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# Pump Shed
## Qualitative Engineering Evaluation

**Reference:** 231559
**Prepared for**:
Christchurch City Council

Functional Location ID: PRK 2653 BLDG 001

Address: 31 Wairoa Street

**Revision:** 2
**Date:** 5 July 2013

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| Title | Senior Structural Engineer | Title | Senior Structural Engineer |

# Contents



# Appendices

# Executive Summary

This is a summary of the Qualitative Engineering Evaluation for the 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.

<table>
<tr><th>Building Details</th><th>Name</th><th colspan="4">Pump Shed</th></tr>
<tr><td>Building Location ID</td><td colspan="3">PRK 2653 BLDG 001</td><td>Multiple Building Site</td><td>N</td></tr>
<tr><td>Building Address</td><td colspan="3">31 Wairoa Street</td><td>No. of residential units</td><td>0</td></tr>
<tr><td>Soil Technical Category</td><td>Red Zone</td><td>Importance Level</td><td>4</td><td>Approximate Year Built</td><td>NA</td></tr>
<tr><td>Foot Print (m²)</td><td>18.5</td><td>Storeys above ground</td><td>1</td><td>Storeys below ground</td><td>0</td></tr>
<tr><td>Type of Construction</td><td colspan="5">Concrete roof supported by masonry block-work walls with a slab-on-grade foundation.</td></tr>
<tr><th colspan="6">Qualitative L4 Report Results Summary</th></tr>
<tr><td>Building Occupied</td><td>Y</td><td colspan="4">The Pump Shed is currently in use.</td></tr>
<tr><td>Suitable for Continued Occupancy</td><td>Y</td><td colspan="4">The Pump Shed is suitable for continued occupation.</td></tr>
<tr><td>Key Damage Summary</td><td>Y</td><td colspan="4">Refer to summary of building damage Section 3.1 report body.</td></tr>
<tr><td>Critical Structural Weaknesses (CSW)</td><td>N</td><td colspan="4">No critical structural weaknesses were identified.</td></tr>
<tr><td>Levels Survey Results</td><td>Y</td><td colspan="4">A levels survey indicated that the floor was outside of DHB guidelines with a maximum slope of 2.74%.</td></tr>
<tr><td>Building %NBS From Analysis</td><td>>100%</td><td colspan="4">Based on an analysis of bracing capacity and demand.</td></tr>
<tr><th colspan="6">Qualitative L4 Report Recommendations</th></tr>
<tr><td>Geotechnical Survey Required</td><td>N</td><td colspan="4">Due to Red Zone location, a geotechnical survey is not required.</td></tr>
<tr><td>Proceed to L5 Quantitative DEE</td><td>N</td><td colspan="4">A quantitative DEE is not required for this structure.</td></tr>
<tr><th colspan="6">Approval</th></tr>
<tr><td>Author Signature</td><td colspan="2"></td><td colspan="2">Approver Signature</td><td></td></tr>
<tr><td>Name</td><td colspan="2">Luis Castillo</td><td colspan="2">Name</td><td>Eric Simeone</td></tr>
<tr><td>Title</td><td colspan="2">Senior Structural Engineer</td><td colspan="2">Title</td><td>Senior Structural Engineer</td></tr>
</table>

# 1 Introduction

## 1.1 General

On 3 December 2012 an Aurecon engineer visited the Pump Shed to carry out a qualitative building damage assessment on behalf of Christchurch City Council. Detailed visual inspections were carried out to assess the damage caused by the earthquakes on 4 September 2010, 22 February 2011, 13 June 2011, 23 December 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 if the building is currently occupied.
- Assessment of requirements for detailed engineering evaluation including geotechnical investigation, level survey and any areas where linings and floor coverings need removal to expose structural damage.

This report outlines the results of our Qualitative Assessment of damage to the 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 building is a simple single storey square structure. It comprises of a concrete roof, masonry block-work walls, and a concrete slab-on-grade foundation. The building has an approximate floor area of 18.5m$^2$. It is considered as an importance level 4 structure as per 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 not known.

## 2.2 Building Structural Systems Vertical and Horizontal

The Pump Shed is a very simple structure. Its concrete roof is supported by block-work 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 Pump Shed is a basic structure typical of its age and style. It was not subject to specific engineering design; rather it was constructed to a reliable formula known to achieve the performance and aesthetic objectives of the time it was built.

## 2.4 Building Foundation System and Soil Conditions

The Pump Shed is based on a concrete slab-on-grade as its foundation system, used for non-residential purposes. The Department of Building and Housing (DBH) have classified the land in the immediate vicinity of the Pump Shed as Red Zone. According to the Canterbury Earthquake Repair Authority (CERA), the Red Zone land is defined as “land repair would be prolonged and uneconomical.”

## 2.5 Available Structural Documentation and Inspection Priorities

No architectural or structural drawings were available for the Pump Shed. Inspection priorities related to a review of potential damage to foundations and consideration of wall bracing adequacy.

## 2.6 Available Survey Information

A floor level survey was undertaken to establish the level of unevenness across the floors. The results of the survey are presented on the attached sketch in Appendix A. All of the levels were taken on top of the existing floor coverings which may have introduced some margin of error.

The Department of Building and Housing (DBH) published the “Revised Guidance on Repairing and Rebuilding Houses Affected by the Canterbury Earthquake Sequence” in November 2011, which recommends some form of re-levelling or rebuilding of the floor

1. If the slope is greater than 0.5% for any two points more than 2m apart, or
2. If the variation in level over the floor plan is greater than 50mm, or
3. If there is significant cracking of the floor.

It is important to note that these figures are recommendations and are only intended to be applied to residential buildings. However, they provide useful guidance in determining acceptable floor level variations.

After completing a levels survey of the building it was found that the Pump Shed was sloping downwards from the south end to the north end (towards the Avon River). The maximum slope was found to be 2.74% which is outside of the recommended tolerances.

# 3 Structural Investigation

## 3.1 Summary of Building Damage

It was observed that the building itself has not suffered any structural damage.

## 3.2 Record of Intrusive Investigation

As the building has not suffered any damage, an intrusive investigation was neither warranted nor undertaken for Pump Shed.

## 3.3 Damage Discussion

No damage was observed for the building. From this 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 Pump Shed. Because of the generic nature of the building a significant amount of information can be inferred from an external and internal inspection.

## 4.2 Critical Structural Weaknesses

No critical structural weaknesses were identified as part of the building qualitative assessment.

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

## 5.1 General

The Pump Shed is primarily supported by block-work 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 Pump Shed has not been subject to specific engineering design and the initial evaluation procedure or IEP is not an appropriate method of assessment for this building. Nevertheless an estimate of lateral load capacity can be made by adopting assumed values for strengths of existing materials and calculating the capacity of existing walls.

Selected assessment seismic parameters are tabulated in the Table 1 on the next page.

**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 Transverse Direction, $\mu$ | 1.5 | NZS 1170.5:2004, Clause 2.2.2, Reinforced masonry structure with limited ductility |
| Ductility Factor in Longitudinal Direction, $\mu$ | 1.5 | NZS 1170.5:2004, Clause 2.2.2, Reinforced masonry structure with limited ductility |

The seismic demand for the Pump Shed has been calculated based on the current code requirements of NZS 1170:5. The capacity of the existing walls in the building was calculated from assumed strengths of existing materials and the number and length of walls present. The seismic demand was then compared with the building capacity. The building was found to have sufficient strength in excess of 100% of the new building standard (NBS).

## 5.3 Results Discussion

Basic analysis shows that the Pump Shed is capable of achieving seismic performance in line with the current code requirements. 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%.

# 6 Conclusions and Recommendations

The building itself has performed very well during the Canterbury earthquake sequence as shown by the lack of structural damage observed. The only area of concern is the slope of the building which exceeds DHB guidelines. As the building is located in the Red Zone, **a geotechnical investigation is currently not considered necessary** as the land is known to be prone to earthquake damage.

The building is currently occupied and in use and in our opinion the Pump Shed **is considered suitable for continued occupation**.

# 7 Explanatory Statement

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

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

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

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

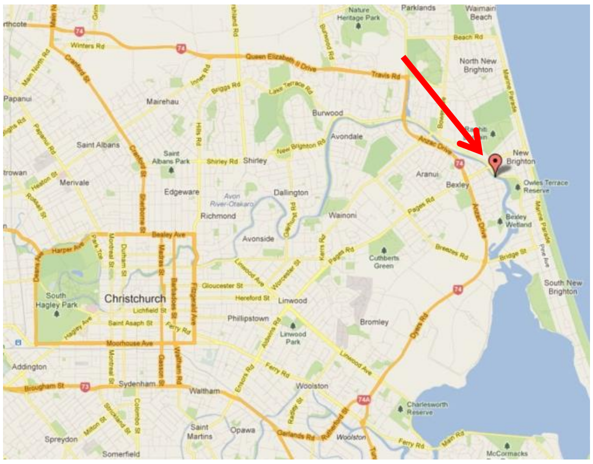
Without limiting any of the above, Aurecon's liability, whether under the law of contract, tort, statute, equity or otherwise, is limited as set out in the terms of the engagement with the client.

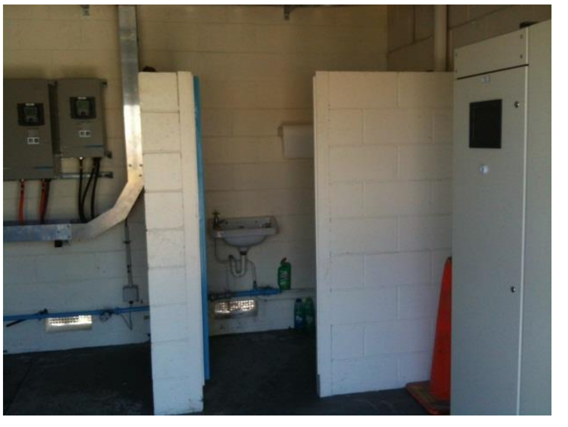
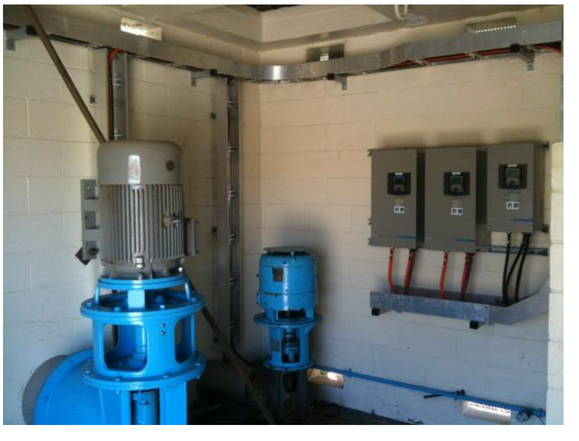
# Appendices

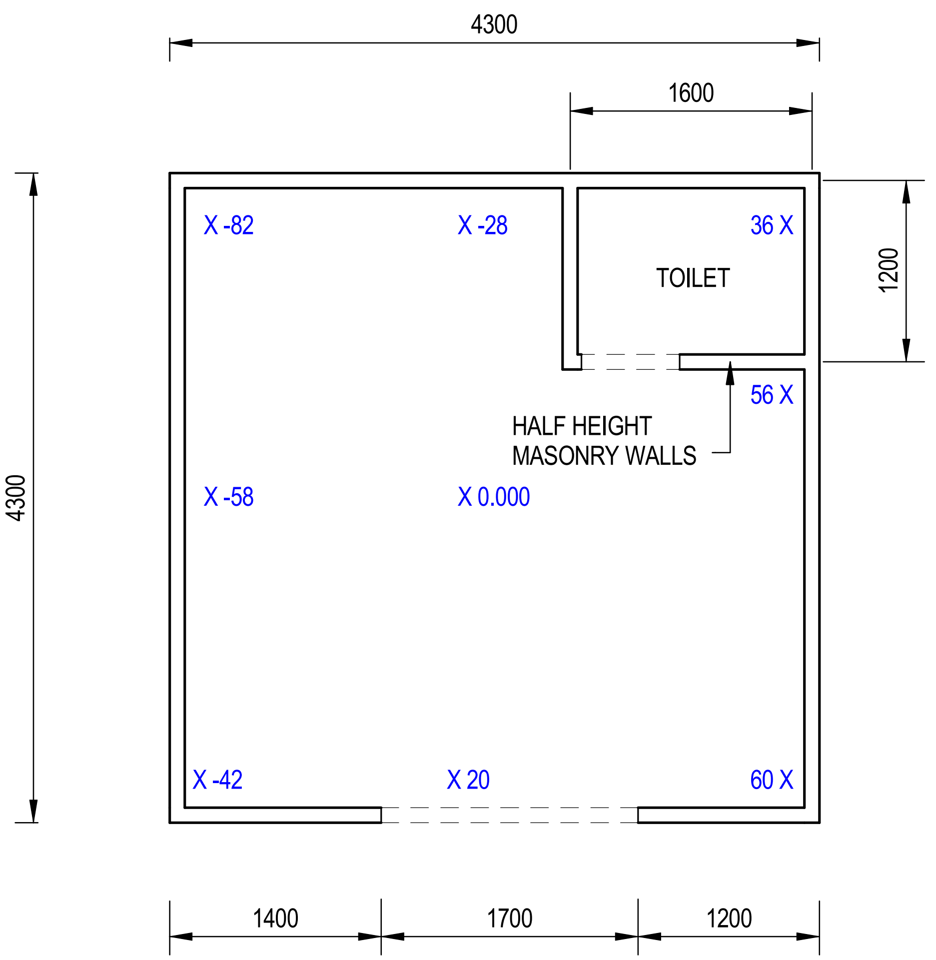
# Appendix A

## Site Location, Photos and Levels Survey Results

**3 December 2012 – Pump Shed Site Photographs**

| | |
|---|---|
| Location of Pump Station |   |
| Aerial photograph of Pump Station |  |
| Front elevation of building (western view) |  |

| | |
|---|---|
| Side elevation of building (northern view) |  |
| Inside view of Pump Station |  |
| Inside view of Pump Station |  |


8/01/2013 4:36:47 p.m.

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CLIENT
Christchurch City Council

| REV | DATE | REVISION DETAILS | APPROVAL |
|---|---|---|---|
| | | | |

| DRAWN | DESIGNED |
|---|---|
| D.HUNIA | A.WILLARD |

CHECKED: L.CASTILLO

APPROVED: L.CASTILLO DATE

PROJECT: AVON RIVERBANK TRUE RIGHT PUMP SHED

TITLE: LEVEL SURVEY

PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT No.: 231559

| SCALE | SIZE |
|---|---|
| 1 : 50 | A4 |

| DRAWING No. | REV |
|---|---|
| S-01-00 | |

# 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: | Avon River True Right - Pump Station | Reviewer: | Lee Howard |
| | Unit / No: / Street | CPEng No: | 1008889 |
| Building Address: | 31 Wairoa Street | Company: | Aurecon |
| Legal Description: | PRK 2653 BLDG 001 EQ2 | Company project number: | 231559 |
| | Degrees / Min / Sec | Company phone number: | 3366 0821 |
| GPS south: | | Date of submission: | July 2013 |
| GPS east: | | Inspection Date: | 3/12/2012 |
| | | Revision: | 2 |
| Building Unique Identifier (CCC): | PRK 2653 BLDG 001 | Is there a full report with this summary? | Yes |

## Site

| | | | |
|---|---|---|---|
| Site slope: | flat | Max retaining height (m): | |
| Soil type: | sandy silt | Soil Profile (if available): | |
| Site Class (to NZS1170.5): | D | | |
| Proximity to waterway (m, if <100m): | 1 | If Ground improvement on site, describe: | |
| Proximity to clifftop (m, if < 100m): | | | |
| Proximity to cliff base (m,if <100m): | | Approx site elevation (m): | 2.00 |

## 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): | 0.60 |
| Storeys below ground | 0 | | |
| Foundation type: | raft slab | if Foundation type is other, describe: | |
| Building height (m): | 2.80 | height from ground to level of uppermost seismic mass (for IEP only) (m): | 2.8 |
| Floor footprint area (approx): | 19 | | |
| Age of Building (years): | | Date of design: | |
| 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): | | | |
| Importance level (to NZS1170.5): | IL4 | | |

### Gravity Structure

| | | | |
|---|---|---|---|
| Gravity System: | load bearing walls | | |
| Roof: | concrete | slab thickness (mm) | 190 |
| Floors: | concrete flat slab | slab thickness (mm) | 600 above ground |
| Beams: | cast-insitu concrete | overall depth x width (mm x mm) | |
| Columns: | other (note) | typical dimensions (mm x mm) | |
| Walls: | partially filled concrete masonry | thickness (mm) | |

### Lateral load resisting structure

Note: Define along and across in detailed report!

| | | | | |
|---|---|---|---|---|
| Lateral system along: | fully filled CMU | | | |
| Ductility assumed, μ: | 1.50 | | 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? | estimated |
| maximum interstorey deflection (ULS) (mm): | | | estimate or calculation? | estimated |
| 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? | estimated |
| maximum interstorey deflection (ULS) (mm): | | | estimate or calculation? | estimated |

### Separations:

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

### Non-structural elements

Stairs:
Wall cladding:
Roof Cladding:
Glazing:
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: | |
| 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: | widespread to major (in in 3 to most) | notes (if applicable): | Red Zone land |

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 e'quakes: | 100% | #### %NBS from IEP below | If IEP not used, please detail assessment methodology: |
| | Assessed %NBS after e'quakes: | 100% | | |
| Across | Assessed %NBS before e'quakes: | 100% | #### %NBS from IEP below | |
| | Assessed %NBS after e'quakes: | 100% | | |

## 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): 0 — $h_n$ from above: 2.8m

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: | 0.0% | |
| 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 |
| **Final $(\%NBS)_{nom}$:** | **0%** | **0%** |

**2.2 Near Fault Scaling Factor**

| | along | across |
|---|---|---|
| Near Fault scaling factor, from NZS1170.5, cl 3.1.6: | | |
| 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 =$k_\mu$, if pre-1976, fromTable 3.3: | | |
| Ductiity Scaling Factor, **Factor D**: | 0.00 | 0.00 |

**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** — **$\%NBS_b$:** **#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: 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 | | |
| 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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