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Duvauchelle Works Yard Shelter
PRO 3612-001

Detailed Engineering Evaluation
Qualitative Report
Version Final

Pawsons Valley Road, Duvauchelle

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

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Detailed Engineering Evaluation
Qualitative Report
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Pawsons Valley Road, Duvauchelle

Christchurch City Council

Prepared By
Cormac Joy

Reviewed By
Stephen Lee

Date
24/05/12

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Duvauchelle Works Yard Shelter

PRO 3612-001

Detailed Engineering Evaluation

Qualitative Report - SUMMARY

Version Final

Pawsons Valley Road, Duvauchelle

Background

This is a summary of the Qualitative 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 26 January 2012.

Key Damage Observed

No damage was observed to the building.

Critical Structural Weaknesses

The lack of diagonal in-line roof bracing has been identified as a critical structural weakness.

Indicative Building Strength (from IEP and CSW assessment)

Based on the information available, and using the NZSEE Initial Evaluation Procedure, the buildings original capacity has been assessed to be in the order of 39% NBS. The buildings post-earthquake capacity excluding critical structural weaknesses is in the order of 45% NBS.

The building has been assessed to have a seismic capacity in the order of 39% NBS and is therefore an Earthquake Risk.

Recommendations

It is recommended that:

A quantitative assessment is not deemed to be necessary, as the building has been assessed to not be earthquake prone however it is still regarded as an earthquake risk.

The current green placard status of the building is to remain as is.

1. Background

GHD has been engaged by the Christchurch City Council (CCC) to undertake a detailed engineering evaluation of the Duvauchelle Works Yard Shelter.

This report is a Qualitative Assessment of 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.

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. The building description is based on the visual inspection carried out on site.

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 fire depot shelter is located in the Duvauchelle works yard, Pawsons Valley Road, Akaroa. The original construction date of the shelter is unknown but from site observation is estimated to be in the 1940's. The structure can be observed aerially in Photograph 7 in Appendix A.

The site slopes gradually towards the Christchurch Akaroa Road and seafront.

The building is used as general storage for the works yard. It consists of a timber post system. Six 150 mm small edge diameter poles and hardwood corner posts 200x100 mm with front and rear timber lintel beams form the structure. These support the corrugated sheet steel cladding on the northern, southern and western sides of the building with the eastern side open. A corrugated sheet steel roof at approximately 15 degrees pitch is fixed onto 150x150 rafters at 800 c/c with timber purlins. 'Loose gravel' has been laid as there is no concrete slab floor. It appears that the posts are embedded in concrete foundations.

No plans or drawings were available for this building.

The dimensions of the building are approximately 11 m long by 6 m wide and 4 m tall.

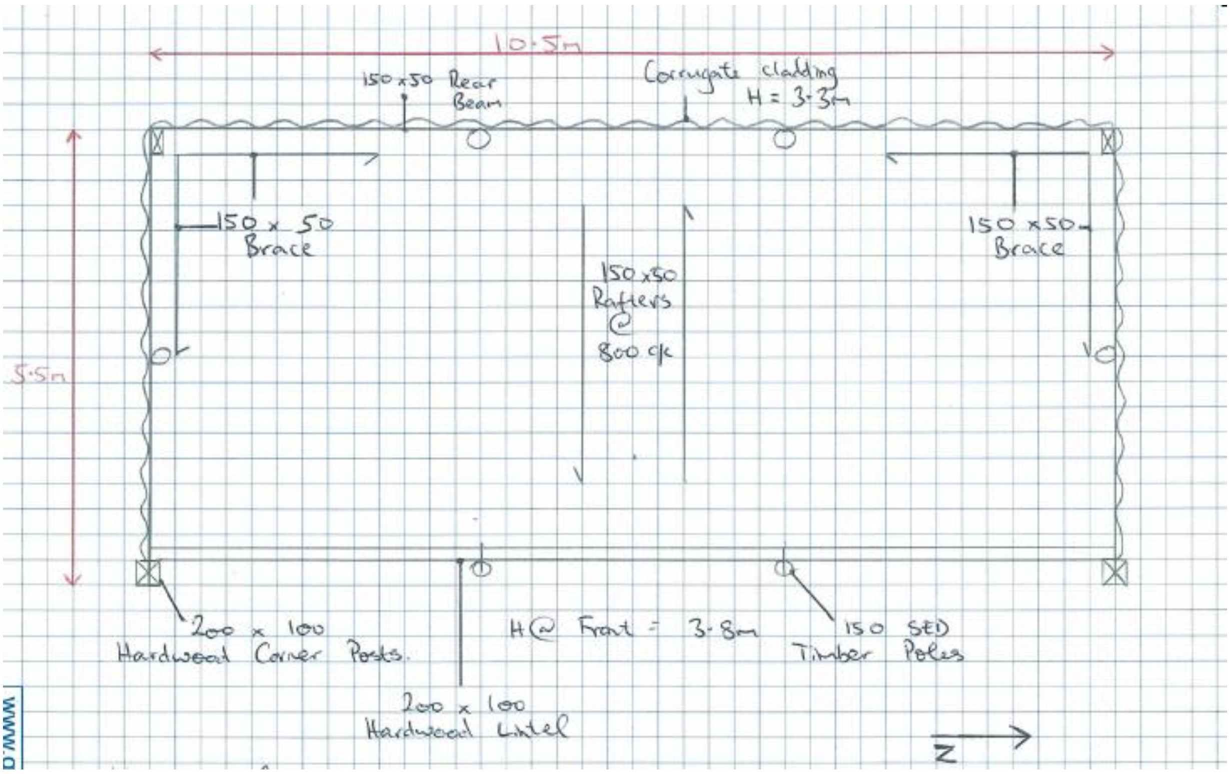


Figure 2 Plan Sketch Showing Key Structural Elements

4.2 Gravity Load Resisting System

The building has a timber framed gravity support system consisting of front and rear timber bearers supported by rectangular and circular timber posts embedded into the ground. The lintels support the timber rafters which in turn are overlaid by timber purlins for roof cladding support. This structure is most likely wind load dominated.

4.3 Lateral Load Resisting System

The seismic bracing system observed for both longitudinal and transverse directions is the diagonal 150x50 tension/compression timber braces present in each of the three corrugate clad walls, as shown in Photograph 3 in Appendix A. As these are present in only three sides of the structure, diagonal roof bracing would be required to transfer seismic and wind loads from the front of the building to the rear where the wall braces are; these roof braces however were absent.

The structure's timber poles may also be cantilever embedded to the ground, though this would require further physical investigation on site to prove. If there is no cantilevering capacity in the poles, the diagonal braces remain the sole bracing system, making the absence of roof bracing a critical structural weakness.

5. Assessment

A visual inspection of the building was undertaken on 26 January 2012. Both the interior and exterior of the building were inspected. The building was observed to have a green placard in place. The main structural components of the building were able to be viewed due to the exposed construction of the building.

The visual 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.

The %NBS score is determined using the IEP procedure described by the NZSEE which is based on the information obtained from visual observation of the building. Plan irregularity in the form of a lack of roof and front side bracing were observed, thus reducing the overall % NBS.

6. Damage Assessment

6.1 Surrounding Buildings

Slight cracking was noted in the front wall of the Duvauchelle works yard fire garage nearby. In addition a neighbouring residential dwelling was observed to have minor cracking in its exterior blockwork.

6.2 Residual Displacements and General Observations

No residual displacements of the structure were apparent during the inspection of the building.

No damage was evident to the exterior of the building.

No damage was evident to the timber framed structure or its claddings.

6.3 Ground Damage

No ground damage was observed during our inspection of the site.

7. Critical Structural Weakness

7.1 Short Columns

The building does not contain any short columns.

7.2 Lift Shaft

The building does not contain a lift shaft.

7.3 Roof

The roof had no diagonal in-line bracing which contributes significantly to resist seismic load over its open-fronted plan irregularity.

7.4 Plan Irregularity

By nature of the function of the structure, the front side has less bracing than the other three sides, resulting in plan irregularity. For the purposes of % NBS determination in the IEP, for this building 'significant' was selected in accordance with NZSEE guidelines.

7.5 Staircases

The building does not contain a staircase.

7.6 Liquefaction

No liquefaction was observed on site.

8. Geotechnical Consideration

8.1 Site Description

The site is located at the Duvauchelle Bay (Akaroa Harbour) end of the Pawsons Valley Road and within a predominantly rural area of Christchurch. To the east of the road the terrain rises moderately, but to the west and south of the site the terrain is gentle sloping down to the water's edge (180m to the south). The site is at approximately 10m above mean sea level, and approximately 35km (straight line distance) from Christchurch City centre. A stream is located approximately 100m to the west of the site.

8.2 Published Information on Ground Conditions

8.2.1 Published Geology

The geological map of the area1 indicates that the site is at the boundary of the following layers:

- Grey river alluvium, comprising gravel, sand and silt (Holocene in age); and
- Yellow-brown windblown silt (>3m thick and commonly in multiple layers) (Pleistocene in age) (commonly called Loess).

These layers are underlain by basaltic to trachytic lava flows with associated tuff and pyroclastic breccia of the Akaroa Volcanic Group.

8.2.1 Environment Canterbury Logs

Information from Environment Canterbury (ECan) indicates that there is one borehole is located within 350 m of the site. The lithology is summarised below. This log indicates the area is predominantly underlain by layers of volcanic rocks and clay (see Table 2).

Table 2 ECan Bore Log Summary Table

Bore Name	Grid Reference	Log Summary	Distance & Direction from Site
M35/9948	2504300 mE 5717500 mN	0 – 2.0 m Clay 2.0 m 2.59 m Large stones and rocks 2.59 – 5.5 m Claybound volcanic rocks 5.5 – 6.9 m Blue and brown clay 6.9 – 7.3 m Hard claybound volcanic rock	310m WSW

It should be noted that the purpose of the boreholes the well logs are associated with, were sunk for groundwater extraction and not for geotechnical purposes. Therefore, the amount of material recovered and available for interpretation and recording will have been variable at best and may not be

[1] Brown, L. J. and Weeber J.H. 1992: Geology of the Christchurch Urban Area. Institute of Geological and Nuclear Sciences 1:25,000 Geological Map 1. Lower Hutt. Institute of Geological and Nuclear Sciences Limited.

representative. 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.

8.2.2 EQC Geotechnical Investigations

No Earthquake Commission geotechnical testing has been undertaken in this area.

8.2.3 Land Zoning

Canterbury Earthquake Recovery Authority (CERA) has published areas showing the Green Zone Technical Category in relation to the risk of future liquefaction and how these areas are expected to perform in future earthquakes. Properties in the Port Hills and Banks Peninsula have not been given a Technical Category.

8.2.4 Post February Aerial Photography

There is no post Feburary 2011 earthquake aerial photography of this site available from Koordinates.

8.2.5 Summary of Ground Conditions

From the published and available data the site is indicated to be underlain by shallow soils comprising alluvial materials, loess and volcanic rocks.

8.3 Seismicity

8.3.1 Nearby Faults

There are many faults in the Christchurch 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 (km)	Max Likely Magnitude	Avg Recurrence Interval
Alpine Fault	165	~8.3	300 years
Greendale (2010) Fault	50	7.1	~15,000 years
Hope Fault	145	7.2~7.5	120~200 years
Kelly Fault	145	7.2	150 years
Porters Pass Fault	100	7.0	1100 years

Recent earthquakes since 22 February 2011 have identified the presence of a previously undetected active fault system / zone underneath Christchurch City and the Port Hills. Research and published

[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, pp 1878-1903, June 2002.

[3] GNS Active Faults Database

information on this system is in development and not generally available. Average recurrence intervals are yet to be estimated.

8.4 Ground Shaking Hazard

This seismic activity has produced earthquakes of Magnitude-6.3 with peak ground accelerations (PGA) up to twice the acceleration due to gravity (2g) in some parts of the city. This has resulted in widespread liquefaction throughout Christchurch.

New Zealand Standard NZS 1170.5:2004 quantifies the Seismic Hazard factor for Akaroa as 0.16, 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.

In addition, anticipation of alluvium and loess over volcanic rocks, and a 475-year PGA (peak ground acceleration) of ~0.4 (Stirling et al, 20024). Ground shaking is expected to be moderate.

8.5 Slope Failure and / or Rockfall Potential

Shallow highly saturated failures and deep seated instability to the east of the road may have the ability to impact the site. However the site itself is on predominately flat land. Rockfall is not considered to be an issue at the site based on the information available.

8.6 Liquefaction Potential

Due to the likely presence of alluvial soils and loess at the site it is considered possible that liquefaction will occur where sands and silts are present with a sufficiently high groundwater table. No signs of liquefaction were observed by the personnel inspecting the structures on the site.

8.7 Recommendations

To better clarify the material underlying the site given its proximity to the material boundaries on the map, a shallow borehole would be recommended. This may result in the liquefaction potential of the site being reduced.

8.8 Conclusions & Summary

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 at the boarder of loess and alluvial deposits. Associated with this the loess and fine grained alluvial deposits the site also has a moderate to high liquefaction potential.

Should a more comprehensive liquefaction and/or ground condition assessment be required, it is recommended that an intrusive investigation comprising of at least one piezocone CPT be conducted.

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

9. Survey

No level or verticality surveys have been undertaken for this building at this stage.

10. Initial Capacity Assessment

10.1 % NBS Assessment

Following an IEP assessment, the building has been assessed as achieving 39% New Building Standard (NBS). Under the New Zealand Society for Earthquake Engineering (NZSEE) guidelines the building is considered not potentially Earthquake Prone as it achieves above 33% NBS. This score has not been adjusted when considering damage to the structure as no damage was observed during the inspection. However as these types of structures are wind load dominated and are subsequently designed (cantilever) with this in mind a value of 1.25 has been selected for the F factor.

Item	%NBS
Building excluding CSW's	45
Plan Irregularity	31
Increase using Other Factors	39

Table 4 Indicative Building and Critical Structural Weaknesses Capacities based on the NZSEE Initial Evaluation Procedure

10.2 Seismic Parameters

The seismic design parameters based on current design requirements from NZS1170:2002 and the NZBC clause B1 for this building are:

- Site soil class: D, NZS 1170.5:2004, Clause 3.1.3, Soft Soil
- Site hazard factor, Z = 0.3, NZBC, Clause B1 Structure, Amendment 11 effective from 1 August 2011
- Return period factor R_u = 0.5, NZS 1170.5:2004, Table 3.5, Importance Level 1 structure with a 50 year design life.

Several key seismic parameters have influenced the %NBS score obtained from the IEP assessment. The building has been assessed as an Importance Level 1 building and as a result the Return Period Scaling Factor increases to 2.0. This allows for the overall increase in the %NBS. An increased Z factor of 0.3 for Christchurch has been used in line with recommendations from the Department of Building and Housing recommendations resulting in a reduced % NBS score. The use of the F factor with a value of 1.25 has increased the %NBS from 31% to 39%.

10.3 Expected Structural Ductility Factor

A structural ductility factor of 2.0 has been assumed longitudinally and transversely based on the timber framed structure.

10.4 Discussion of Results

This structure is considered not Earthquake Prone as it achieves 39% NBS. The building was estimated to be an Importance Level 1 building hence the Return Period Scaling Factor is increased to 2.0, this results in an increased %NBS. Plan Irregularity was selected as a 'significant' critical structural weakness due to the bracing layout and missing roof bracing. As these type of structures are generally designed to resist wind loading primarily and a cantilever system is being utilised the F Factor has been used to increase the % NBS.

10.5 Occupancy

As the structure achieves 39% NBS, it is not deemed a potentially Earthquake Prone structure in accordance with the NZSEE guidelines. As a result of this occupancy is permitted.

11. Initial Conclusions

The building has been assessed to have a seismic capacity in the order of 39% NBS and is therefore not potentially Earthquake Prone however it is still regarded as an Earthquake Risk. Occupancy is allowed.

12. Recommendations

No damage has been noted to the structure after the recent seismic activity in Christchurch.

As the building has achieved greater than 33% NBS following an initial IEP assessment it is regarded as an Earthquake Risk. As a result, we recommend that further detailed assessment of the structure is not necessary.

Further investigation to prove or disprove the existence of cantilever action in the poles and the installation of diagonal-in-plane roof bracing would benefit this structure.

The addition of strap bracing to the roof in order to reduce the plan irregularity is recommended.

13. Limitations

13.1 General

This report has been prepared subject to the following limitations:

- 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.
- No calculations, other than those included as part of the IEP in the CERA Building Evaluation Report, have been undertaken. 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.

13.2 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. 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: East (front) Elevation

Photograph 2: South and West Elevations

Photograph 3: Tension/Compression bracing

Photograph 4: Pitched timber framed roof structure

Photograph 5: Loose gravel ground material

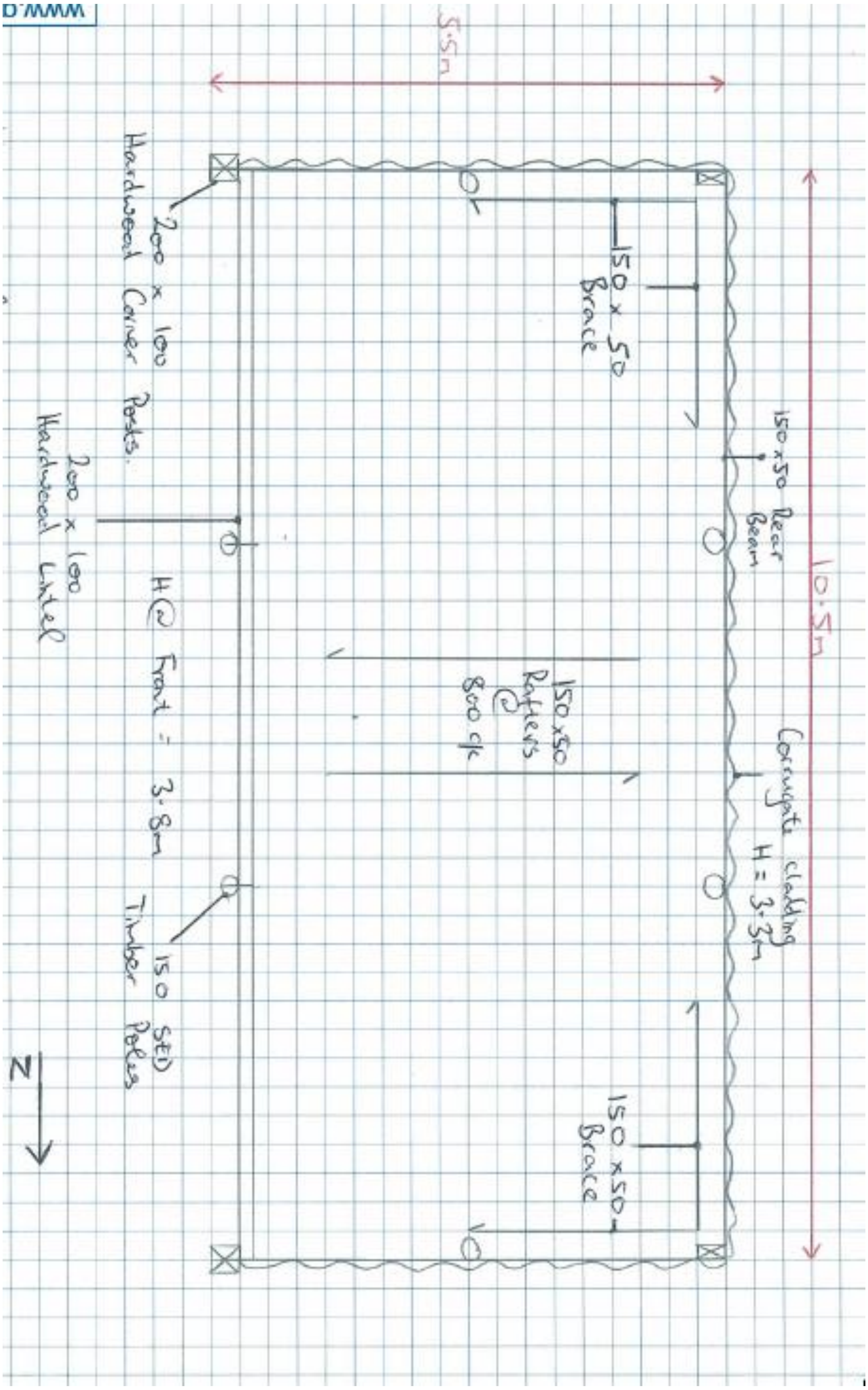
Photograph 6: Diagonal bracing to column connection

Photograph 7: Aerial Plan with Arrow pointing to Shelter Structure

Appendix B

Existing Drawings/Sketches

No drawings have been made available for this building. Shown below is a sketch of the building showing key structural elements.



Appendix C

CERA Building Evaluation Form

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Duvauchelle Works Yard Shelter		Reviewer:	Stephen Lee
	Unit / No: / Street		CPEng No:	1006840
Building Address:	Pawsons Valley Road, Duvauchelle		Company:	GHD
Legal Description:	LOT 3 DP 5105		Company project number:	513059603
			Company phone number:	33780900

	Degrees	Min	Sec		
GPS south:	43	44	59.00	Date of submission:	24/05/13
GPS east:	172	56	2.00	Inspection Date:	26-01-12
				Revision:	Final
Building Unique Identifier (CCC):	PRO 3612-001			Is there a full report with this summary?	yes

Site

Site slope:	slope < 1in 10	Max retaining height (m):	
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):	

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m):	
Ground floor split?	no		Ground floor elevation above ground (m):	
Storeys below ground	0			
Foundation type:	other (describe)		if Foundation type is other, describe:	No Foundation, timber posts driven into ground possible
Building height (m):	3.80		height from ground to level of uppermost seismic mass (for IEP only) (m):	4.1
Floor footprint area (approx):				
Age of Building (years):	70		Date of design:	1935-1965
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):	Shelter for store of equipment/materials			
Importance level (to NZS1170.5):	IL1			

<u>Gravity Structure</u>

Gravity System:	frame system		
Roof:	timber framed	rafter type, purlin type and cladding	150x50 Rafters @800 c/c, purlins across
Floors:			
Beams:	timber	type	Front & rear timber lintel/beams
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:	other (note)		describe system	150x50 Tension/compression timber braces & post cantilever embedded poles
Ductility assumed, μ:	2.00			
Period along:	0.10	0.00	estimate or calculation?	
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	other (note)		describe system	150x50 Tension/compression timber braces & post cantilever embedded poles
Ductility assumed, μ:	2.00			
Period across:	0.10	0.00	estimate or calculation?	
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	

Separations:

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

Non-structural elements

Stairs:			
Wall cladding:	other light	describe	Courrigated steel iron cladding
Roof Cladding:	Metal	describe	Courrigated steel iron cladding
Glazing:			
Ceilings:	none		
Services(list):			

Available documentation

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

Damage

Site:
(refer DEE Table 4-2)

Site performance:		Describe damage:	
Settlement:	none observed	notes (if applicable):	
Differential settlement:	none observed	notes (if applicable):	
Liquefaction:	none apparent	notes (if applicable):	
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	none apparent	notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	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:	no		Describe:	
	Interim occupancy recommendations:	full occupancy		Describe:	
Along	Assessed %NBS before:	39%	39% %NBS from IEP below	If IEP not used, please detail assessment methodology:	
	Assessed %NBS after:	39%			
Across	Assessed %NBS before:	39%	39% %NBS from IEP below		
	Assessed %NBS after:	39%			

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): 1935-1965

h_n from above: 4.1m

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):	0.1	0.1
(%NBS)nom from Fig 3.3:	3.0%	3.0%

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 $(\%NBS)_{nom}$:	**3%**	**3%**

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:	0.30
Z_{1992}, from NZS4203:1992	0.8
Hazard scaling factor, **Factor B:**	3.333333333

2.4 Return Period Scaling Factor

Building Importance level (from above):	1
Return Period Scaling factor from Table 3.1, **Factor C**:	2.00

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	2.00	2.00
Ductility scaling factor: =1 from 1976 onwards; or =k_μ, if pre-1976, fromTable 3.3:	1.57	1.57
Ductiity Scaling Factor, **Factor D**:	1.57	1.57

2.6 Structural Performance Scaling Factor:

	along	across
Sp:	0.700	0.700
Structural Performance Scaling Factor **Factor E**:	1.428571429	1.428571429

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

	along	across
$\%NBS_b$:	**45%**	**45%**

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

3.1. Plan Irregularity, factor A:	significant	0.7
3.2. Vertical irregularity, Factor B:	insignificant	1
3.3. Short columns, Factor C:	insignificant	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	insignificant	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	1.3	1.3
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)	**0.88**	**0.88**
4.3 PAR x (%NBS)b: PAR x Baselline %NBS:	**39%**	**39%**
4.4 Percentage New Building Standard (%NBS), (before)		**39%**

GHD

226 Antigua Street, Christchurch 8011
T: 64 3 378 0900   F: 64 3 377 8575   E: chcmail@ghd.com

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
FINAL	Cormac Joy	Stephen Lee		Nick Waddington		24/05/12