

Branston Park Pavilion  
Qualitative Engineering Evaluation

**Reference:** 229607  
**Prepared for:**  
Christchurch City Council

Functional Location ID: PRK\_1593\_BLDG\_001

Address: 15 Witham Street

**Revision:** 2

**Date:** 14 October 2013

# Document Control Record

Document prepared by:



**Aurecon New Zealand Limited**  
**Level 2, 518 Colombo Street**  
**Christchurch 8011**  
 PO Box 1061  
 Christchurch 8140  
 New Zealand

**T** +64 3 375 0761  
**F** +64 3 379 6955  
**E** christchurch@aurecongroup.com  
**W** aurecongroup.com

A person using Aurecon documents or data accepts the risk of:

- Using the documents or data in electronic form without requesting and checking them for accuracy against the original hard copy version.
- Using the documents or data for any purpose not agreed to in writing by Aurecon.

| Document control              |                 |  |                       | aurecon       |                   |                 |
|-------------------------------|-----------------|--|-----------------------|---------------|-------------------|-----------------|
| <b>Report Title</b>           |                 | Qualitative Engineering Evaluation       |                       |               |                   |                 |
| <b>Functional Location ID</b> |                 | <b>PRK_1593_BLDG_001</b>                 | <b>Project Number</b> |               | 229607            |                 |
| <b>File Path</b>              |                 | P:\ 229607 - Branston Park Pavilion.docx |                       |               |                   |                 |
| <b>Client</b>                 |                 | Christchurch City Council                | <b>Client Contact</b> |               | Michael Sheffield |                 |
| <b>Rev</b>                    | <b>Date</b>     | <b>Revision Details/Status</b>           | <b>Prepared</b>       | <b>Author</b> | <b>Verifier</b>   | <b>Approver</b> |
| 1                             | 1 May 2013      | Draft                                    | C. Bong               | C. Bong       | L. Castillo       | L. Castillo     |
| 2                             | 14 October 2013 | Final                                    | C. Bong               | C. Bong       | L. Castillo       | L. Castillo     |
| <b>Current Revision</b>       |                 | 2  |                       |               |                   |                 |

| Approval         |   |                    |   |
|------------------|---|--------------------|---|
| Author Signature |  | Approver Signature |  |
| Name             | Christopher Bong  | Name               | Luis Castillo   |
| Title            | Structural Engineer   | Title              | Senior Structural Engineer  |



# Contents

|   |          |
|---|----------|
| <b>Executive Summary</b>  | <b>1</b> |
| <b>1 Introduction</b>   | <b>2</b> |
| 1.1 General   | 2        |
| <b>2 Description of the Building</b>  | <b>2</b> |
| 2.1 Building Age and Configuration  | 2        |
| 2.2 Building Structural Systems Vertical and Horizontal                     | 2        |
| 2.3 Reference Building Type   | 2        |
| 2.4 Building Foundation System and Soil Conditions                          | 4        |
| 2.5 Available Structural Documentation and Inspection Priorities            | 4        |
| 2.6 Available Survey Information  | 4        |
| <b>3 Structural Investigation</b>   | <b>5</b> |
| 3.1 Summary of Building Damage  | 5        |
| 3.2 Record of Intrusive Investigation                                       | 5        |
| 3.3 Damage Discussion   | 5        |
| <b>4 Building Review Summary</b>  | <b>5</b> |
| 4.1 Building Review Statement   | 5        |
| 4.2 Critical Structural Weaknesses  | 5        |
| <b>5 Building Strength (Refer to Appendix C for background information)</b> | <b>6</b> |
| 5.1 General   | 6        |
| 5.2 Initial %NBS Assessment   | 6        |
| 5.3 Results Discussion  | 7        |
| <b>6 Conclusions and Recommendations</b>                                    | <b>7</b> |
| <b>7 Explanatory Statement</b>  | <b>7</b> |

## Appendices

**Appendix A Site Map, Photos and Levels Survey**

**Appendix B References**



**Appendix C Strength Assessment Explanation**

**Appendix D Background and Legal Framework**

**Appendix E Standard Reporting Spread Sheet**

# Executive Summary

This is a summary of the Qualitative Engineering Evaluation for the Branston Park Pavilion 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.

|  |  |   |   |                               |       |
|--|--|---|---|-------------------------------|-------|
| <b>Building Details</b>                      | <b>Name</b>  | Branston Park Pavilion  |   |                               |       |
| <b>Building Location ID</b>                  | PRK_1593_BLDG_001  | <b>Multiple Building Site</b>   | N   |                               |       |
| <b>Building Address</b>                      | 15 Witham Street, Hornby   | <b>No. of residential units</b>   | 0   |                               |       |
| <b>Soil Technical Category</b>               | NA   | <b>Importance Level</b>   | 2   | <b>Approximate Year Built</b> | 1970s |
| <b>Foot Print (m<sup>2</sup>)</b>            | 47   | <b>Storeys above ground</b>   | 1   | <b>Storeys below ground</b>   | 0     |
| <b>Type of Construction</b>                  | Light weight roof, timber purlins and rafters, concrete masonry walls, concrete slab on grade foundations with local thickenings for structural elements |   |   |                               |       |
| <b>Qualitative L4 Report Results Summary</b> |  |   |   |                               |       |
| <b>Building Occupied</b>                     | Y  | The Branston Park Pavilion is currently in service.   |   |                               |       |
| <b>Suitable for Continued Occupancy</b>      | Y  | The Branston Park Pavilion is suitable for continued use.   |   |                               |       |
| <b>Key Damage Summary</b>                    | Y  | Refer to summary of building damage Section 3.1 of report body.   |   |                               |       |
| <b>Critical Structural Weaknesses (CSW)</b>  | N  | No critical structural weaknesses were identified.  |   |                               |       |
| <b>Levels Survey Results</b>                 | Y  | Levels survey results were within the Department of Building and Housing Guidelines. Refer to the levels survey results in Appendix A of report body. |   |                               |       |
| <b>Building %NBS From Analysis</b>           | 61%  | Based on an analysis of the in-plane and out-of-plane checks in accordance with NZ Society for Earthquake Engineering (NZSEE) Guidelines.             |   |                               |       |
| <b>Qualitative L4 Report Recommendations</b> |  |   |   |                               |       |
| <b>Geotechnical Survey Required</b>          | N  | Geotechnical survey not required due to lack of observed ground damage on site.   |   |                               |       |
| <b>Proceed to L5 Quantitative DEE</b>        | N  | A quantitative DEE is not required for this structure.  |   |                               |       |
| <b>Approval</b>                              |  |   |   |                               |       |
| <b>Author Signature</b>                      |   | <b>Approver Signature</b>   |  |                               |       |
| <b>Name</b>                                  | Christopher Bong   | <b>Name</b>   | Luis Castillo   |                               |       |
| <b>Title</b>                                 | Structural Engineer  | <b>Title</b>  | Senior Structural Engineer  |                               |       |

# 1 Introduction

## 1.1 General

On 11 June 2012 Aurecon engineers visited the Branston Park Pavilion to undertake 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; and
- 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 Branston Park Pavilion 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 Branston Park Pavilion is single storey pavilion. Although the exact age of the building is not known, it is estimated to be constructed in the 1970s. The building is of concrete masonry wall construction. The building has a light weight timber roof, clad in colour steel and a concrete slab on grade with, we assume local thickenings on the perimeter.

The building has an approximate floor area of 47 square metres. It is considered as an Importance Level 2 Structure in accordance with AS/NZS 1170 Part 0:2002.

### 2.2 Building Structural Systems Vertical and Horizontal

The Branston Park Pavilion is of concrete masonry construction. The gravity loads from the timber framed roof are transferred into the ground via the concrete masonry walls and presumably, local thickenings in the concrete slab on grade.

The lateral load resisting system is identical to the gravity system in which the lateral loads in both principal directions are resisted by the concrete masonry walls.

### 2.3 Reference Building Type

Although there were no drawings to indicate the age of the building or whether the concrete block walls were partially or fully filled, it was noted that:-

- There is a concrete bond beam on the top of the wall at eaves height;
- There were no clean out blocks on the internal and external walls; and
- The concrete blocks above the drains to the showers were not filled.

The characteristics and features above are consistent with the lightly reinforced partially filled concrete masonry construction of the 1970s.

A general overview of the reference building type, construction era and likely earthquake risk is presented in the figure below. The Branston Park Pavilion is a lightly reinforced partially filled concrete masonry building constructed in the 1970s and according to the figure below is “possibly earthquake prone”.



Figure 1: Timeline showing the building types, approximate time of construction and likely earthquake risk. (From the Draft Guidance on DEEs of non-residential buildings by the Engineering Advisory Group)

Lightly reinforced partially filled concrete masonry buildings are particularly prone to:

- Plan irregularities which introduce localised areas of high seismic stresses and torsional instabilities, causing localised failure of the structure; and
- Inadequate connections between the wall-floor, the wall-wall and the wall-roof diaphragms.

However, as the Branston Park Pavilion lacks significant door, window or service openings, the Branston Park Pavilion is precluded from the aforementioned plan irregularities. Additionally, there were no noted instances of connection failures between the wall-floor, the wall-wall and the wall-roof diaphragms in the damage assessment.



## 2.4 Building Foundation System and Soil Conditions

The Branston Park is used for non-residential recreational purposes and therefore the Department of Building and Housing (DBH) does not have a technical classification for the land.

It is of note however, that the adjacent residential properties are classified as “Technical Category 1” (TC 1) land. According to the Canterbury Earthquake Recovery Authority (CERA), TC 1 land “is unlikely to incur future land damage from liquefaction”.

## 2.5 Available Structural Documentation and Inspection Priorities

There were no drawings available for the Branston Park Pavilion at the time of writing. While it is acknowledged that such drawings will aid in the improving the findings and recommendations of this report, the common and well understood structural system of the building has allowed us to gather a significant amount of information from a visual inspection.

The inspection priorities for the building are the review of damage to the mortar joints which are inherently weaker than the concrete masonry blocks. Additionally, the damage assessment focused on the building geometry and other forms of potential damage such as cracking in the concrete masonry block and concrete floor.

## 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.

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.

The floor levels for the Branston Park Pavilion were within the recommendations above.





## 3 Structural Investigation

### 3.1 Summary of Building Damage

There was no noted damage in the damage assessment. However, it should be noted that there were cracks in the concrete floor inside the building and the concrete apron outside the building but these do not seem to be caused by the recent seismic activity.

### 3.2 Record of Intrusive Investigation

There was no noted damage to the building and therefore, an intrusive investigation was neither warranted nor undertaken for Branston Park Pavilion. Although there is a degree of uncertainty with regards to the details of the diaphragm connectors, it is assumed these are adequate given the lack of noted damage.

### 3.3 Damage Discussion

No seismic related damage was noted in the damage assessment. This is not surprising given that the building has well-distributed walls in both principal directions.

## 4 Building Review Summary

### 4.1 Building Review Statement

As noted above no intrusive investigations were carried out for the Branston Park Pavilion due to the common and well understood structural system of the building. Although there is a degree of uncertainty with regards to the details of the diaphragm connectors, it is assumed these are adequate given the lack of damage noted.

### 4.2 Critical Structural Weaknesses

No specific 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 Branston Park Pavilion is of lightly reinforced partially filled concrete masonry construction. With well distributed walls, the building has performed well in the Canterbury earthquake sequence as evidenced by the lack of noted damage in section 3 above.

### 5.2 Initial %NBS Assessment

The Branston Park Pavilion 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. A more appropriate method is the bracing check as noted below:-

1. Evaluating the seismic demands based on the current earthquake loadings code.
2. Calculating the seismic capacity by adopting assumed values for strengths of existing materials and the geometry of the bracing elements.
3. Comparing the seismic demands to the seismic capacity to obtain a ratio, expressed as a percentage of new building standard (%NBS).

The selected assessment seismic parameters are tabulated in the tables below.

Table 1: Parameters used in the Seismic Assessment

| Seismic Parameter                               | Quantity | Comment/Reference   |
|---|----------|---|
| Site Soil Class                                 | D        | NZS 1170.5:2004, Clause 3.1.3, Deep or Soft Soil  |
| Site Hazard Factor, Z                           | 0.30     | DBH Info Sheet on Seismicity Changes (Effective 19 May 2011)                            |
| Return period Factor, $R_u$                     | 1.00     | NZS 1170.5:2004, Table 3.5, Importance Level 2 Structure with a Design Life of 50 years |
| Ductility Factor in the Along Direction, $\mu$  | 1.25     | Lightly reinforced partially filled concrete masonry walls                              |
| Ductility Factor in the Across Direction, $\mu$ | 1.25     | Lightly reinforced partially filled concrete masonry walls                              |

The seismic demand for the Branston Park Pavilion has been calculated based on the current code requirements of NZS 4229:1999 (Concrete Masonry Buildings Not Requiring Specific Engineering Design). 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 for both the along and across directions. The seismic demand was then compared with the building capacity in these directions. The building was found to have a sufficient number and length of walls in both the along and across directions to achieve a capacity of 61% NBS.



### 5.3 Results Discussion

The bracing check is in agreement with the observations of the damage assessment. This is not surprising given that the building has an even distribution of long walls that allow the seismic shear forces to be spread over a large wall area; giving the building good seismic performance and torsional stability.

## 6 Conclusions and Recommendations

Given the good performance of the Branston Park Pavilion in the Canterbury earthquake sequence, the lack of foundation damage and the floor levels considered to be within acceptable limits, **a geotechnical investigation is currently not considered necessary.**

Additionally, the building has suffered no loss of functionality and in our opinion the Branston Park Pavilion **is considered suitable for continued use.**

## 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 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

## Site Map, Photos and Levels Survey

11 June 2012 – Branston Park Pavilion Site Photographs



North western elevation of the Branston Park Pavilion.



Eastern elevation of the Branston Park Pavilion.



Rear elevation of the Branston Park Pavilion.



Concrete bond beam above the entrance.



Thickness of the concrete block wall.



Interior of the pavilion in the north western elevation.





Interior of the pavilion in the south eastern elevation.



Top detail of the concrete masonry wall showing a concrete bond beam and a timber eaves beam.

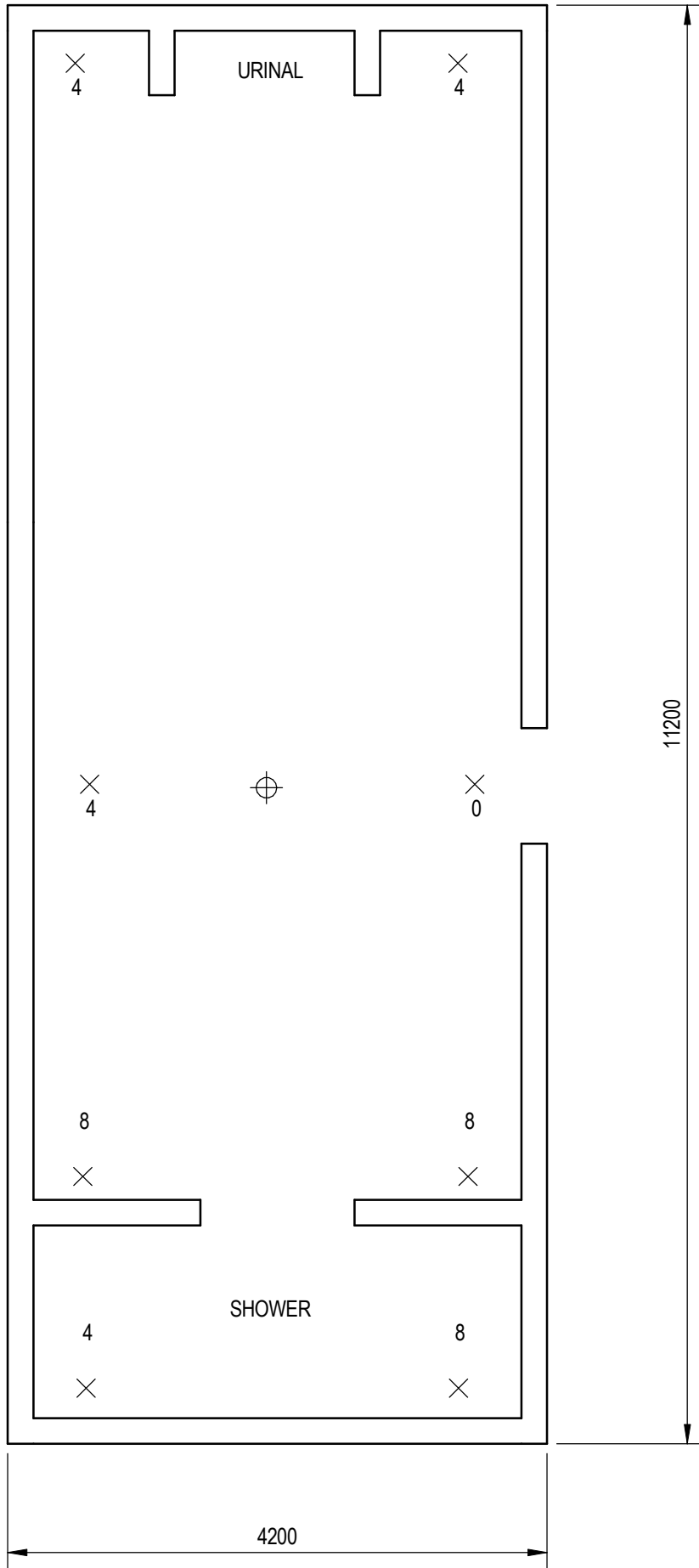


Shower floor in the south eastern corner of the pavilion.



Cracking in the concrete floor just by the entrance.





3/08/2012 4:55:53 pm

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

| DRAWN      | DESIGNED |
|------------|----------|
| D.HUNIA    | C.BONG   |
| CHECKED    |          |
| L.CASTILLO |          |
| APPROVED   |          |
|            | DATE     |
| L.CASTILLO |          |

| PROJECT                                    |
|--|
| BRANSTON PARK PAVILION<br>15 WITHAM STREET |
| TITLE                                      |
| LEVEL SURVEY                               |

| PRELIMINARY<br>NOT FOR CONSTRUCTION |            |
|-------------------------------------|------------|
| PROJECT No.<br>229607               |            |
| SCALE<br>1:50                       | SIZE<br>A4 |
| DRAWING No.<br>S-01-01              | REV        |



# 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 3603, 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 22<sup>nd</sup> 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

|   |  |  |                        |                             |
|---|--|--|------------------------|-----------------------------|
| <b>Location</b>   |  | Building Name: <u>Granston Park Pavilion</u>         | Unit No: <u>Street</u> | Reviewer: <u>Lee Howard</u> |
| Building Address: <u>15 Witham Street</u>                   |  | CPEng No: <u>1008889</u>                             |                        |                             |
| Legal Description: <u>Lot 81 DP 22338</u>                   |  | Company: <u>Aurecon NZ Ltd</u>                       |                        |                             |
| GPS south: <u>43</u> Degrees <u>33</u> Min <u>10.51</u> Sec |  | Company project number: <u>229607</u>                |                        |                             |
| GPS east: <u>172</u> <u>31</u> <u>44.07</u>                 |  | Company phone number: <u>03 366 0821</u>             |                        |                             |
| Building Unique Identifier (CCC): <u>FRK 1593 BLDG_001</u>  |  | Date of submission: <u>Oct-13</u>                    |                        |                             |
|   |  | Inspection Date: <u>Jun-12</u>                       |                        |                             |
|   |  | Revision: <u>2</u>                                   |                        |                             |
|   |  | Is there a full report with this summary? <u>yes</u> |                        |                             |

|  |  |  |                                    |
|--|--|--|------------------------------------|
| <b>Site</b>                                    |  | Site slope: <u>flat</u>                          | Max retaining height (m): <u>0</u> |
| Soil type: <u>mixed</u>                        |  | Soil Profile (if available): <u></u>             |                                    |
| Site Class (to NZS1170.5): <u>D</u>            |  | If Ground improvement on site, describe: <u></u> |                                    |
| Proximity to waterway (m, if <100m): <u></u>   |  | Approx site elevation (m): <u>22.00</u>          |                                    |
| Proximity to cliff top (m, if <100m): <u></u>  |  |  |                                    |
| Proximity to cliff base (m, if <100m): <u></u> |  |  |                                    |

|   |  |                                       |   |  |
|---|--|---------------------------------------|---|--|
| <b>Building</b>                             |  | No. of storeys above ground: <u>1</u> | single storey = 1   | Ground floor elevation (Absolute) (m): <u>22.10</u>  |
| Ground floor split? <u>no</u>               |  | Stores below ground: <u>0</u>         |   | Ground floor elevation above ground (m): <u>0.10</u> |
| Foundation type: <u>raft slab</u>           |  | Building height (m): <u>3.50</u>      | height from ground to level of uppermost seismic mass (for IEP only) (m): <u></u> | If Foundation type is other, describe: <u></u>       |
| Floor footprint area (approx): <u>47</u>    |  | Age of Building (years): <u>40</u>    | Date of design: <u>1976-1992</u>  |  |
| Strengthening present? <u>no</u>            |  | Use (ground floor): <u>public</u>     | If so, when (year)? <u></u>   | And what load level (%g)? <u></u>                    |
| Use (upper floors): <u>sports pavillion</u> |  | Use notes (if required): <u>IL2</u>   | Brief strengthening description: <u></u>  |  |
| Importance level (to NZS1170.5): <u>IL2</u> |  |                                       |   |  |

|   |  |   |   |
|---|--|---|---|
| <b>Gravity Structure</b>                        |  | Gravity System: <u>load bearing walls</u> | rafter type, purlin type and cladding: <u>timber purlins and rafters, colour steel roof</u> |
| Roof: <u>timber framed</u>                      |  | Floors: <u>concrete flat slab</u>         | slab thickness (mm): <u>100</u>   |
| Beams: <u></u>                                  |  | Columns: <u></u>                          | thickness (mm): <u>190</u>  |
| Walls: <u>partially filled concrete masonry</u> |  |   |   |

|  |  |  |  |   |   |
|--|--|--|--|---|---|
| <b>Lateral load resisting structure</b>            |  | Lateral system along: <u>partially filled CMU</u>  | Ductility assumed, $\mu$ : <u>1.25</u>                     | Period along: <u>0.40</u> ##### enter height above at H31 | note total length of wall at ground (m): <u>estimated</u> |
| Total deflection (ULS) (mm): <u></u>               |  | maximum interstorey deflection (ULS) (mm): <u></u> | estimate or calculation? <u></u>                           |   |   |
| Lateral system across: <u>partially filled CMU</u> |  | Ductility assumed, $\mu$ : <u>1.25</u>             | Period across: <u>0.40</u> ##### enter height above at H31 | note total length of wall at ground (m): <u>estimated</u> |   |
| Total deflection (ULS) (mm): <u></u>               |  | maximum interstorey deflection (ULS) (mm): <u></u> | estimate or calculation? <u></u>                           |   |   |

|                     |  |                     |                    |                     |                    |                             |
|---------------------|--|---------------------|--------------------|---------------------|--------------------|-----------------------------|
| <b>Separations:</b> |  | north (mm): <u></u> | east (mm): <u></u> | south (mm): <u></u> | west (mm): <u></u> | leave blank if not relevant |
|---------------------|--|---------------------|--------------------|---------------------|--------------------|-----------------------------|

|                                |  |                 |                        |                             |                  |                   |                          |                                       |
|--------------------------------|--|-----------------|------------------------|-----------------------------|------------------|-------------------|--------------------------|---------------------------------------|
| <b>Non-structural elements</b> |  | Stairs: <u></u> | Wall cladding: <u></u> | Roof Cladding: <u>Metal</u> | Glazing: <u></u> | Ceilings: <u></u> | Services (list): <u></u> | describe: <u>corrugated iron roof</u> |
|--------------------------------|--|-----------------|------------------------|-----------------------------|------------------|-------------------|--------------------------|---------------------------------------|

|                                |  |                            |                         |                         |                         |                             |                                      |
|--------------------------------|--|----------------------------|-------------------------|-------------------------|-------------------------|-----------------------------|--------------------------------------|
| <b>Available documentation</b> |  | Architectural: <u>none</u> | Structural: <u>none</u> | Mechanical: <u>none</u> | Electrical: <u>none</u> | Geotech report: <u>none</u> | original designer name/date: <u></u> |
|--------------------------------|--|----------------------------|-------------------------|-------------------------|-------------------------|-----------------------------|--------------------------------------|

|   |  |   |                                    |
|---|--|---|------------------------------------|
| <b>Damage</b>                                 |  | Site performance: <u>good</u>                     | Describe damage: <u>none noted</u> |
| Site: (refer DEE Table 4-2)                   |  | Settlement: <u>none observed</u>                  | notes (if applicable): <u></u>     |
| Differential settlement: <u>none observed</u> |  | Liquefaction: <u>none apparent</u>                | notes (if applicable): <u></u>     |
| Lateral Spread: <u>none apparent</u>          |  | Differential lateral spread: <u>none apparent</u> | notes (if applicable): <u></u>     |
| Ground cracks: <u>none apparent</u>           |  | Damage to area: <u>none apparent</u>              | notes (if applicable): <u></u>     |

|                  |                         |                                      |   |
|------------------|-------------------------|--------------------------------------|---|
| <b>Building:</b> |                         | Current Placard Status: <u>green</u> | Describe how damage ratio arrived at: <u></u> |
| Along            | Damage ratio: <u>0%</u> | Describe (summary): <u></u>          |   |
| Across           | Damage ratio: <u>0%</u> | Describe (summary): <u></u>          |   |
| Diaphragms       | Damage?: <u>no</u>      | Describe: <u></u>                    |   |
| CSWs:            | Damage?: <u>no</u>      | Describe: <u></u>                    |   |
| Pounding:        | Damage?: <u>no</u>      | Describe: <u></u>                    |   |
| Non-structural:  | Damage?: <u>no</u>      | Describe: <u></u>                    |   |

|                                      |  |  |  |
|--------------------------------------|--|--|--|
| <b>Recommendations</b>               |  | Level of repair/strengthening required: <u>none</u>      | Describe: <u></u>  |
| Building Consent required: <u>no</u> |  | Interim occupancy recommendations: <u>full occupancy</u> | Describe: <u></u>  |
| Along                                | Assessed %NBS before e'quakes: <u>100%</u> ##### %NBS from IEP below | Assessed %NBS after e'quakes: <u>100%</u>                | If IEP not used, please detail assessment methodology: <u>bracing check to NZS 4229:1999</u> |
| Across                               | Assessed %NBS before e'quakes: <u>100%</u> ##### %NBS from IEP below | Assessed %NBS after e'quakes: <u>100%</u>                |  |

|   |  |  |  |
|---|--|--|--|
| <b>IEP</b>  |  | 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): <u>1976-1992</u>   | $t_n$ from above: <u>m</u>                     |  |  |
| Seismic Zone, if designed between 1965 and 1992: <u></u>  | not required for this age of building: <u></u> |  |  |
| Period (from above): <u>0.4</u>   | along  | across   |  |
| (%NBS)nom from Fig 3.3:   | <u>0.4</u>                                     | <u>0.4</u>   |  |
| 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 buildings designed prior to 1935 use 0.8, except in Wellington (1.0)  |  |  |  |

Final (%NBS)<sub>nom</sub>:

2.2 Near Fault Scaling Factor

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

Near Fault scaling factor (1/(T.D), Factor A:

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3:   
Z<sub>1992</sub>, from NZS4203:1992  
 Hazard scaling factor, Factor B:

2.4 Return Period Scaling Factor

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

2.5 Ductility Scaling Factor

Assessed ductility (less than max in Table 3.2)   
 Ductility scaling factor: =1 from 1976 onwards; or =k<sub>u</sub>, if pre-1976, from Table 3.3:   
along  across

Ductility Scaling Factor, Factor D:

2.6 Structural Performance Scaling Factor:

Sp:   
 Structural Performance Scaling Factor Factor E:

2.7 Baseline %NBS, (NBS%)<sub>b</sub> = (%NBS)<sub>nom</sub> x A x B x C x D x E

%NBS<sub>b</sub>:

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

3.1 Plan Irregularity, factor A:

3.2 Vertical irregularity, Factor B:

3.3 Short columns, Factor C:

3.4 Pounding potential  
 Pounding effect D1, from Table to right:   
 Height Difference effect D2, from Table to right:   
 Therefore, Factor D:

3.5 Site Characteristics

| Table for selection of D1               | Separation | Severe      | Significant | Insignificant/none |
|---|------------|-------------|-------------|--------------------|
|   |            | 0<sep<.005H |             | .005<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        | Separation | Severe      | Significant | Insignificant/none |
|----------------------------------|------------|-------------|-------------|--------------------|
|                                  |            | 0<sep<.005H |             | .005<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

For ≤ 3 storeys, max value =2.5, otherwise max value =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

3.7 Overall Performance Achievement ratio (PAR)

4.3 PAR x (%NBS)<sub>b</sub>:

PAR x Baseline %NBS:

4.4 Percentage New Building Standard (%NBS), (before)

Official Use only:

Accepted By:   
 Date:



**Aurecon New Zealand Limited**

**Level 2, 518 Colombo Street  
Christchurch 8011**

PO Box 1061  
Christchurch 8140  
New Zealand

**T** +64 3 375 0761

**F** +64 3 379 6955

**E** [christchurch@aurecongroup.com](mailto:christchurch@aurecongroup.com)

**W** [aurecongroup.com](http://aurecongroup.com)

Aurecon offices are located in:

Angola, Australia, Botswana, China,  
Ethiopia, Hong Kong, Indonesia,  
Lesotho, Libya, Malawi, Mozambique,  
Namibia, New Zealand, Nigeria,  
Philippines, Singapore, South Africa,  
Swaziland, Tanzania, Thailand, Uganda,  
United Arab Emirates, Vietnam.