.0 – 10.0	Clay and rocks
				10.0 – 10.9	Volcanic rock

It should be noted that the logs have been written by the well driller and not a geotechnical professional or to a standard. In addition strength data is not recorded.

7.2.3 EQC Geotechnical Investigations

The Canterbury Geotechnical Database (CGD) shows no nearby geotechnical testing has been undertaken in the area by EQC and other independent investigations

7.2.4 CERA Land Zoning

Canterbury Earthquake Recovery Authority (CERA) has indicated the site is situated within the Green Zone, indicating that repair and rebuild may take place.

The site has been categorised as “Port Hills & Banks Peninsula” because sites in the Port Hills and Banks Peninsula have not been given technical categories by CERA.

7.2.5 Aerial Photography

The site is not in coverage for aerial photography flown following major earthquakes of the Canterbury Earthquake sequence. An aerial photograph from March 2013 shows the sites location on the valley floor.

Figure 3 Aerial Photography

7.2.6 Summary of Ground Conditions

From the information presented above, the ground conditions underlying the site are anticipated to comprise loess colluvium and alluvium with occasional volcanic boulders to ~20 m bgl, underlain by volcanic rock to ~60 m bgl.

Groundwater is considered to vary between 1.85 m and 3.7 m bgl.

7.3 Seismicity

7.3.1 Nearby Faults

There are many faults in the Canterbury region, however only those considered most likely to have an adverse effect on the site are detailed below.

Table 3 Summary of Known Active Faults[2,3]

Known Active Fault	Distance from Site	Direction from Site	Max Likely Magnitude	Avg Recurrence Interval
Alpine Fault	150 km	NW	~8.3	~300 years
Greendale Fault (2010)	40 km	NW	7.1	~15,000 years
Hope Fault	130 km	N	7.2~7.5	120~200 years
Porters Pass Fault	90 km	NW	7.0	~1100 years
Port Hills Fault (2011)	23 km	NW	6.3	*Not Estimated*

The recent earthquake sequence since 4 September 2010 has identified the presence of a previously unmapped active fault system underneath the Canterbury Plains; this includes the Greendale Fault and Port Hills Fault listed in Table 3 above. Research and published information on this system is in development and the average recurrence interval is yet to be established for the Port Hills Fault.

7.3.2 Ground Shaking Hazard

New Zealand Standard NZS 1170.5:2004 quantifies the Seismic Hazard factor for Christchurch as 0.30, being in a moderate to high earthquake zone. This value has been provisionally upgraded recently (from 0.22) to reflect the seismicity hazard observed in the earthquakes since 4 September 2010.

The Christchurch earthquake sequence has produced earthquakes with high peak ground accelerations (PGA) across large parts of the city. The CGD contains conditional peak ground accelerations during selected earthquakes of the Canterbury earthquake sequence.

Conditional PGA's from the CGD[4] are not available for the Banks Peninsula.

7.4 Global Land Movement

Given the site's location on flat land in the bottom of a valley, global slope instability is considered negligible. However, any localised retaining structures or embankments should be further investigated to determine the site-specific slope instability potential.

7.5 Listed Land Use Register

A search of the property address in the Environment Canterbury (ECan) Listed Land Use Register[5] shows the site has no listed land use.

[2] Stirling, M.W, McVerry, G.H, and Berryman K.R. (2002): "A New Seismic Hazard Model for New Zealand", *Bulletin of the Seismological Society of America*, Vol. 92 No. 5, June 2002, pp. 1878-1903.

[3] GNS Active Faults Database, http://maps.gns.cri.nz/website/af/viewer

[4] Canterbury Geotechnical Database (2012): "Conditional PGA for Liquefaction Assessment", Map Layer CGD5110 - 27 Sept 2012, retrieved 31/10/2012 from https://canterburygeotechnicaldatabase.projectorbit.com/

[5] http://llur.ecan.govt.nz/

7.6 Liquefaction Potential

The site is considered to have a minor susceptibly to liquefaction, because the site is situated on fine grained shallow soils (silts and clays) underlain by volcanic bedrock, which are unlikely to liquefy.

7.7 Summary & Recommendations

This assessment is based on a review of the geology and existing ground investigation information, and observations from the Christchurch earthquakes since 4 September 2010.

The site appears to be situated on loess colluvium and alluvium with occasional volcanic boulders to ~20 m bgl, underlain by volcanic rock to ~60 m bgl. The site is unlikely to liquefy.

A soil class of **C** (in accordance with NZS 1170.5:2004) should be adopted for the site.

Should soil parameters be required for foundation repair or design it is recommended that intrusive investigation be conducted.

8. Seismic Capacity Assessment

8.1 Quantitative Assessment

A Quantitative Assessment of the building was carried out using the information obtained during visual inspections of the building carried out on 26th June 2013. From this information, the building's bracing capacity was determined in accordance with NZS 3604:2011 and the NZSEE guidelines. The demand for the building was calculated in accordance with NZS 3604:2011 and the percentage of New Building Standard (%NBS) was assessed.

8.1.1 Building demand

The demand on the structure was determined in accordance with Section 5 of NZS 3604:2011. The bracing unit demand per square metre was determined from Table 5.10. In accordance with Table 5.10 of NZS 3604:2011 (for a single storey building with light roof, light single-storey cladding on concrete slab-on-ground) a bracing demand of 6 BU/m^2 for the single storey walls is taken. As the building has a part storey in the roof space, the bracing demand shall be increased by 4 BU/m^2 in accordance with clause 5.3.4.3 of NZS 3604: 2011. As the building is located on the banks peninsula (Earthquake Zone 2) on Class C soils, a multiplication factor of 0.6 is applied to reduce the demand in accordance with Table 5.10 of NZS 3604:2011. Therefore the total bracing demand for the building is;

$$\text{Single storey walls BU}_{\text{demand}} = (0.6 \text{ x } (6+4) \ \text{BU/m}^2 \ \text{ x } 93.5\text{m}^2\ )$$

$$= 561 \text{ BU}$$

8.1.2 Wall bracing capacity

The buildings construction date is unknown. No information was available with regards to the capacity of the bracing elements used in the building. Therefore the bracing capacity of the particleboard linings was assumed to be 2 kN/m.

For this purpose, the strength value of particleboard was converted to equivalent bracing units (1 kN = 20BU) and then multiplied by the strength reduction factor of 0.7. This value was used for all walls with particleboard lining on one side only. Therefore the bracing capacity for walls with particleboard lining on only one side is taken as;

$$\text{BU}_{\text{equivalent}} = \left(0.7 \text{ x} \frac{2\text{kN}}{\text{m}} \text{x} \frac{20\text{BU}}{\text{kN}} = 28\text{BU/m each side}\right)$$

Section 11.4 of the NZSEE guidelines states that shear panels can utilise their full bracing capacity for aspect ratios (height-to-width) up to 2:1. For aspect ratios greater than 2:1 and up to 3.5:1 a limiting factor can be applied in accordance with the NEHRP Recommended Provisions (BSSC, 2000) as follows;

$$\text{Aspect Ratio Factor} = \frac{2 \text{ x Width of Wall}}{\text{Wall Height}}$$

Any sections of wall with an aspect ratio greater than 3.5:1 were not included for the purpose of the bracing calculations. The walls in this building are 2.5 m in height, and as such any wall less than 0.7 m in length was not considered for the bracing calculations.

The calculated bracing capacities along and across the building are shown in Table 4.

Table 4 Bracing Units Provided

Direction	Bracing Units Provided
Along the building	518 BUs
Across the building	192 BUs

8.1.3 %NBS

The bracing capacity both along and across the building are compared to the demand to determine the critical direction, and therefore the overall %NBS for the building. The %NBS value is calculated as follows;

$$\%\mathrm{NBS} = \frac{\mathrm{BU}_{\mathrm{provided}}}{\mathrm{BU}_{\mathrm{demand}}} \text{ x } \%100$$

The calculated %NBS for both along and across the building is presented in Table 5.

Table 5 %NBS

Direction	%NBS
Along the building	93%
Across the building	34%

Following a detailed assessment the building has been assessed as having a seismic capacity 34% NBS. Under the NZSEE guidelines the building is not considered to be either an Earthquake Prone building or an Earthquake Risk as it achieves above 67% NBS.

8.1 Occupancy

As the building has been assessed to have a %NBS greater than 67% NBS, it is not considered to be an Earthquake Prone Building or an Earthquake Risk. In addition there are no immediate collapse hazards, or Critical Structural weaknesses associated with the structure, therefore general occupancy of the building is permitted.

9. Recommendations and Conclusions

The building has been assessed to have a seismic capacity of 34% NBS. As the building's capacity is assessed to be greater than 34% NBS, it is not considered to be either an Earthquake Prone building. It is however, considered to be a potentially Earthquake Risk building as it has achieved less than 67% NBS.

Although the building has achieved greater than 34% NBS, GHD recommend that strengthening of the building be carried out to increase the % NBS of the building to a minimum of 67% NBS in accordance with the NZSEE guidelines.

In addition there are no immediate collapse hazards, or Critical Structural Weaknesses associated with the structure, therefore general occupancy of the building is permitted.

10. Limitations

10.1 General

This report has been prepared subject to the following limitations:

- Drawings of the building were unavailable. As a result the information contained in this report has been inferred from visual inspections of the building and site only.
- The foundations of the building were only able to be inspected where they were above ground level.
- No intrusive structural investigations have been undertaken.
- No intrusive geotechnical investigations have been undertaken.
- No level or verticality surveys have been undertaken.
- No material testing has been undertaken. Material properties have been assumed based on the recommendations from the NZSEE guidelines for the Assessment and Improvement of the Structural Performance of Buildings in Earthquakes
- No modelling of the building for structural analysis purposes has been performed.

It is noted that this report has been prepared at the request of Christchurch City Council and is intended to be used for their purposes only. GHD accepts no responsibility for any other party or person who relies on the information contained in this report.

10.2 Geotechnical Limitations

This report presents the results of a geotechnical appraisal prepared for the purpose of this commission, and for prepared solely for the use of Christchurch City Council and their advisors. The data and advice provided herein relate only to the project and structures described herein and must be reviewed by a competent geotechnical engineer before being used for any other purpose. GHD Limited (GHD) accepts no responsibility for other use of the data.

The advice tendered in this report is based on a visual geotechnical appraisal. No subsurface investigations have been conducted by GHD. An assessment of the topographical land features have been made based on this information. It is emphasised that Geotechnical conditions may vary substantially across the site from where observations have been made. Subsurface conditions, including groundwater levels can change in a limited distance or time. In evaluation of this report cognisance should be taken of the limitations of this type of investigation.

An understanding of the geotechnical site conditions depends on the integration of many pieces of information, some regional, some site specific, some structure specific and some experienced based. Hence this report should not be altered, amended or abbreviated, issued in part and issued incomplete in any way without prior checking and approval by GHD. GHD accepts no responsibility for any circumstances, which arise from the issue of the report, which have been modified in any way as outlined above..

Appendix A
Photographs

Photograph 1 Transverse gable wall

Photograph 2 Longitudinal wall

Photograph 3 Internal view showing eastern gable

Photograph 4 Internal view showing western gable

Photograph 5 Typical of cracking to the foundations

Photograph 6 Crack width is greater than 3.5 mm

Appendix B

Existing Drawings / Sketches

No structural or architectural drawings have been made available for this building. Shown below is a marked up plan of the building showing key structural elements.

Appendix C

CERA Standardized Report Form

Detailed Engineering Evaluation Summary Data V1.14

Location

Building Name:	Shed 005		Reviewer:	Hamish MacKinven
	Unit / No: / Street		CPEng No:	
Building Address:	5 / 4310 / Christchurch Akaroa Road		Company:	GHD Ltd
Legal Description:	Lot 1 DP 423920		Company project number:	
			Company phone number:	03 3780900
	Degrees / Min / Sec			
GPS south:	43 / 45 / 51.64		Date of submission:	
GPS east:	172 / 47 / 47.28		Inspection Date:	26-06-13
			Revision:	FINAL
Building Unique Identifier (CCC):	PRK 3746 BLDG 005		Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	0
Soil type:	mixed	Soil Profile (if available):	N/A
Site Class (to NZS1170.5):	C		
Proximity to waterway (m, if <100m):	40	If Ground improvement on site, describe:	N/A
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m):	
Ground floor split?	no		Ground floor elevation above ground (m):	0.00
Storeys below ground	0			
Foundation type:	strip footings		if Foundation type is other, describe:	
Building height (m):	4.40		height from ground to level of uppermost seismic mass (for IEP only) (m):	4
Floor footprint area (approx):	94			
Age of Building (years):			Date of design:	1976-1992
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	other (specify)		Brief strengthening description:	
Use (upper floors):	other (specify)			
Use notes (if required):	storage			
Importance level (to NZS1170.5):	IL1			

Gravity Structure

Gravity System:	frame system		
Roof:	timber truss	truss depth, purlin type and cladding	
Floors:	concrete flat slab	slab thickness (mm)	
Beams:	timber	type	Timber top and bottom plates
Columns:	timber	typical dimensions (mm x mm)	Timber studs
Walls:			

Lateral load resisting structure

Lateral system along:	lightweight timber framed walls	**Note: Define along and across in detailed report!**	note typical wall length (m)	20
Ductility assumed, μ:	2.00			
Period along:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	lightweight timber framed walls		note typical wall length (m)	6
Ductility assumed, μ:	2.00			
Period across:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	

Separations:

north (mm):		leave blank if not relevant
east (mm):	0	
south (mm):		
west (mm):		

Non-structural elements

Stairs:			
Wall cladding:	other light	describe	Timber weatherboard
Roof Cladding:	Metal	describe	Corrugated Steel
Glazing:	timber frames		
Ceilings:			
Services(list):			

Available documentation

Architectural	none	original designer name/date	
Structural	none	original designer name/date	
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

Damage

Site: (refer DEE Table 4-2)	Site performance:	Good	Describe damage:	N/A
	Settlement:	none observed	notes (if applicable):	
	Differential settlement:	none observed	notes (if applicable):	
	Liquefaction:	none apparent	notes (if applicable):	
	Lateral Spread:	none apparent	notes (if applicable):	
	Differential lateral spread:	none apparent	notes (if applicable):	
	Ground cracks:	none apparent	notes (if applicable):	
	Damage to area:	none apparent	notes (if applicable):	
Building:				
	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):			
Across	Damage ratio:	0%		
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	no	Describe:	

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

Recommendations

	Level of repair/strengthening required:	minor structural	Describe:	Repair cracks to strip footings
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before e'quakes:	93% ##### %NBS from IEP below	If IEP not used, please detail assessment methodology:	NZS 3604: 2011 & NZSEE Guidelines
	Assessed %NBS after e'quakes:	93%		
Across	Assessed %NBS before e'quakes:	34% ##### %NBS from IEP below		
	Assessed %NBS after e'quakes:	34%		

GHD

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
DRAFT	Peter O'Brien	Hamish MacKinven		Donna Bridgman		28/08/2013
FINAL	Peter O'Brien	Hamish MacKinven		Donna Bridgman		26/09/2013