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# Paeroa Pump Shed
# Qualitative Engineering Evaluation

**Reference:** 231561

**Prepared for**:

Christchurch City Council

Functional Location ID: PRK 2936 BLDG 002

Address: 6 Paeroa Street, Riccarton

**Revision:** 2

**Date:** 2 July 2013

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| | | | | | | |
| | | | | | | |
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| Approval | | | |
|---|---|---|---|
| Author Signature | | Approver Signature | |
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| Title | Structural Engineer | Title | Senior Structural Engineer |

# Contents



# Appendices

# Executive Summary

This is a summary of the Qualitative Engineering Evaluation for the Paeroa Pump Shed 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** | Paeroa Pump Shed | | | |
|---|---|---|---|---|---|
| **Building Location ID** | PRK 2936 BLDG 002 | | | **Multiple Building Site** | N |
| **Building Address** | 6 Paeroa Street, Riccarton | | | **No. of residential units** | 0 |
| **Soil Technical Category** | NA | **Importance Level** | 4 | **Approximate Year Built** | NA |
| **Foot Print (m²)** | 10 | **Storeys above ground** | 1 | **Storeys below ground** | 0 |
| **Type of Construction** | Bondek roof supported by blockwork walls with a slab-on-grade foundation. | | | | |

| **Qualitative L4 Report Results Summary** | | |
|---|---|---|
| **Building Occupied** | N | The Paeroa Pump Shed is not currently in service. |
| **Suitable for Continued Occupancy** | Y | The Paeroa Pump Shed is considered safe to use. |
| **Key Damage Summary** | Y | Minor cracking of the foundation. |
| **Critical Structural Weaknesses (CSW)** | N | No weaknesses observed. |
| **Levels Survey Results** | N | Level survey not carried out. |
| **Building %NBS From Analysis** | 77% | Based on an analysis of capacity and demand. |

| **Qualitative L4 Report Recommendations** | | |
|---|---|---|
| **Geotechnical Survey Required** | N | Geotechnical survey not required due to lack of observed ground damage on site. |
| **Proceed to L5 Quantitative DEE** | N | A quantitative DEE is not required for this structure. |

| **Approval** | | | |
|---|---|---|---|
| Author Signature | | Approver Signature | |
| Name | Oleg Belov | Name | Luis Castillo |
| Title | Structural Engineer | Title | Senior Structural Engineer |

# 1 Introduction

## 1.1 General

On 31 August 2012 an Aurecon engineer visited the Paeroa Pump Shed to undertake a qualitative building damage assessment on behalf of Christchurch City Council. A detailed visual inspection was carried out to assess the damage caused by the earthquakes on 4 September 2010, 22 February 2011, 13 June 2011, 23 December 2011 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.
- A detailed engineering evaluation (DEE) including engineering calculations to determine extent of damage.

This report outlines the results of our Qualitative Assessment of damage to the Paeroa Pump Shed and is based on the Detailed Engineering Evaluation Procedure document issued by the Structural Advisory Group on 19 July 2011, visual inspections, available structural documentation and summary calculations as appropriate.

# 2 Description of the Building

## 2.1 Building Age and Configuration

The Paeroa Pump Shed is a single storey structure. It comprises of a Bondek roof, which is supported by perimeter blockwork walls. The foundation consists of a concrete slab-on-grade.

The building has an approximate floor area of 10 square metres. It is considered as an importance level 4 structure in accordance with AS/NZS 1170 Part 0:2002. The importance level of 4 has been adopted due to the assumption that this building will be required to be functional in a post-disaster scenario.

The age of the building is unknown.

## 2.2 Building Structural Systems Vertical and Horizontal

The Paeroa Pump Shed is a very simple structure. Its Bondek roof is supported by blockwork walls that transfer loads to the foundation. Lateral loads are resisted by the same walls mentioned before which are located around the perimeter of the structure.

## 2.3 Reference Building Type

The Paeroa Pump Shed is of a more recent construction type due to the use of a proprietary Bondek roof system as well as reinforced blockwork. It was likely subjected to a limited engineering design using appropriate Standards that were available at the time.

## 2.4 Building Foundation System and Soil Conditions

The Paeroa Pump Shed is based on a concrete slab as its foundation system, used for non-residential purposes. The Department of Building and Housing (DBH) do not currently have a technical classification for the land in the immediate vicinity of the Paeroa Pump Shed; however the nearby surrounding area in Riccarton consists of Technical Category 2 (TC2) land. According to the Canterbury Earthquake Repair Authority (CERA), TC2 land is defined as “minor to moderate land damage from liquefaction is possible in future significant earthquakes”.

## 2.5 Available Structural Documentation and Inspection Priorities

No drawings were available for this site. Inspection priorities for the building are related to a review of potential damage to the structural areas of the building caused by the Canterbury Earthquakes.

## 2.6 Available Survey Information

Due to the small floor area and a structurally sound foundation a floor level survey was not carried out. During the inspection it was observed that the building is well levelled. Approximate layout of reinforcement was measured at some locations, namely the walls, to determine the general arrangement of reinforcement within the building. This information was used for assessment purposes. Please refer to Appendix A details of recorded reinforcement.

# 3 Structural Investigation

## 3.1 Summary of Building Damage

It was observed that the building has not suffered any structural damage. There is a minor crack in the foundation, which has likely occurred due to concrete shrinkage rather than earthquake damage.

## 3.2 Record of Intrusive Investigation

An intrusive investigation was not carried out and no previous records of any intrusive investigations for the Paeroa Pump Shed were available.

## 3.3 Damage Discussion

The structure is comprised of three primary components; the Bondek roof, the blockwork walls and the concrete foundation. Based on the geometry of the structure, refer to Appendix A, and the observed damage it can be concluded that the structure appears to have sufficient strength to resist earthquake loads.

# 4 Building Review Summary

## 4.1 Building Review Statement

As noted above no intrusive investigations were carried out for the Paeroa Pump Shed. Because of the generic nature of the building a significant amount of information can be inferred by a visual inspection. Refer to Appendix A for approximate geometry of the structure.

## 4.2 Critical Structural Weaknesses

As mentioned in the damage discussion, section 3.3 of this report, the Paeroa Pump Shed does not have any obvious critical structural weaknesses.

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

## 5.1 General

The Paeroa Pump Shed is primarily supported by blockwork walls that resist earthquake loads. The existing condition of the structure indicates that there are no signs of structural damage.

## 5.2 Initial %NBS Assessment

The Paeroa Pump Shed has been subject to a detailed engineering evaluation (DEE). Table 1 below indicates the input parameters adopted during the DEE assessment.

**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, $R_u$ | 1.8 | NZS 1170.5:2004, Table 3.5, Importance Level 4 Structure (post-disaster function) with a Design Life of 50 years |
| Ductility Factor in the Along Direction, $\mu$ | 1.5 | NZS 1170.5:2004, Clause 2.2.2, Reinforced masonry structure with limited ductility |
| Ductility Factor in the Across Direction, $\mu$ | 1.5 | NZS 1170.5:2004, Clause 2.2.2, Reinforced masonry structure with limited ductility |

The seismic demand for the Paeroa Pump Shed has been calculated based on the current code requirements. It is noted that the assessment was focused on the critical elements of the structure, namely the blockwork walls. The concrete roof and concrete foundation have been assumed to be acceptable based on their geometry and lack of any notable damage.

The capacity of the blockwork walls was calculated based on details obtained during the site inspection; refer to Appendix A. The seismic demand imposed on the walls was then compared with their capacity. It was found that the walls do not have sufficient capacity to adequately resist the current design earthquake actions. The strength of the building was found to be 77% of the new building standard (NBS).

## 5.3 Results Discussion

The results indicate that the structural integrity of the building is above the legal requirement of 33% NBS, which indicates that the building is not earthquake prone. The building has also satisfied the recommended minimum %NBS by the New Zealand Society for Earthquake Engineering (NZSEE) of 67%.

No damage was observed during the inspection, which corresponds with the calculated NBS of 77%.

# 6 Conclusions and Recommendations

The Paeroa Pump Shed has satisfied the minimum legal %NBS of 33% and has also satisfied the recommended minimum %NBS by the NZSEE of 67%. Thus, the building is suitable to continue performing its designated function.

# 7 Explanatory Statement

The inspection of the building discussed in this report has 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.

While this report may assist the client in assessing whether the building should be repaired, strengthened, or replaced 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
## Photos, Site Map and Building Geometry

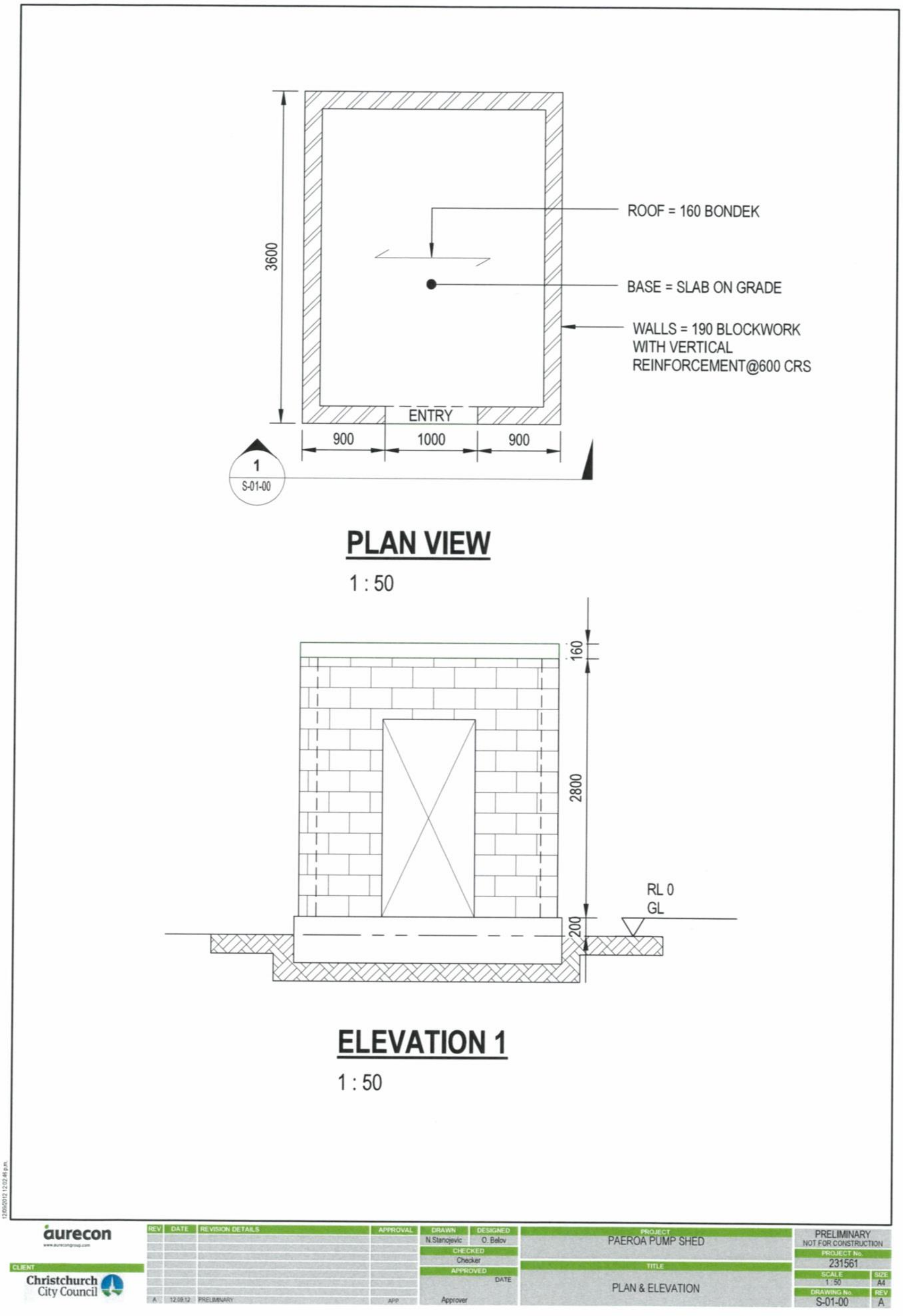
**31 August 2012 – Paeroa Pump Shed Photos, Site Map and Building Geometry**

| | |
|---|---|
| General view of the Paeroa Pump Shed. |  |
| Side view of the Paeroa Pump Shed. |  |
| General view of the roof.<br><br>Bondek roof. |  |

| | |
|---|---|
| Existing crack in the slab-on-grade.<br><br>Suspected to be a shrinkage crack. |  |


General Map (6 Sep 2012, Aerial photo sourced from LINZ © ®)


Local Map (6 Sep 2012, Aerial photo sourced from LINZ © ®)




Geometry of the Structure

# Appendix B
## References


1. Department of Building and Housing (DBH), “Revised Guidance on Repairing and Rebuilding Houses Affected by the Canterbury Earthquake Sequence”, November 2011

2. New Zealand Society for Earthquake Engineering (NZSEE), “Assessment and Improvement of the Structural Performance of Buildings in Earthquakes”, April 2012

3. Standards New Zealand, “AS/NZS 1170 Part 0, Structural Design Actions: General Principles”, 2002

4. Standards New Zealand, “AS/NZS 1170 Part 1, Structural Design Actions: Permanent, imposed and other actions”, 2002

5. Standards New Zealand, “NZS 1170 Part 5, Structural Design Actions: Earthquake Actions – New Zealand”, 2004

6. Standards New Zealand, “NZS 3101 Part 1, The Design of Concrete Structures”, 2006

7. Standards New Zealand, “NZS 3404 Part 1, Steel Structures Standard”, 1997

8. Standards New Zealand, “NZS 3606, Timber Structures Standard”, 1993

9. Standards New Zealand, “NZS 3604, Timber Framed Structures”, 2011

10. Standards New Zealand, “NZS 4229, Concrete Masonry Buildings Not Requiring Specific Engineering Design”, 1999

11. Standards New Zealand, “NZS 4230, Design of Reinforced Concrete Masonry Structures”, 2004

# Appendix C
## Strength Assessment Explanation

### New building standard (NBS)

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

### Earthquake Prone Buildings

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

### Christchurch City Council Earthquake Prone Building Policy 2010

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

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

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

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

### Christchurch Seismicity

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

For this assessment, the building's earthquake resistance is compared with the current New Zealand Building Code requirements for a new building constructed on the site. This is expressed as a percentage of new building standard (%NBS). The new building standard load requirements have been determined in accordance with the current earthquake loading standard (NZS 1170.5:2004 Structural design actions - Earthquake actions - New Zealand).

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

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

| Description | Grade | Risk | %NBS | Existing Building Structural Performance | Improvement of Structural Performance | |
|---|---|---|---|---|---|---|
| | | | | | Legal Requirement | NZSEE Recommendation |
| Low Risk Building | A or B | Low | Above 67 | Acceptable (improvement may be desirable) | The Building Act sets no required level of structural improvement (unless change in use) This is for each TA to decide. Improvement is not limited to 34%NBS. | 100%NBS desirable. Improvement should achieve at least 67%NBS |
| Moderate Risk Building | B or C | Moderate | 34 to 66 | Acceptable legally. Improvement recommended | | Not recommended. Acceptable only in exceptional circumstances |
| High Risk Building | D or E | High | 33 or lower | Unacceptable (Improvement | Unacceptable | Unacceptable |

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

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

**Table C1: Relative Risk of Building Failure In A**

| Percentage of New Building Standard (%NBS) | Relative Risk (Approximate) |
|---|---|
| >100 | <1 time |
| 80-100 | 1-2 times |
| 67-80 | 2-5 times |
| 33-67 | 5-10 times |
| 20-33 | 10-25 times |
| <20 | >25 times |

# Appendix D
## Background and Legal Framework

### Background

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

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

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

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

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

### Compliance

This section contains a brief summary of the requirements of the various statutes and authorities that control activities in relation to buildings in Christchurch at present.

### Canterbury Earthquake Recovery Authority (CERA)

CERA was established on 28 March 2011 to take control of the recovery of Christchurch using powers established by the Canterbury Earthquake Recovery Act enacted on 18 April 2011. This act gives the Chief Executive Officer of CERA wide powers in relation to building safety, demolition and repair. Two relevant sections are:

**Section 38 – Works**

This section outlines a process in which the chief executive can give notice that a building is to be demolished and if the owner does not carry out the demolition, the chief executive can commission the demolition and recover the costs from the owner or by placing a charge on the owners' land.

**Section 51 – Requiring Structural Survey**

This section enables the chief executive to require a building owner, insurer or mortgagee carry out a full structural survey before the building is re-occupied.

We understand that CERA will require a detailed engineering evaluation to be carried out for all buildings (other than those exempt from the Earthquake Prone Building definition in the Building Act). It is anticipated that CERA will adopt the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011. This document sets out a methodology for both qualitative and quantitative assessments.

The qualitative assessment is a desk-top and site inspection assessment. It is based on a thorough visual inspection of the building coupled with a review of available documentation such as drawings and specifications. The quantitative assessment involves analytical calculation of the buildings strength and may require non-destructive or destructive material testing, geotechnical testing and intrusive investigation.

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

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

## Building Act

Several sections of the Building Act are relevant when considering structural requirements:

### Section 112 – Alterations

This section requires that an existing building complies with the relevant sections of the Building Code to at least the extent that it did prior to any alteration. This effectively means that a building cannot be weakened as a result of an alteration (including partial demolition).

### Section 115 – Change of Use

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

### Section 121 – Dangerous Buildings

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

- in the ordinary course of events (excluding the occurrence of an earthquake), the building is likely to cause injury or death or damage to other property; or
- in the event of fire, injury or death to any persons in the building or on other property is likely because of fire hazard or the occupancy of the building; or
- there is a risk that the building could collapse or otherwise cause injury or death as a result of earthquake shaking that is less than a 'moderate earthquake' (refer to Section 122 below); or
- there is a risk that that other property could collapse or otherwise cause injury or death; or
- a territorial authority has not been able to undertake an inspection to determine whether the building is dangerous.

### Section 122 – Earthquake Prone Buildings

This section defines a building as earthquake prone if its ultimate capacity would be exceeded in a 'moderate earthquake' and it would be likely to collapse causing injury or death, or damage to other property. A moderate earthquake is defined by the building regulations as one that would generate ground shaking 33% of the shaking used to design an equivalent new building.

**Section 124 – Powers of Territorial Authorities**

This section gives the territorial authority the power to require strengthening work within specified timeframes or to close and prevent occupancy to any building defined as dangerous or earthquake prone.

**Section 131 – Earthquake Prone Building Policy**

This section requires the territorial authority to adopt a specific policy for earthquake prone, dangerous and insanitary buildings.

## Christchurch City Council Policy

Christchurch City Council adopted their Earthquake Prone, Dangerous and Insanitary Building Policy in 2006. This policy was amended immediately following the Darfield Earthquake of the 4th September 2010.

The 2010 amendment includes the following:

- A process for identifying, categorising and prioritising Earthquake Prone Buildings, commencing on 1 July 2012;
- A strengthening target level of 67% of a new building for buildings that are Earthquake Prone;
- A timeframe of 15-30 years for Earthquake Prone Buildings to be strengthened; and,
- Repair works for buildings damaged by earthquakes will be required to comply with the above.

The council has stated their willingness to consider retrofit proposals on a case by case basis, considering the economic impact of such a retrofit.

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

If strengthening works are undertaken, a building consent will be required. A requirement of the consent will require upgrade of the building to comply 'as near as is reasonably practicable' with:

- The accessibility requirements of the Building Code.
- The fire requirements of the Building Code. This is likely to require a fire report to be submitted with the building consent application.

## Building Code

The building code outlines performance standards for buildings and the Building Act requires that all new buildings comply with this code. Compliance Documents published by The Department of Building and Housing can be used to demonstrate compliance with the Building Code.

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

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

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

# Appendix E
## Standard Reporting Spread Sheet

**Detailed Engineering Evaluation Summary Data** V1.11

## Location

| | | | | | |
|---|---|---|---|---|---|
| Building Name: | Paeroa Pump Shed | | | Reviewer: | Lee Howard |
| | Unit | No: | Street | CPEng No: | 1008889 |
| Building Address: | | 6 | Paeroa Street | Company: | Aurecon NZ Ltd |
| Legal Description: | Res 5128 | | | Company project number: | 231561 |
| | | | | Company phone number: | 03 366 0821 |
| | Degrees | Min | Sec | | |
| GPS south: | 43 | 31 | 54.92 | Date of submission: | June-13 |
| GPS east: | 172 | 35 | 23.44 | Inspection Date: | Aug-12 |
| | | | | Revision: | 2 |
| Building Unique Identifier (CCC): | PRK 2936 BLDG 002 | | | 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): | |
| 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): | 9.00 |

## Building

| | | | | |
|---|---|---|---|---|
| No. of storeys above ground: | 1 | single storey = 1 | Ground floor elevation (Absolute) (m): | 9.20 |
| Ground floor split? | no | | Ground floor elevation above ground (m): | 0.20 |
| Storeys below ground | 0 | | | |
| Foundation type: | raft slab | | if Foundation type is other, describe: | |
| Building height (m): | 2.88 | | height from ground to level of uppermost seismic mass (for IEP only) (m): | 2.88 |
| Floor footprint area (approx): | 10 | | | |
| Age of Building (years): | | | Date of design: | 1976-1992 |
| Strengthening present? | no | | If so, when (year)? | |
| | | | And what load level (%g)? | |
| Use (ground floor): | public | | Brief strengthening description: | |
| Use (upper floors): | | | | |
| Use notes (if required): | Pump Shed | | | |
| Importance level (to NZS1170.5): | IL4 | | | |

### Gravity Structure

| | | | |
|---|---|---|---|
| Gravity System: | load bearing walls | | |
| Roof: | concrete | slab thickness (mm) | 160mm Bondek Roof |
| Floors: | concrete flat slab | slab thickness (mm) | 200mm above ground |
| Beams: | | | |
| Columns: | | | |
| Walls: | fully filled concrete masonry | #N/A | |

### Lateral load resisting structure

| | | | | |
|---|---|---|---|---|
| Lateral system along: | fully filled CMU | **Note: Define along and across in** | | |
| Ductility assumed, μ: | 1.50 | **detailed report!** | note total length of wall at ground (m): | |
| Period along: | 0.40 | ##### enter height above at H31 | estimate or calculation? | estimated |
| Total deflection (ULS) (mm): | | | estimate or calculation? | |
| maximum interstorey deflection (ULS) (mm): | | | estimate or calculation? | |
| Lateral system across: | fully filled CMU | | | |

| | | | | |
|---|---|---|---|---|
| Ductility assumed, μ: | 1.50 | | note total length of wall at ground (m): | |
| Period across: | 0.40 | ##### enter height above at H31 | 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): | | |
| south (mm): | | |
| west (mm): | | |

Non-structural elements

| | | | |
|---|---|---|---|
| Stairs: | | | |
| Wall cladding: | | | |
| Roof Cladding: | Other (specify) | describe | 160mm Bondek Roof |
| Glazing: | | | |
| Ceilings: | | | |
| Services(list): | Pump shed utility services | | |

**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: | none noted |
| 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: | 0-20mm/20m | notes (if applicable): | 1 shrinkage crack |
| 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: | 23% | | |
| | 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 e'quakes: | 100% | ##### %NBS from IEP below | If IEP not used, please detail assessment methodology: | Detailed Engineering Assessment |
| | Assessed %NBS after e'quakes: | 100% | | | |
| Across | Assessed %NBS before e'quakes: | 100% | ##### %NBS from IEP below | | |
| | Assessed %NBS after e'quakes: | 77% | | | |

**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): 1976-1992

$h_n$ from above: 2.88m

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

Note 2: for RC buildings designed between 1976-1984, use 1.2

Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (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:

| | along | across |
|---|---|---|
| Near Fault scaling factor (1/N(T,D), **Factor A**: | #DIV/0! | #DIV/0! |

**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): | 4 |
| 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) | | |
| Ductility scaling factor: =1 from 1976 onwards; or =kμ, if pre-1976, fromTable 3.3: | | |
| Ductiity Scaling Factor, **Factor D**: | 1.00 | 1.00 |

**2.6 Structural Performance Scaling Factor:**

| | along | across |
|---|---|---|
| Sp: | | |
| Structural Performance Scaling Factor **Factor E**: | #DIV/0! | #DIV/0! |

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

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

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

**3.1. Plan Irregularity, factor A:** insignificant | 1

**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

Height Difference effect D2, from Table to right

Therefore, Factor D: 0

**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 | | |
| 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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