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Owner Occupied HP Smith Courts

Quantitative Engineering Evaluation

Functional Location ID: PRO 0675

Address: 66 Perth Street, Christchurch

Reference:

237696

Prepared for:

Christchurch City Council

Revision: 2

Date: 27 September 2013

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Approval			
Author Signature		**Approver Signature**	
Name	Manoochehr Ardalany	**Name**	Eric Simeone
Title	Structural Engineer	**Title**	Senior Structural Engineer

Contents

Appendices

Executive Summary – Residential Building

This is a summary of the Quantitative Engineering Evaluation for the Owner Occupied HP Smith Courts which 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**	Owner Occupied HP Smith Courts			
Building Location ID	PRO 0675 B001			**Multiple Building Site**	Y
Building Address	66 Perth Street, Christchurch			**No. of residential units**	2
Soil Technical Category	TC2	**Importance Level**	2	**Year Built**	1984
Foot Print (m²)	125	**Storeys above ground**	1	**Storeys below ground**	0
Type of Construction	Chip coated tiles, lightweight timber roof with purlins and rafters, plasterboard ceiling, plasterboard walls, perimeter concrete foundation on piles.				

Quantitative L5 Report Results Summary		
Building Occupied	Y	The Owner Occupied HP Smith Courts is currently in use.
Suitable for Continued Occupancy	Y	The Owner Occupied HP Smith Courts is considered suitable for continued occupancy.
Key Damage Summary	Y	Refer to summary of building damage in Section 3.1 report body.
Critical Structural Weaknesses (CSW)	N	No critical structural weaknesses were identified.
Levels Survey Results	Y	The Levels were within tolerable limits for the building.
Building %NBS From Analysis	37%	Limited by in plane shear capacity of the plasterboard walls.

Approval			
Author Signature		**Approver Signature**	
Name	Manoochehr Ardalany	**Name**	Eric Simeone
Title	Structural Engineer	**Title**	Structural Engineer

Executive Summary - Garages

This is a summary of the Quantitative Engineering Evaluation for the Owner Occupied HP Smith Courts Garages which 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**	Owner Occupied HP Smith Courts Garages			
Building Location ID	PRO 0675 B002			**Multiple Building Site**	Y
Building Address	66 Perth Street, Christchurch			**No. of residential units**	-
Soil Technical Category	TC2	**Importance Level**	2	**Year Built**	1984
Foot Print (m²)	39	**Storeys above ground**	1	**Storeys below ground**	0
Type of Construction	Corrugated steel sheeting, lightweight timber roof, precast concrete panels and perimeter concrete foundation on piles.				
Quantitative L5 Report Results Summary					
Building Occupied	Y	The Owner Occupied HP Smith Courts is currently in use.			
Suitable for Continued Occupancy	Y	The Owner Occupied HP Smith Courts is considered suitable for continued occupation.			
Key Damage Summary	Y	Refer to summary of building damage in Section 3.1 report body.			
Critical Structural Weaknesses (CSW)	N	No critical structural weaknesses were identified.			
Levels Survey Results	Y	Levels were within allowable limits.			
Building %NBS From Analysis	35%	Given by moment capacity of the concrete piers.			
Approval					
Author Signature	M Ardalany	**Approver Signature**	Eric Simeone		
Name	Manoochehr Ardalany	**Name**	Eric Simeone		
Title	Structural Engineer	**Title**	Structural Engineer		

1 Introduction

1.1 General

On 6 August 2013, Aurecon engineers visited the Owner Occupied HP Smith Courts 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 if the building is currently occupied
- Assessment of requirements for detailed engineering evaluation including geotechnical investigation, level survey and any areas where linings and floor coverings need removal to expose structural damage.

This report outlines the results of our Quantitative Assessment of damage to the Owner Occupied HP Smith Courts 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.

There are a number of buildings located at Owner Occupied HP Smith Courts. This report covers units 19 and 20 and the adjacent garages.

2 Description of the Building

2.1 Building Age and Configuration

Built in 1984, the building at Owner Occupied HP Smith Courts is subdivided into two residential units which are separated with a concrete firewall. The residential building has a lightweight timber framed roof with the pitched roof which is covered by chip coated tiles. The timber framed walls are externally clad with a blockwork veneer and internally lined with plasterboard. The approximate total floor area of the building is 125 square metres.

The garage is also subdivided into two garages by a concrete wall. The garage has a lightweight timber framed flat roof. Internal and external walls are of precast concrete construction. The approximate total floor area of the garages is 39 square meters.

Both buildings are classified as Importance Level 2 structure according to NZS 1170 Part 0: 2002.

2.2 Building Structural Systems Vertical and Horizontal

For the residential building, vertical loads from the roof are resisted by the timber framed roof structure which transfers the vertical loads to the timber walls and then to the foundation. Horizontal loads from the roof diaphragm are resisted in both the along and across directions by the plasterboard lined timber framed walls which transfer the loads to the foundations.

For the garages, the vertical loads from the roof are transferred to the precast concrete panels which are founded on the concrete slab on grade. Horizontal loads are carried out by a combination of the concrete precast panels and the connections which are connected to the concrete slab on grade.

2.3 Reference Building Type

Originally built in 1984, the building at Owner Occupied HP Smith Courts is a timber framed building. Timber buildings have shown greater levels of building performance and resilience when compared to other buildings during earthquakes in 2010 and 2011 and aftershocks.

2.4 Building Foundation System and Soil Conditions

Both buildings have a concrete slab on grade foundation. The land in the area, based on Canterbury Geotechnical Database, is classified as "TC2" which means "minor to moderate land damage from liquefaction is possible in future significant earthquakes".

2.5 Available Structural Documentation and Inspection Priorities

Architectural/structural drawings for the Owner Occupied HP Smith Courts were provided by the Christchurch City Council designed by "Warren R. Lewis" with a design date of 1984 on the drawings.

The inspections were undertaken to understand the construction of the buildings and to identify any likely critical areas and potential damage such as cracking to the blockwork veneers and plasterboard walls.

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 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 2 m apart, or
2. If the variation in level over the floor plan is greater than 50 mm, 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.

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

The levels show that the following areas are out of the recommend level of 0.5 % by the Ministry of Business, Innovation and Employment (MBIE) dates December 2012 V3.

- In kitchen area of unit 1, a fall of 18 mm over an approximate length of 3 meters gives a slope of 0.6 %.
- In bedroom 2 of unit 1, a fall of 20 mm over an approximate length of 3 meters gives a slope of 0.7 %
- In bedroom 2 of unit 2, a fall of 28 mm over an approximate length of 3 meters gives a slope of 0.9 %.

Other areas of the building and the garages were within the recommend limit of 0.5%.

Since the building has a concrete slab on piles, the observed slopes are still within the tolerable limit for the building and no re-levelling is recommended.

3 Structural Investigation

3.1 Summary of Building Damage

Minimal damage was observed at the time of the inspection as shown in Appendix A. Damage noted included:

- Minor cracks in the mortar joints of the blockwork veneers
- Minor cracks around the timber beam moulding which crosses the lounge room
- Minor cracks in the plasterboard walls
- Deformation of the door frames in the kitchen area in the along direction (east-west direction).

Overall, the damage to the buildings was minor.

3.2 Record of Intrusive Investigation

Due to the generic nature of the Owner Occupied HP Smith Courts, a significant amount of structural information can be inferred from the building form and construction materials. As no significant damage was noted, an intrusive investigation was neither warranted nor undertaken for the Owner Occupied HP Smith Courts

3.3 Damage Discussion

The level of damage observed at Owner Occupied HP Smith Courts building is considered minor.

4 Building Review Summary

4.1 Building Review Statement

Not all of the primary structure at Owner Occupied HP Smith Courts was immediately visible. A non-intrusive damage assessment was undertaken under the justification that the damage to brittle non-structural elements, cladding and finishes for the building would indicate the level of damage to the primary structure.

4.2 Critical Structural Weaknesses

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

5 Building Strength (refer Appendix C for background information)

5.1 General

The buildings at Owner Occupied HP Smith Courts has well distributed walls and therefore performed well in the Canterbury earthquake sequence with the minor damage as referenced in section 3.

5.2 Existing Building Strength

We consider that the damage to the building has not resulted in any measurable reduction in the strength of the building and so our strength assessment is based on the pre-earthquake condition of the building. Selected assessment seismic parameters are tabulated 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
Ductility Factor μ	2	Timber framed walls
	1.25	Reinforced concrete precast walls

The seismic demand for Owner Occupied HP Smith Courts has been calculated based on the current code requirements of NZS 1170.5 (Structural Design Actions 1170.5:2004). The capacity of the existing walls in the building was calculated from the assumed strengths of the existing materials and the number and length of walls present for both the along and across directions. These values were compared with the calculated seismic demand. A summary of the building strength is presented in Table .

Table 2: Calculated % NBS

Member	NBS (%)	Comments
Residential building in the along direction (east-west direction)	52	Given by shear strength of the walls in the along direction
Residential building in the across direction (north-south direction)	57	Given by shear strength of the walls in the across direction
*Firewall between units 1 and 2 assuming roof diaphragm is connected to the fire wall	100	Given by out of plane capacity of the fire wall between the units
Firewall between units 1 and 2 assuming roof diaphragm is not connected to the fire wall	37	Given by out of plane capacity of the fire wall between the units
Garages in the along direction	35	Given by moment capacity of the concrete piers
Garages in the across direction	100	Given by shear capacity of the connections

*Note: We were not able to inspect the attic to verify if the diaphragm is connected to the firewall. If the diaphragm is connected then % NBS is 100% otherwise the %NBS is 37 %.

5.3 Results Discussion

The residential building has well distributed walls in the along and across directions. This increases the capacity of the building in the both directions.

The garage have concrete walls in the along and across directions but they do not have an appropriate roof diaphragm to transfer earthquake induced forces to the back walls in the along direction. The capacity is limited to the moment capacity of the piers which provide a strength of 35% NBS.

6 Conclusions and Recommendations

As noted within the body of the report the level survey has shown that floor levels for Owner Occupied HP Smith Courts are within tolerable limits.

As only low levels of visible damage were observed in the damage assessment, it is considered that the buildings at Owner Occupied HP Smith Courts are **suitable for continued occupancy**.

As there is no clear evidence of movement of the ground in the vicinity of the Owner Occupied HP Smith Courts **a geotechnical investigation is currently not considered necessary**.

Despite the fact that we were not able to confirm the connection between the gable blockwork veneer wall to the timber frame wall and the available drawings do not show any connections, we have assumed that the blockwork veneer is properly connected to the interior timber frame based on the lack of visible damage. Due to the heavy weight of the gable end blockwork veneers, we recommend that the gable blockwork veneers on the east and west side of the building are replaced with an equivalent lightweight cladding.

Strengthening of the building and garages is recommended. We recommend strengthening to 67% NBS or 100% NBS if possible. Strengthening would most likely involve installation of a cross-bracing for the roof of the garages and adding/replacing a number of walls in along and across directions for the residential building.

As part of the strengthening works, it is recommended that the following intrusive investigations are carried out to confirm the building strengths calculated:

- Connection between the firewall and roof diaphragm; and
- Connection between the timber diaphragm and the firewall.

We recommend all damage is repaired by a licensed building practitioner. The repair work should include the followings:

- Grout repair cracking to the masonry joints;
- Cracking to internal wall and ceiling fibrous plaster linings should be repaired similar to that used for GIB linings in accordance with GIB 'Guidelines for repairing GIB plasterboard linings in wind and earthquake damaged properties'; and
- Re-hanging the frames of the doors which do not operate well.

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 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 strengthened, that decision is the sole responsibility of the client.

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

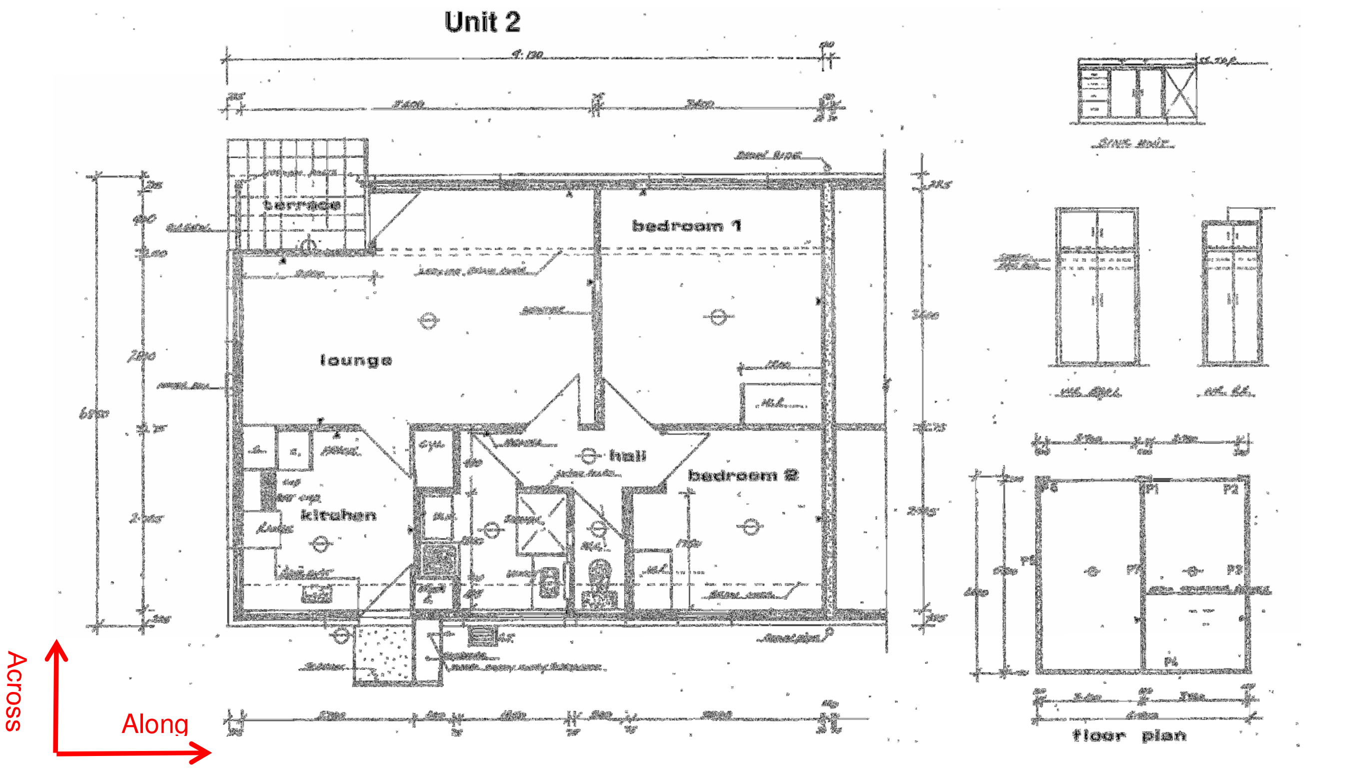
Without limiting any of the above, Aurecon's liability, whether under the law of contract, tort, statute, equity or otherwise, is limited as set out in the terms of the engagement with the client.

Appendices

Appendix A

Plan, Photos and Levels Survey

Site photographs (6 August 2013)



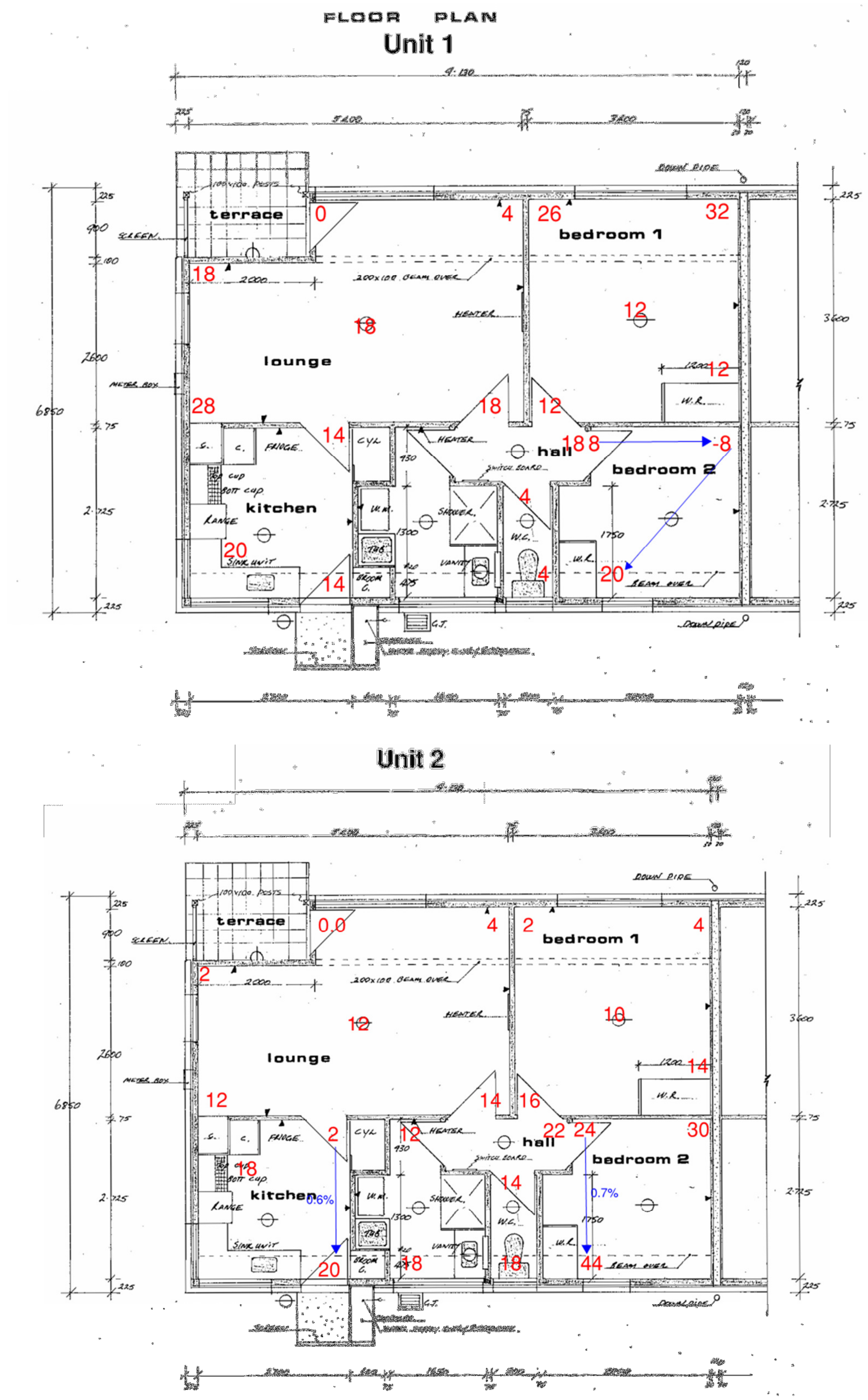
Residential buiding	
North view of the building.	

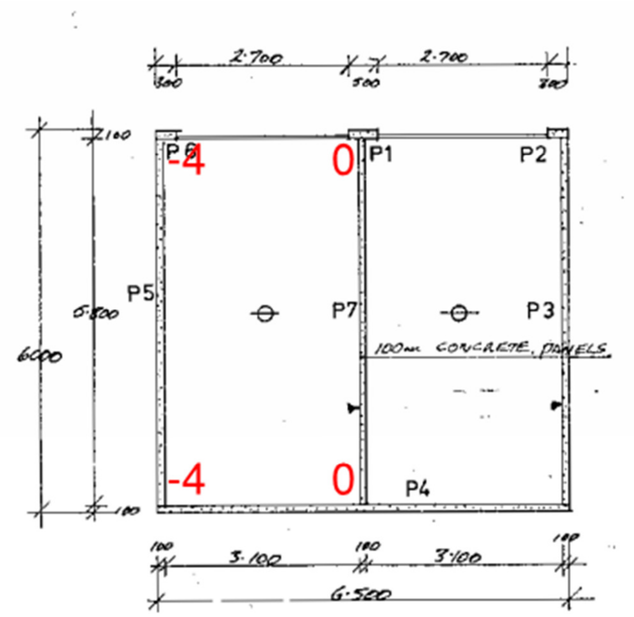
Cracks in the blockwork veneer covered by a paper tape.	
Cracks in the corner of the moulding.	
Cracks in the plasterboard wall at the corner of windows.	

Garages	
North view of the garages.	
Timber framed roof of the garage.	
Roof of the garage.	

Precast wall to precast wall connection.	

Level survey – Residential Building



Level survey – garages


Appendix B

References

- Standards New Zealand, “AS/NZS 1170: Parts 0,1 and 5 and commentaries”

- Standards New Zealand, “NZS 3101:2006, Concrete Structures Standard”

- Standards New Zealand, “NZS 3404:1997, Steel Structures Standard”

- Standards New Zealand, “NZS 3604:2011: Timber Framed Structures”

- Standards New Zealand, “NZS 4229:1999, Concrete Masonry Buildings Not Requiring Specific Design”

- Standards New Zealand, “NZS 4230:2004, Design of Reinforced Concrete Masonry Structures”

- New Zealand Society for Earthquake Engineering (NZSEE), “Assessment and Improvement of the Structural Performance of Buildings in Earthquakes, June 2006”

- Engineering Advisory Group, “Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-Residential Buildings in Canterbury. Part 2 Evaluation Procedure. Revision 5, 19 July 2011”

Appendix C
Strength Assessment Explanation

New building standard (NBS)

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

Earthquake Prone Buildings

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

Christchurch City Council Earthquake Prone Building Policy 2010

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

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

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

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

Christchurch Seismicity

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

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

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

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

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

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

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

Table C1: Relative Risk of Building Failure In A

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

Appendix D
Background and Legal Framework

Background

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

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

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

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

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

Compliance

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

Canterbury Earthquake Recovery Authority (CERA)

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

Section 38 – Works

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

Section 51 – Requiring Structural Survey

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

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

The qualitative assessment is a desk-top and site inspection assessment. It is based on a thorough visual inspection of the building coupled with a review of available documentation such as drawings and specifications.

The quantitative assessment involves analytical calculation of the buildings strength and may require non-destructive or destructive material testing, geotechnical testing and intrusive investigation.

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

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

Building Act

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

Section 112 – Alterations

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

Section 115 – Change of Use

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

Section 121 – Dangerous Buildings

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

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

Section 122 – Earthquake Prone Buildings

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

Section 124 – Powers of Territorial Authorities

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

Section 131 – Earthquake Prone Building Policy

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

Christchurch City Council Policy

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

The 2010 amendment includes the following:

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

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

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

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

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

Building Code

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

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

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

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

Appendix E

Standard Reporting Spread Sheet

PRO 0675 B001 Owner Occupied HP Smith Courts

PRO 0675 B002 Owner Occupied HP Smith Courts Garages

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	O/O HP Smith Courts	Reviewer:	Lee Howard
Building Address:	Unit: Units 19 and 20; No: 66; Street: Perth Street	CPEng No:	1008889
Legal Description:		Company:	Aureon
		Company project number:	237696
		Company phone number:	33660821
GPS south:	Degrees 43, Min 31, Sec 9.07	Date of submission:	27/09/2013
GPS east:	Degrees 172, Min 39, Sec 15.56	Inspection Date:	6/08/2013
		Revision:	2
Building Unique Identifier (CCC):	PRO 0675 B001	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):	

Building

No. of storeys above ground:	1 (single storey = 1)	Ground floor elevation (Absolute) (m):	
Ground floor split?	no	Ground floor elevation above ground (m):	
Storeys below ground	0		
Foundation type:	strip footings	if Foundation type is other, describe:	
Building height (m):	2.50	height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	125		
Age of Building (years):	22	Date of design:	1976-1992
Strengthening present?	no	If so, when (year)?	
		And what load level (%g)?	
Use (ground floor):	public	Brief strengthening description:	
Use (upper floors):			
Use notes (if required):			
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber framed	rafter type, purlin type and cladding	about 1400, timber, chip coated tiles
Floors:			100
Beams:	timber	type	Timber
Columns:			
Walls:			

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	lightweight timber framed walls			
Ductility assumed, μ:	2.00		note typical wall length (m)	
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:	lightweight timber framed walls			
Ductility assumed, μ:	2.00		note typical wall length (m)	
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:			none
Wall cladding:	brick or tile	describe (note cavity if exists)	Blockwork
Roof Cladding:	Other (specify)	describe	Chip coated tiles
Glazing:	timber frames		
Ceilings:	plaster, fixed		
Services(list):			

Available documentation

Architectural	partial	original designer name/date	CCC/1984
Structural	partial	original designer name/date	CCC/1984
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:	25-100m	notes (if applicable):	Values from levels of the buildings
Differential settlement:	none observed	notes (if applicable):	
Liquefaction:	none apparent	notes (if applicable):	Some liquefaction in the area
Lateral Spread:		notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	slight	notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):			
Across	Damage ratio:	0%		
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	no	Describe:	

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

Recommendations

	Level of repair/strengthening required:	significant structural		Describe:	Repair of the cracks in the floor/ Strengtheing
	Building Consent required:	yes		Describe:	
	Interim occupancy recommendations:	full occupancy		Describe:	
Along	Assessed %NBS before e'quakes:	52%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology:	Quantitative
	Assessed %NBS after e'quakes:	52%			
Across	Assessed %NBS before e'quakes:	37%	##### %NBS from IEP below		
	Assessed %NBS after e'quakes:	37%			

IEP Use of this method is not mandatory - more detailed analysis may give a different answer, which would take precedence. Do not fill in fields if not using IEP.

Period of design of building (from above): 1976-1992

h_n from above: 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

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

2.6 Structural Performance Scaling Factor:

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

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

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

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

3.1. Plan Irregularity, factor A: 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:

Height Difference effect D2, from Table to right:

Therefore, Factor D: 0

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

3.5. Site Characteristics 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:

	along	across
PAR x Baselline %NBS:	**#DIV/0!**	**#DIV/0!**

4.4 Percentage New Building Standard (%NBS), (before) **#DIV/0!**

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	O/O HP Smith Courts Garages	Reviewer:	Lee Howard
	Unit / No: 66 / Street: Perth Street	CPEng No:	1008889
Building Address:	Garages for Units 19 and 20	Company:	Aureon
Legal Description:		Company project number:	237696
		Company phone number:	33660821
	Degrees / Min / Sec		
GPS south:	43 / 31 / 8.62	Date of submission:	27/09/2013
GPS east:	172 / 39 / 13.51	Inspection Date:	6/08/2013
		Revision:	1
Building Unique Identifier (CCC):	PRO 0675 B002	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):	

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m):
Ground floor split?	no		Ground floor elevation above ground (m):
Storeys below ground	0		
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):	39		
Age of Building (years):	29		Date of design: 1976-1992
Strengthening present?	no		If so, when (year)?
			And what load level (%g)?
Use (ground floor):	parking		Brief strengthening description:
Use (upper floors):			
Use notes (if required):			
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	steel framed	rafter type, purlin type and cladding	
Floors:	concrete flat slab	slab thickness (mm)	
Beams:			None
Columns:			None
Walls:	load bearing concrete	#N/A	

Lateral load resisting structure

Lateral system along:	concrete shear wall	**Note: Define along and across in detailed report!**	enter wall data in "IEP period calcs" worksheet for period calculation	
Ductility assumed, μ:	1.25			
Period along:	0.40	##### enter height above at H31	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	concrete shear wall		enter wall data in "IEP period calcs" worksheet for period calculation	
Ductility assumed, μ:	1.25			
Period across:	0.40	##### enter height above at H31	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	

Separations:

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

Non-structural elements

Stairs:			None
Wall cladding:			Tilt up panel
Roof Cladding:	Metal	describe	None
Glazing:			None
Ceilings:			None
Services(list):			

Available documentation

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

Damage

Site: (refer DEE Table 4-2)

Site performance:	Good	Describe damage:	
Settlement:	0-25mm	notes (if applicable):	Values from levels of the building
Differential settlement:	none observed	notes (if applicable):	
Liquefaction:	none apparent	notes (if applicable):	
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	none apparent	notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):			
Across	Damage ratio:	0%		
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	no	Describe:	

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

Recommendations

	Level of repair/strengthening required:	significant structural	Describe:	Roof cross bracing
	Building Consent required:	yes	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before e'quakes:	35%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology: Quantitative
	Assessed %NBS after e'quakes:	35%		
Across	Assessed %NBS before e'quakes:	100%	##### %NBS from IEP below	
	Assessed %NBS after e'quakes:	100%		

IEP **Use of this method is not mandatory - more detailed analysis may give a different answer, which would take precedence. Do not fill in fields if not using IEP.**

Period of design of building (from above): 1976-1992

h_n from above: m

Seismic Zone, if designed between 1965 and 1992: B

not required for this age of building: D soft soil

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

2.6 Structural Performance Scaling Factor:

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

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

$\%NBS_b$:	**#DIV/0!**	**#DIV/0!**

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

3.1. Plan Irregularity, factor A:	insignificant	1
3.2. Vertical irregularity, Factor B:	insignificant	1
3.3. Short columns, Factor C:	insignificant	1

3.4. Pounding potential

Pounding effect D1, from Table to right	1.0
Height Difference effect D2, from Table to right	1.0
Therefore, Factor D:	1

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

3.5. Site Characteristics		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!**

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