Hagley Park North – Band Rotunda

Quantitative Engineering Evaluation

Functional Location ID: PRK_1190_BLDG_033

Address: 6 Riccarton Avenue

Reference: 228660

Prepared for:

Christchurch City Council

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Approval			
Author Signature		Approver Signature	
Name	Oleg Belov	Name	Lee Howard
Title	Structural Engineer	Title	Senior Structural Engineer

Contents

Appendices

Executive Summary

This is a summary of the Quantitative Engineering Evaluation for the Hagley Park North – Band Rotunda 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**	Hagley Park North – Band Rotunda			
Building Location ID	PRK_1190_BLDG_033			**Multiple Building Site**	N
Building Address	6 Riccarton Avenue (access off Chenery Ave)			**No. of residential units**	0
Soil Technical Category	NA	**Importance Level**	2	**Approximate Year Built**	1925
Foot Print (m²)	55	**Storeys above ground**	2	**Storeys below ground**	0
Type of Construction	Concrete roof supported by six concrete columns and a concrete cellar under the base of the columns.				
Quantitative L5 Report Results Summary					
Building Occupied	N	The Hagley Park North – Band Rotunda is not currently in service.			
Suitable for Continued Occupancy	N	The Hagley Park North – Band Rotunda could be considered safe to use after corresponding replacement of the columns have been made.			
Key Damage Summary	Y	Significant damage to the six columns supporting the roof.			
Critical Structural Weaknesses (CSW)	Y	Columns are damaged at the base and top ends.			
Levels Survey Results	Y	Concrete roof requires re-levelling.			
Building %NBS From Analysis	17%	Based on an analysis of capacity and demand.			
Report Recommendations					
Geotechnical Survey Required	N	Geotechnical survey not required due to lack of observed ground damage on site.			
Strengthening Required	Y	Replacement of existing columns with new columns designed to 100%NBS.			
Approval					
Author Signature		Approver Signature			
Name	Oleg Belov	Name	Lee Howard		
Title	Structural Engineer	Title	Senior Structural Engineer		

1 Introduction

1.1 General

On 25 May 2012, 10 July 2012 and 22 August 2012 Aurecon engineers visited the Hagley Park North – Band Rotunda to undertake a 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.
- A detailed engineering evaluation (DEE) including engineering calculations and a level survey of the building to determine extent of damage.

This report outlines the results of our assessment of damage to the Hagley Park North – Band Rotunda 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 calculations as appropriate.

It is noted that at the extent of damage observed during our inspection was significant and that a qualitative assessment would not be appropriate to assess the structure to a reasonable degree of accuracy. Thus a quantitative assessment was carried out.

2 Description of the Building

2.1 Building Age and Configuration

The Hagley Park North – Band Rotunda is a two storey neo-classical structure constructed in 1925. It has a reinforced concrete (RC) roof, which is supported by six RC columns located around the perimeter of the base, which is elevated from ground level by a perimeter wall. The foundation consists of a concrete slab-on-grade.

The building has an approximate floor area of 55 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 Hagley Park North – Band Rotunda is a very simple structure. Its Reinforced Concrete (RC) slab roof is supported on RC columns that transfer loads to the foundation. Lateral loads are resisted by the same columns mentioned before which are located around the perimeter of the structure.

2.3 Reference Building Type

The Hagley Park North – Band Rotunda is a basic neo-classical building typical of its age and style. It was not subjected to specific engineering design; rather it was constructed to a reliable formula known to achieve the performance and aesthetic objectives of the time it was built.

2.4 Building Foundation System and Soil Conditions

The Hagley Park North – Band Rotunda is based on a concrete slab as its foundation system, used for non-residential recreational purposes, the Department of Building and Housing (DBH) do not currently have a technical classification for the land in the immediate vicinity of the Hagley Park North – Band Rotunda. It is of note however, that the nearby area within the suburb of Christchurch Central consists primarily of Technical Category 2 (TC 2) land. According to CERA, TC2 land is considered to "incur minor to moderate land damage from liquefaction".

2.5 Available Structural Documentation and Inspection Priorities

The only drawing available for the Hagley Park North – Band Rotunda was the structural drawing showing the new columns. The drawing was prepared by City Solutions and dated May 2002 for the Christchurch City Council.

Inspection priorities for the building are related to a review of potential damage to foundations and consideration of column repairs or complete replacement due to the considerable damage at the base and top ends of the columns caused by the Canterbury Earthquakes.

2.6 Available Survey Information

A level survey was carried out of the roof and suspended concrete base to determine the extent of movement that has occurred. Our findings indicate that the roof requires re-levelling, which could be carried out during the replacement of the columns. The levels of the concrete base are acceptable. Refer to Appendix A for detailed survey data.

3 Structural Investigation

3.1 Summary of Building Damage

The columns and their connections have suffered significant structural damage. All other areas of the structure suffered none to minor damage and can be repaired to a functional level.

3.2 Record of Intrusive Investigation

The building is fully exposed and structural details of the columns were obtained from Christchurch City Council. Thus, an intrusive investigation was not required.

3.3 Damage Discussion

The structure is comprised of three primary components; the roof, the columns and the cellar. Based on the geometry of the structure, refer to Appendix A, it can be concluded that the primary failure mechanism and the most critical component during a significant earthquake event is the collapse of the columns. This is supported by the observation of existing damage to the structure during the site inspections; refer to images in Appendix A.

The column elements and their connections suffered serious damage, beyond structurally acceptable levels. There are visible signs that the columns have undergone lateral deformation, which indicates that the vertical reinforcement has yielded beyond structurally acceptable stress limits. The rest of the structure (roof and cellar) was relatively intact and within structurally acceptable levels with only minor repairs required, namely at the column connections.

4 Building Review Summary

4.1 Building Review Statement

Because of the generic nature of the building a significant amount of information can be inferred by visual inspection. Refer to Appendix A for approximate geometry of the structure. Note that some of the sizes were not able to be numerically measured and these have been approximated based on visual appearance and available existing information.

4.2 Critical Structural Weaknesses

As mentioned in the damage discussion, section 3.3 of this report, the critical structural weaknesses of Hagley Park North – Band Rotunda are the concrete columns.

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

5.1 General

The Hagley Park North – Band Rotunda is a concrete sway frame consisting of a concrete roof, concrete columns and a concrete cellar. The existing condition of the structure indicates that there is significant damage to the columns, which have deformed beyond structurally acceptable levels. The columns can be considered to be nominally ductile elements and this is supported by visual inspections, refer to images in Appendix A, which clearly show that the columns have suffered considerable damage due to lateral loads as a result of the recent earthquakes. The remainder of the structure has been left relatively intact with only minor works required.

5.2 %NBS Assessment

The Hagley Park North – Band Rotunda has been subject to a detailed engineering evaluation (DEE). Table 1 below indicates the input parameters adopted during the DEE assessment.

Table 1: Parameters used in the Seismic Assessment

Seismic Parameter	Quantity	Comment/Reference
Site Soil Class	D	NZS 1170.5:2004, Clause 3.1.3, Deep or Soft Soil
Site Hazard Factor, Z	0.30	DBH Info Sheet on Seismicity Changes (Effective 19 May 2011)
Return period Factor, R_u	1.0	NZS 1170.5:2004, Table 3.5, Importance Level 2 Structure with a Design Life of 50 years
Seismic Parameter	**Quantity**	**Comment/Reference**
Ductility Factor in the Along Direction, μ	1.25	NZS 1170.5:2004, Clause 2.2.3, Nominally ductile reinforced concrete structure
Ductility Factor in the Across Direction, μ	1.25	NZS 1170.5:2004, Clause 2.2.3, Nominally ductile reinforced concrete structure

The seismic demand for the Hagley Park North – Band Rotunda has been calculated based on the current code requirements. It is noted that the assessment was focused on the critical elements of the structure, namely the columns. The concrete roof and concrete cellar have been assumed to be acceptable based on their geometry and lack of any notable existing damage.

The capacity of the columns was calculated based on available column details; refer to Appendix A for details. The seismic demand imposed on the columns was then compared with the column capacity. It was found that the columns do not have sufficient capacity to adequately resist earthquake actions. The maximum percentage of new building standard (%NBS) was found to be **17%**.

5.3 Results Discussion

The results indicate that the structural integrity of the columns is below the legal requirement of 33% NBS, which confirms that the building is earthquake prone. This has also been confirmed by visual inspections, refer to images in Appendix A, which show that the columns have developed unacceptable levels of cracking. There are also signs that the columns have undergone lateral deformation. Both the cracking and the lateral deformation indicate that the steel reinforcement has undergone yielding beyond the allowable limits, and thus the columns can no longer be considered safe to use. A result of 17% NBS translates to a risk level that is approximately >25 times that of a building that has been designed to 100% NBS, refer to Table C1 in Appendix C for details.

6 Conclusions and Recommendations

The Hagley Park North – Band Rotunda structure is currently zoned off from general public and not in use. In our opinion the structure is **not suitable for future use** and should remain zoned off until strengthening works have been completed.

As there is no clear evidence of any liquefaction or ground movement in the vicinity of the Hagley Park North – Band Rotunda a **geotechnical investigation is currently not considered necessary**.

In order to preserve the heritage aspects of the structure it is recommended that the **existing columns need to be replaced with new columns** that are capable of resisting the applied loads (i.e. designed to 100% NBS).

Aurecon are able to provide the design and documentation of the new columns and associated details should you wish to proceed with strengthening works.

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 drawings of the columns were obtained from the Christchurch City Council records. We have assumed that the columns have 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.

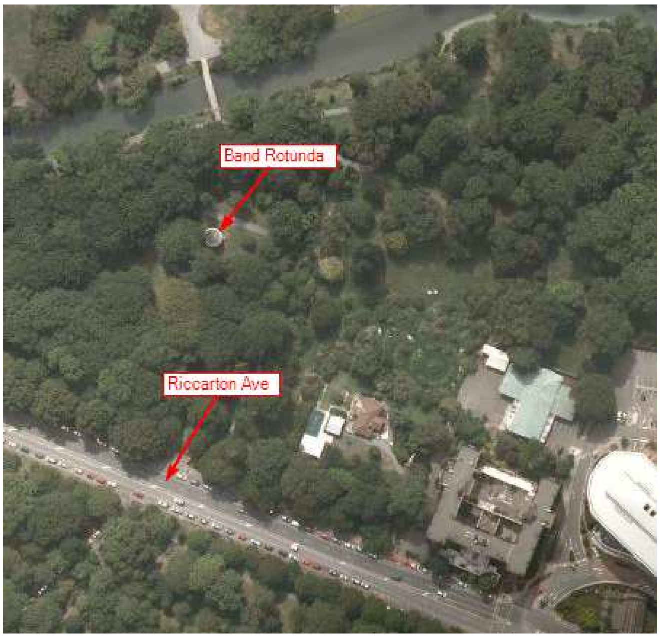
Without limiting any of the above, Aurecon's liability, whether under the law of contract, tort, statute, equity or otherwise, is limited as set out in the terms of the engagement with the client.

Appendices

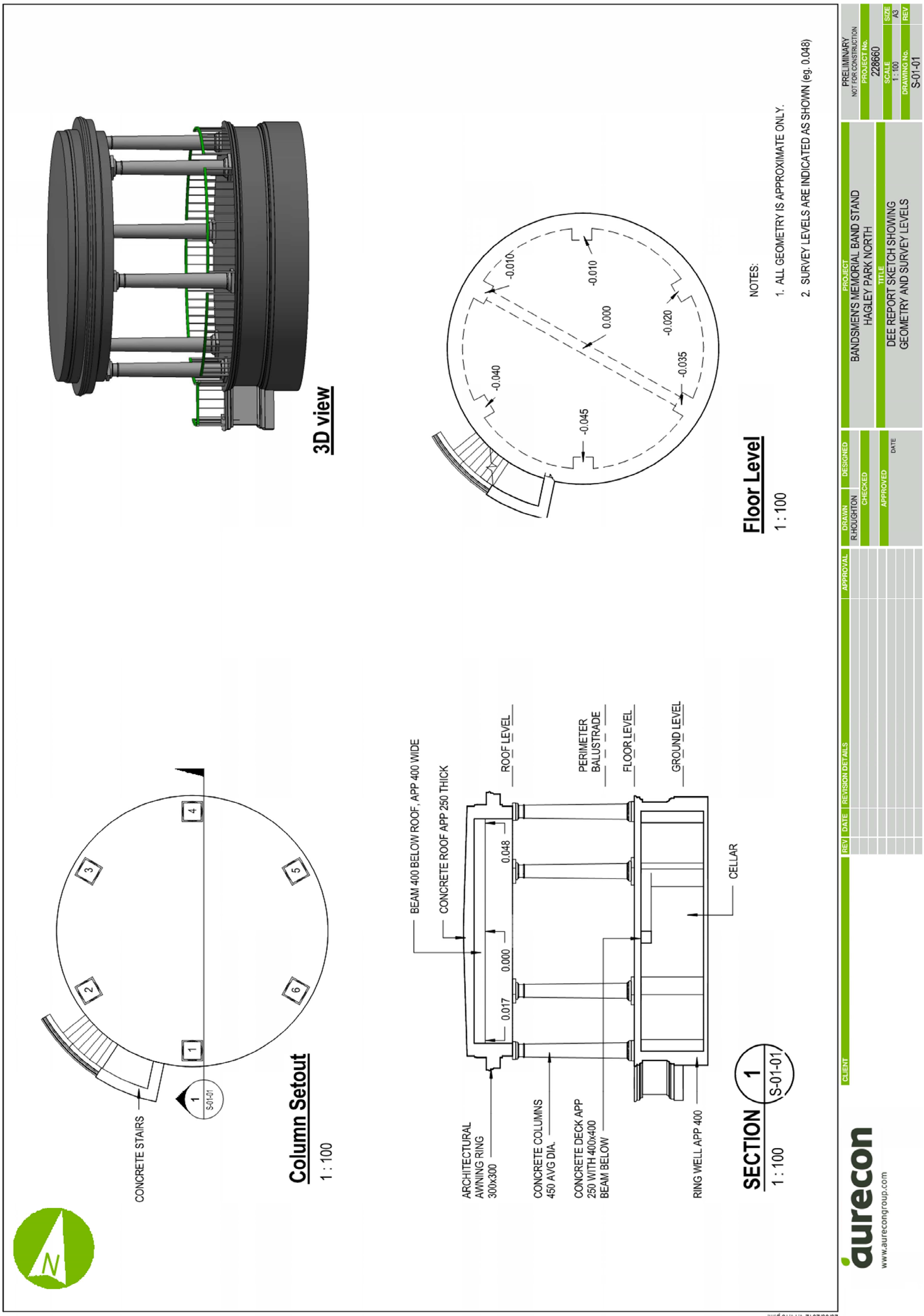
Appendix A
Site Map, Geometry, Levels Survey and Photos

25 May 2012, 10 July 2012 and 22 August 2012 – Hagley Park North – Band Rotunda Site Map, Geometry, Levels Survey and Photographs

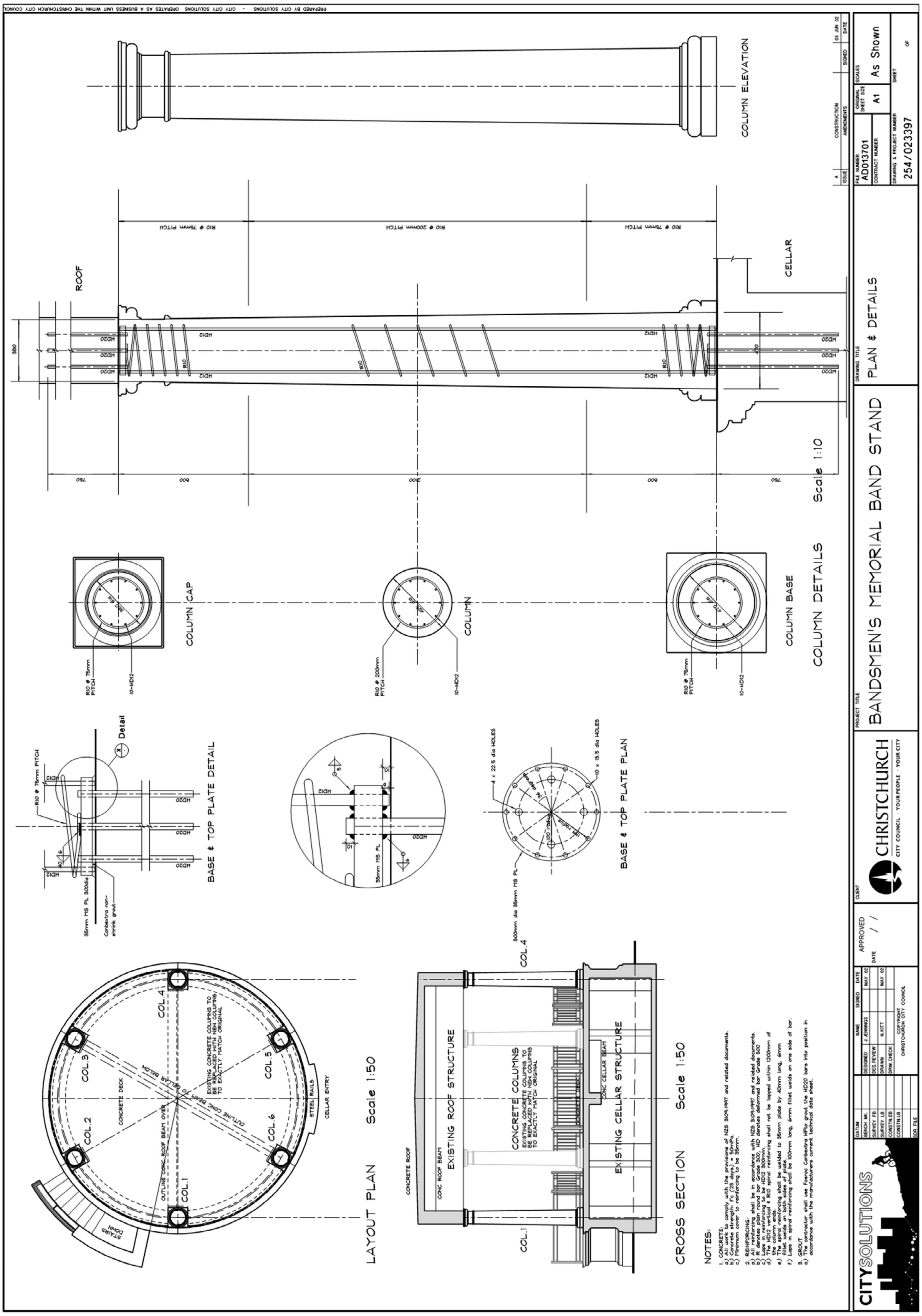
General Map (12 Sep 2012, Aerial photo sourced from LINZ © ®)



Local Map (12 Sep 2012, Aerial photo sourced from LINZ © ®)



Geometry and Survey Levels of the Structure



Available Column Details

(C/O Christchurch City Council)

Image 1. General view of the Hagley Park North – Band Rotunda.	
Image 2. General view 1 of the roof.	
Image 3. General view 2 of the roof.	
Image 4. General view 1 of the base.	

Image 5.

General view 2 of the base.

Image 6.

General view of the stair.

Image 7.

General view of the cellar entry.

Image 8.

Detail 1 of Column 1.

Image 9. Detail 2 of Column 1.	
Image 10. Detail 3 of Column 1.	
Image 11. Detail 4 of Column 1.	
Image 12. Detail 5 of Column 1.	

Image 13. Detail 6 of Column 1.	
Image 14. Detail 1 of Column 2.	
Image 15. Detail 2 of Column 2.	
Image 16. Detail 3 of Column 2.	

Image 17. Detail 4 of Column 2.	
Image 18. Detail 5 of Column 2.	
Image 19. Detail 6 of Column 2.	
Image 20. Detail 1 of Column 3.	

Image 21. Detail 2 of Column 3.	
Image 22. Detail 3 of Column 3.	
Image 23. Detail 4 of Column 3.	
Image 24. Detail 5 of Column 3.	

Image 25. Detail 6 of Column 3.	
Image 26. Detail 1 of Column 4.	
Image 27. Detail 2 of Column 4.	
Image 28. Detail 3 of Column 4.	

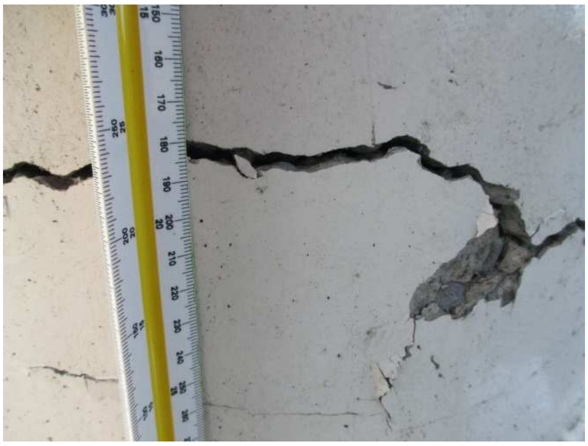
Image 29. Detail 4 of Column 4.	
Image 30. Detail 5 of Column 4.	
Image 31. Detail 6 of Column 4.	
Image 32. Detail 7 of Column 4.	

Image 33.

Detail 8 of Column 4.

Image 34.

Detail 1 of Column 5.

Image 35.

Detail 2 of Column 5.

Image 36.

Detail 3 of Column 5.

Image 37. Detail 4 of Column 5.	
Image 38. Detail 5 of Column 5.	
Image 39. Detail 6 of Column 5.	
Image 40. Detail 7 of Column 5.	

Image 41. Detail 1 of Column 6.	
Image 42. Detail 2 of Column 6.	
Image 43. Detail 3 of Column 6.	

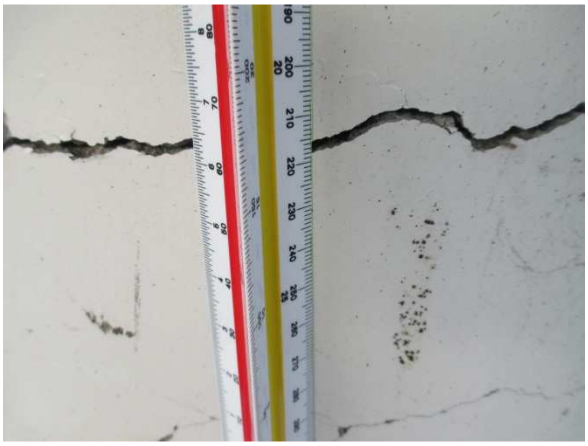
Image 44. Detail 4 of Column 6.	
Image 45. Detail 5 of Column 6.	
Image 46. Detail 6 of Column 6.	

Image 47. Detail 7 of Column 6.	
Image 48. Detail 8 of Column 6.	
Image 49. Detail 1 of the roof.	
Image 50. Detail 2 of the roof.	

Image 51. Detail 1 of the base.	
Image 52. Detail 2 of the base.	
Image 53. Detail 3 of the base.	
Image 54. Detail 1 of the stair.	

Image 55.

Detail 2 of the stair.

Image 56.

Detail 3 of the stair.

Image 57.

Detail 1 of the reference stone.

Image 58.

Detail 1 of the reference cellar.

Image 58. Detail 2 of the reference cellar.	
Image 59. Detail 3 of the reference cellar.	
Image 60. Detail 4 of the reference cellar.	
Image 61. Detail 5 of the reference cellar.	

Appendix B
References

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

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

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

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

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

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

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

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

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

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

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

Appendix C
Strength Assessment Explanation

New Building Standard (NBS)

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

Earthquake Prone Buildings

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

Christchurch City Council Earthquake Prone Building Policy 2010

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

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

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

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

Christchurch Seismicity

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

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

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

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

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

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

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

Table C1: Relative Risk of Building Failure In A

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

Appendix D
Background and Legal Framework

Background

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

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

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

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

Compliance

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

Canterbury Earthquake Recovery Authority (CERA)

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

Section 38 – Works

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

Section 51 – Requiring Structural Survey

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

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

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

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

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

Building Act

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

Section 112 – Alterations

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

Section 115 – Change of Use

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

Section 121 – Dangerous Buildings

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

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

Section 122 – Earthquake Prone Buildings

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

Section 124 – Powers of Territorial Authorities

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

Section 131 – Earthquake Prone Building Policy

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

Christchurch City Council Policy

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

The 2010 amendment includes the following:

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

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

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

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

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

Building Code

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

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

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

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

Appendix E
Standard Reporting Spread Sheet

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Hagley Park North - Band Rotunda	Reviewer:	Lee Howard
	Unit / No: / Street	CPEng No:	1008889
Building Address:	6 Riccarton Avenue	Company:	Aurecon
Legal Description:	RS 41181	Company project number:	228660
	Degrees / Min / Sec	Company phone number:	03 366 0821
GPS south:	43 / 31 / 57.55	Date of submission:	11/10/2013
GPS east:	172 / 37 / 18.84	Inspection Date:	22/08/2012
		Revision:	2
Building Unique Identifier (CCC):	PRK_1190_BLDG_033	Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	mixed	Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
Proximity to waterway (m, if <100m):		If Ground improvement on site, describe:	
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	5.00

Building

No. of storeys above ground:	2 (single storey = 1)	Ground floor elevation (Absolute) (m):	4.40
Ground floor split?	no	Ground floor elevation above ground (m):	-0.60
Storeys below ground	0		
Foundation type:	strip footings	if Foundation type is other, describe:	
Building height (m):	8.00	height from ground to level of uppermost seismic mass (for IEP only) (m):	8
Floor footprint area (approx):	55		
Age of Building (years):	87	Date of design:	Pre 1935
Strengthening present?	yes	If so, when (year)?	2002
		And what load level (%g)?	
Use (ground floor):	public	Brief strengthening description:	Column replacement
Use (upper floors):			
Use notes (if required):	community hall		
Importance level (to NZS1170.5):	IL3		

Gravity Structure

Gravity System:	frame system		
Roof:	concrete	slab thickness (mm)	
Floors:	concrete flat slab	slab thickness (mm)	
Beams:	cast-insitu concrete	overall depth x width (mm x mm)	
Columns:	precast concrete	typical dimensions (mm x mm)	
Walls:	load bearing concrete	#N/A	

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	other (note)		describe system	nominally ductile moment frame
Ductility assumed, μ:	1.25			
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	nominally ductile moment frame
Ductility assumed, μ:	1.25			
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:	exposed structure	describe	
Roof Cladding:	Other (specify)	describe	exposed structure
Glazing:	other (specify)		steel balustrades
Ceilings:	none		
Services(list):	Electrical cables		

Available documentation

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

Damage

Site: (refer DEE Table 4-2)

Site performance:	Good	Describe damage:	
Settlement:	none observed	notes (if applicable):	
Differential settlement:	1:350-1:250	notes (if applicable):	
Liquefaction:	none apparent	notes (if applicable):	
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	none apparent	notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	100%	Describe how damage ratio arrived at:	
	Describe (summary):			
Across	Damage ratio:			
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	no	Describe:	

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

Recommendations

	Level of repair/strengthening required:	significant structural and strengthening	Describe:	Replacement of columns
	Building Consent required:	yes	Describe:	As above
	Interim occupancy recommendations:	do not occupy	Describe:	Existing damage beyond safe levels
Along	Assessed %NBS before e'quakes:	17% ##### %NBS from IEP below	If IEP not used, please detail assessment methodology:	DEE
	Assessed %NBS after e'quakes:			
Across	Assessed %NBS before e'quakes:	17% ##### %NBS from IEP below		
	Assessed %NBS after e'quakes:			

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): Pre 1935 — h_n from above: 8m

Seismic Zone, if designed between 1965 and 1992: — not required for this age of building; not required for this age of building

	along	across
Period (from above):	0.4	0.4
(%NBS)nom from Fig 3.3:		

Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0

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

Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0)

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

2.2 Near Fault Scaling Factor

	along	across
Near Fault scaling factor, from NZS1170.5, cl 3.1.6:		
Near Fault scaling factor (1/N(T,D), **Factor A**:	#DIV/0!	#DIV/0!

2.3 Hazard Scaling Factor

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

2.4 Return Period Scaling Factor

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

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)		
Ductility scaling factor: =1 from 1976 onwards; or =kμ, if pre-1976, fromTable 3.3:		
Ductiity Scaling Factor, **Factor D**:	0.00	0.00

2.6 Structural Performance Scaling Factor:

Sp:		
Structural Performance Scaling Factor **Factor E**:	#DIV/0!	#DIV/0!

2.7 Baseline %NBS, $(NBS\%)_b = (\%NBS)_{nom}$ x A x B x C x D x E **$\%NBS_b$:** **#DIV/0!** **#DIV/0!**

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

3.1. Plan Irregularity, factor A: insignificant 1

3.2. Vertical irregularity, Factor B: insignificant 1

3.3. Short columns, Factor C: insignificant 1

3.4. Pounding potential

Pounding effect D1, from Table to right:

Height Difference effect D2, from Table to right:

Therefore, Factor D: 0

3.5. Site Characteristics insignificant 1

Table for selection of D1	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
Alignment of floors within 20% of H	**0.7**	**0.8**	**1**
Alignment of floors not within 20% of H	**0.4**	**0.7**	**0.8**

Table for Selection of D2	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
Height difference > 4 storeys	0.4	0.7	1
Height difference 2 to 4 storeys	0.7	0.9	1
Height difference < 2 storeys	1	1	1

3.6. Other factors, Factor F

	Along	Across
For ≤ 3 storeys, max value =2.5, otherwise max valule =1.5, no minimum		
Rationale for choice of F factor, if not 1		

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)

List any: Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

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!**

Official Use only:

Accepted By

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