aurecon

Botanic Gardens – Paddling Pool Plant Shed

Quantitative Engineering Evaluation

Functional Location ID: PRO 1566 B032

Address: Botanic Gardens, Hagley Park, Christchurch

Reference: 235155

Prepared for:

Christchurch City Council

Revision: 2

Date: 11 October 2013

Leading. Vibrant. Global.
www.aurecongroup.com

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

Document control						aurecon
Report Title		Quantitative Engineering Evaluation				
Functional Location ID		**PRO 1566 B032**	**Project Number**		235155	
File Path		P:\ 235155 - Botanic Gardens – Paddling Pool Plant Shed.docx				
Client		Christchurch City Council	**Client Contact**		Will Rolton	
Rev	**Date**	**Revision Details/Status**	**Prepared**	**Author**	**Verifier**	**Approver**
1	**2 July 2013**	Draft	S. McConway	S. McConway	C. Lillywhite	L. Castillo
2	**11 October 2013**	Final	S. McConway	S. McConway	C. Lillywhite	L. Castillo
Current Revision		**2**				

Approval			
Author Signature		Approver Signature	
Name	Steven McConway	Name	Luis Castillo
Title	Structural Engineer	Title	Structural Engineer

Contents

Appendices

Executive Summary

This is a summary of the Quantitative Engineering Evaluation for the Botanic Gardens – Paddling Pool Plant Shed building and is based on the Detailed Engineering Evaluation Procedure document issued by the Engineering Advisory Group on 19 July 2011, visual inspections, available structural documentation and summary calculations as appropriate.

Building Details	**Name**	Botanic Gardens – Paddling Pool Plant Shed			
Building Location ID	PRO 1566 B032			**Multiple Building Site**	N
Building Address	Botanic Gardens, Hagley Park, Christchurch			**No. of residential units**	0
Soil Technical Category	N/A	**Importance Level**	2	**Approximate Year Built**	1971
Foot Print (m²)	10	**Storeys above ground**	1	**Storeys below ground**	0
Type of Construction	Single storey building which is built approximately 1m below low ground level and extends approximately 1.4m above ground level. The walls below ground level are reinforced concrete and the walls above ground level are double skinned reinforced brick. The roof in a reinforced concrete slab and the floor is a concrete slab on grade.				

Quantitative L5 Report Results Summary		
Building Occupied	Y	The Botanic Gardens – Paddling Pool Plant Shed is currently in service.
Suitable for Continued Occupancy	Y	The Botanic Gardens – Paddling Pool Plant Shed is suitable for occupation.
Key Damage Summary	Y	Refer to summary of building damage Section 3.1 report body.
Critical Structural Weaknesses (CSW)	N	No CSW observed.
Levels Survey Results	Y	A level survey has been carried out on 23 April 2013.
Building %NBS From Analysis	80%	Based on an analysis of capacity and demand.

Approval			
Author Signature		Approver Signature	
Name	Steven McConway	Name	Luis Castillo
Title	Structural Engineer	Title	Structural Engineer

1 Introduction

1.1 General

On 3 April 2013 Aurecon engineers visited the Botanic Gardens – Paddling Pool Plant Shed to undertake a quantitative 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.
- 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 Quantitative Assessment of damage to the Botanic Gardens – Paddling Pool Plant 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 Botanic Gardens – Paddling Pool Plant Shed is a rectangular shaped building designed in 1971. The building is a single storey building and is built approximately 1m below ground level and extends approximately 1.4m above ground level. The strip footings/walls below ground level are reinforced concrete and above ground the walls are double leaf bricks that have been reinforced vertically with steel reinforcement bars. The roof is a reinforced concrete slab and the ground floor slab is concrete on grade. Part of the western wall is shared with the underground balance tank.

The building is approximately 10 square meters in floor area and is considered to be an importance level 2 structure in accordance with AS/NZS 1170 Part 0:2002.

There are also two L shaped reinforced brick cantilevered walls to the west of the paddling pool plant shed. These walls were constructed at the same time as the paddling pool plant shed and are used to support seats.

2.2 Building Structural Systems Vertical and Horizontal

The reinforced concrete roof is supported by double leaf reinforced brick walls on all sides, which are supported on reinforced concrete strip footings. These footings also act as the lower walls below ground level.

Horizontal lateral loads are resisted by the double leaf reinforced brick and concrete walls in both directions.

2.3 Reference Building Type

A general overview of the reference building type, construction era and likely earthquake risk is presented in the figure below. The Botanic Gardens – Paddling Pool Plant Shed has been designed in 1971 and according to the figure below, possibly Earthquake prone.

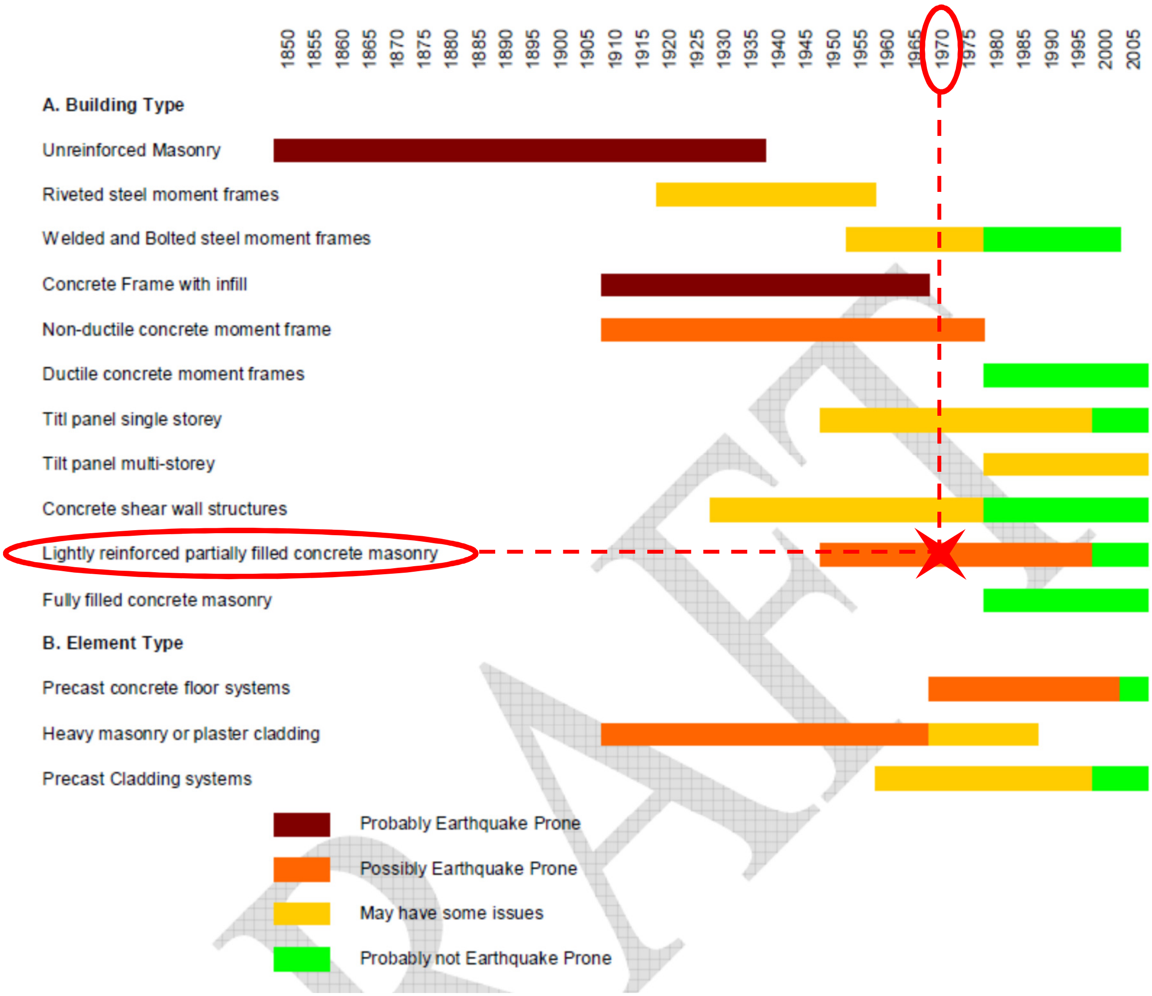


Figure 1: Timeline showing the building types, approximate time of construction and likely earthquake risk. (From the Draft Guidance on DEEs of non-residential buildings by the Engineering Advisory Group)

2.4 Building Foundation System and Soil Conditions

The foundations consist of reinforced concrete strip footings and a concrete slab-on-grade.

The land surrounding the Botanic Garden – Paddling Pool Plant Shed has been zoned N/A. This means that no mapping of the land with respect to technical categories has been done. However there are no signs in the vicinity of the Botanic Gardens – Paddling Pool Plant Shed of liquefaction bulges or boils and subsidence at the time of inspection.

2.5 Available Structural Documentation and Inspection Priorities

Structural plans tilted "Remodelling and extension of the paddling pool in the Christchurch botanic gardens" and dated December 1971 was provided by CCC on 27 April 2013.

2.6 Available Survey Information

A floor level survey was undertaken to establish the level of unevenness across the floor. Not all areas of the floor were surveyed at the time of the inspection due to obstructions. 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 Ministry of Business, Innovation and Employment (MBIE) published the guideline "Repairing and rebuilding houses affected by the Canterbury earthquakes" in 2012, 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 total difference between the slabs highest point and the slabs lowest point is 26mm which is lower than the above recommendation. The maximum floor slope of 1.0% runs in the direction of a sump at the south-west corner of the building and does not represent foundation damage. All other floor slopes are less than 0.5%, refer Appendix A. Therefore in our view the floor does not require re-levelling.

Code requirements covering acceptability criteria for the floors of buildings are written for new buildings and are not appropriate for older buildings which would have settled with time.

3 Structural Investigation

3.1 Summary of Building Damage

The following damage was noticed and reviewed during the inspections of the quantitative assessment;

- Concrete roof has multiple cracks through it. The cracks appear to be old and are unlikely to have been caused by the Canterbury seismic events.
- Minor cracks to concrete floor slab. Cracks appear to be old and unlikely to have been caused by the Canterbury seismic events.
- Vertical cracks to the cantilevered walls west of the building. These cracks appear to have been caused or aggravated by the Canterbury seismic events.

3.2 Record of Intrusive Investigation

Due to the generic nature of the Botanic Gardens – Paddling Pool Plant Shed, a significant amount of structural information can be inferred from the building form and construction materials. Construction drawings had also been sourced from Council records and as no significant damage was noted, an intrusive investigation was neither warranted nor undertaken for the Botanic Gardens – Paddling Pool Plant Shed.

3.3 Damage Discussion

The buildings damage appears to have been caused by environmental effects, rather than seismic actions. Except for the vertical cracks to the cantilevered reinforced brick walls located to the west of the building.

Cracks to the reinforced brick walls and reinforced concrete roof should grouted injected to stop water ingress.

4 Building Review Summary

4.1 Building Review Statement

As no calculations and few drawings or documentations were available, assumptions had to be made in order to complete calculations using current NZ standards (Refer to Appendix B).

4.2 Critical Structural Weaknesses

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

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

5.1 General

The building has performed well during the Canterbury earthquakes evident by the low level of damage noted in Section 3.1 of this report.

5.2 Initial %NBS Assessment

The seismic design parameters used to complete this strength assessment are based on current design requirements from NZS1170:2002 and the NZBC clause B1. For this building, the parameters are:

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	NZS 1170.5:2004, Table 3.5
Ductility Factor for the lightly reinforced double leaf brick walls in both directions, μ	1.25	
Ductility Factor for the unreinforced sections of the double leaf brick walls in both directions, μ	2.0	As per the Faculty of Engineering, The University of Auckland – Assessment and Improvement of Unreinforced Masonry Buildings for Earthquake Resistance (Draft – 02/2011).

Despite the use of best national and international practice in this analysis and assessment, the values are uncertain due to the many assumptions and simplifications which were made during the assessment (Refer to Appendix B for the limitation and assumptions).

A structural performance summary of the building is shown in the Table 2 below. Note that the values given represent the critical elements in the building. When redistributed, the values can be relied on as these effectively define the building's capacity.

Table 2: Summary of Performance

Structural Element/System	Comments	%NBS Based of Detailed Assessment
Paddling pool plant shed		**80%**
Transverse direction (N-S direction) (Across)		
In plane strength		80%
Out of plane strength		90%
Longitudinal direction (E-W direction) (Along)		
In plane strength		100%
Out of plane strength		90%

5.3 Results Discussion

The building has performed well during the Canterbury seismic events with minimum damage. However, the cracks to the concrete roof will need to be injected with a suitable epoxy to stop water ingress into the concrete roof which will degrade over time if not remedied. Vertical cracks to the cantilevered walls west of the building should be also be fully grouted.

In summary, detailed calculations give a percentage new building standard (%NBS) longitudinally of 100%, 90% out of plane and 80% transversally which governs the overall NBS percentage of the building. The calculated strength of the building is in correlation with the observed damage.

6 Conclusions and Recommendations

Given the good performance of the Botanic Gardens – Paddling Pool Plant Shed in the Canterbury earthquake sequence and the lack of foundation damage, **a geotechnical investigation is currently not considered necessary**.

The Botanic Gardens – Paddling Pool Plant Shed is currently in use and in our view is **suitable for continued occupation.**

Repairs as noted in Section 5.3 above should be carried out. Due to the use of the building and the strength calculated above being greater than 67%NBS, strengthening is not warranted.

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.

To carry out the structural review, existing building drawings were obtained (where available) from the Christchurch City Council records. We have assumed that the building has been constructed in accordance with the drawings.

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 Level Survey.

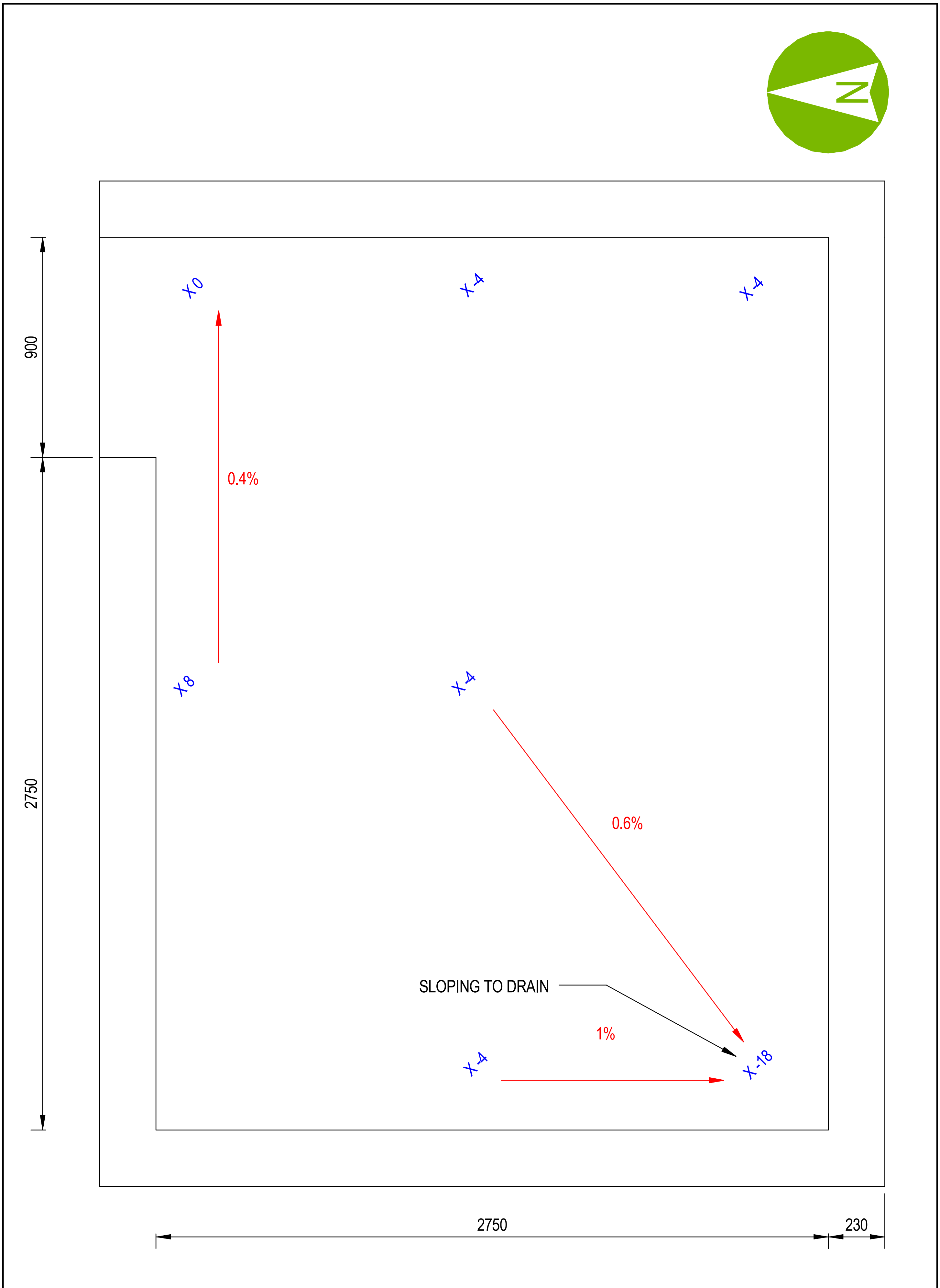
Site Map – Red circle indicates location of the paddling pool plant shed.

This image was created from maps and/or data extracted from the Canterbury Geotechnical Database (https://canterburygeotechnicaldatabase.projectorbit.com), which were prepared and/or compiled for the Earthquake Commission (EQC) to assist in assessing insurance claims made under the Earthquake Commission Act 1993. The source maps and data were not intended for any other purpose. EQC and its engineers, Tonkin & Taylor, have no liability for any use of the maps and data or for the consequences of any person relying on them in any way.

1	General view of building.	
2	General view inside the building.	

3	Cracked roof seen from the interior.	
4	Cracked roof seen from the exterior.	

5	Vertical crack in the cantilever wall west of the paddling pool plant shed.	
6	Close up view of a typical crack in the cantilevered wall west of the paddling pool plant shed.	



17/05/2013 9:38:40 a.m.

aurecon
www.aurecongroup.com

CLIENT
Christchurch City Council

REV	DATE	REVISION DETAILS	APPROVAL

DRAWN	DESIGNED
D.HUNIA	S.McCONWAY

CHECKED

APPROVED
DATE

PROJECT
BOTANIC GARDENS
PADDLING POOL PLANT SHED

TITLE
FLOOR LEVEL SURVEY

PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT No.
235155

SCALE	SIZE
1 : 20	A4

DRAWING No.	REV
SK-01	

Appendix B
References, Limitation and Assumptions

1. Ministry of Business, Innovation and Employment (MBIE) “Repairing and rebuilding houses affected by the Canterbury earthquakes”, December 2012

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. “Assessment and Improvement of Unreinforced Masonry Buildings for Earthquake Resistance – Draft 02/2011” by the faculty of Engineering, The University of Auckland.

Limitation and Assumptions

The following table resume the limitation and assumptions made in order to complete calculations.

Table 1: Assumptions made

Assumptions	Description of the assumptions	Values
Brick	Burnt clay per 10mm of thickness	0.19kN/m2
Concrete		24kN/m3
f_y of all reinforcing bars.		300 MPa
Ductility for the reinforced brick in both directions (μ)		1.25
Ductility for the unreinforced brick in both directions (μ)		2.0

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	Improvement of Structural Performance – 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).

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 V1.14

Location

Building Name:	Botanic Gardens - Paddling pool plant shed		Reviewer:	Lee Howard
	Unit / No: / Street		CPEng No:	1008889
Building Address:	North Hagely Park		Company:	Aurecon New Zealand Ltd
Legal Description:			Company project number:	235155
			Company phone number:	(03) 3750761
	Degrees / Min / Sec			
GPS south:	43 / 31 / 43.51		Date of submission:	11/10/2013
GPS east:	172 / 37 / 11.18		Inspection Date:	3/04/2013
			Revision:	2
Building Unique Identifier (CCC):	PRO 1566 B032		Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	1
Soil type:		Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
Proximity to waterway (m, if <100m):	50	If Ground improvement on site, describe:	
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	10.00

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m):	-0.90
Ground floor split?			Ground floor elevation above ground (m):	
Storeys below ground				
Foundation type:	strip footings		if Foundation type is other, describe:	
Building height (m):	2.40		height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	10			
Age of Building (years):	42		Date of design:	1965-1976
Strengthening present?			If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	other (specify)		Brief strengthening description:	
Use (upper floors):				
Use notes (if required):	Pool plant shed			
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	load bearing walls		
Roof:	concrete	slab thickness (mm)	100 - 125mm
Floors:	concrete flat slab	slab thickness (mm)	
Beams:			
Columns:			
Walls:	load bearing brick	#N/A	

Lateral load resisting structure

Lateral system along:	other (note)	**Note: Define along and across in detailed report!**	describe system	Reinforced brick
Ductility assumed, μ:	2.00			
Period along:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	other (note)		describe system	Reinforced brick
Ductility assumed, μ:	2.00			
Period across:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	

Separations:

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

Non-structural elements

Stairs:	
Wall cladding:	
Roof Cladding:	
Glazing:	
Ceilings:	
Services(list):	

Available documentation

Architectural		original designer name/date	
Structural	full	original designer name/date	Griffiths Moffat & Partners - 1971
Mechanical		original designer name/date	
Electrical		original designer name/date	
Geotech report		original designer name/date	

Damage

Site: (refer DEE Table 4-2)

Site performance:	Minor	Describe damage:	
Settlement:	0-25mm	notes (if applicable):	
Differential settlement:		notes (if applicable):	
Liquefaction:		notes (if applicable):	
Lateral Spread:		notes (if applicable):	
Differential lateral spread:		notes (if applicable):	
Ground cracks:		notes (if applicable):	
Damage to area:	slight	notes (if applicable):	

Building:

	Current Placard Status:			
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):			
Across	Damage ratio:	0%		
	Describe (summary):			
Diaphragms	Damage?:	yes	Describe:	Cracked due to environmental factors
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:		Describe:	

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

Recommendations

	Level of repair/strengthening required:	minor structural	Describe:	Crack injection
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before e'quakes:	90% ##### %NBS from IEP below	If IEP not used, please detail assessment methodology:	Quantitative
	Assessed %NBS after e'quakes:	90%		
Across	Assessed %NBS before e'quakes:	80% ##### %NBS from IEP below		
	Assessed %NBS after e'quakes:	80%		

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): 1965-1976

h_n from above: m

Seismic Zone, if designed between 1965 and 1992:

not required for this age of building

not required for this age of building

	along	across
Period (from above):	0.4	0.4
(%NBS)nom from Fig 3.3:		
Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0	1.00	
Note 2: for RC buildings designed between 1976-1984, use 1.2	1.0	
Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0)	1.0	

	along	across
Final $(\%NBS)_{nom}$:	**0%**	**0%**

2.2 Near Fault Scaling Factor

		along	across
	Near Fault scaling factor, from NZS1170.5, cl 3.1.6:		1.00
	Near Fault scaling factor (1/N(T,D), **Factor A**:	1	1

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3:	
Z_{1992}, from NZS4203:1992	
Hazard scaling factor, **Factor B**:	#DIV/0!

2.4 Return Period Scaling Factor

Building Importance level (from above):	2
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)	1.00	1.00
Ductility scaling factor: =1 from 1976 onwards; or =kμ, if pre-1976, fromTable 3.3:		
Ductiity Scaling Factor, **Factor D**:	0.00	0.00

2.6 Structural Performance Scaling Factor:

Sp:	1.000	1.000
Structural Performance Scaling Factor **Factor E**:	1	1

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: 1

3.2. Vertical irregularity, Factor B: 1

3.3. Short columns, Factor C: 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 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

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!**

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