Proctor Place

Quantitative Engineering Evaluation

Functional Location ID: PRO 0589

Address: 64 Proctor Street, Papanui

Reference: 232538

Prepared for:

Christchurch City Council

Revision: 2

Date: 17 April 2014

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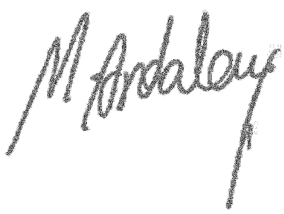
Contents

Appendices

Executive Summary (Housing Unit)

This is a summary of the Quantitative Engineering Evaluation for the Proctor Place 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**	Proctor Place – Housing Unit			
Building Location ID	PRO 0589 B001			**Multiple Building Site**	Y
Building Address	64 Proctor Street, Papanui			**No. of residential units**	5
Soil Technical Category	TC2	**Importance Level**	2	**Approximate Year Built**	1991
Foot Print (m²)	266	**Storeys above ground**	Mixed of 1 and 2	**Storeys below ground**	0
Type of Construction	Light weight roof consisting of timber trusses, post-tensioned concrete slab first floor bearing on precast concrete tilt-up wall panels, a ground floor with a slab-on-grade and the foundations are concrete pile caps on timber piles.				
Quantitative L5 Report Results Summary					
Building Occupied	Y	The Proctor Place is currently occupied.			
Suitable for Continued Occupancy	Y	The Proctor Place is suitable for continued use.			
Key Damage Summary	Y	Refer to summary of building damage Section 3.1 report body.			
Critical Structural Weaknesses (CSW)	N	No critical structural weaknesses were identified.			
Levels Survey Results	Y	Survey shows floor levels are within MBIE guideline limits.			
Building %NBS From Analysis	32%	Based on analysis of bracing and capacity.			
Approval					
Author Signature		Approver Signature			
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Title	Structural Engineer	Title	Senior Structural Engineer		

Executive Summary (Garage Unit)

This is a summary of the Quantitative Engineering Evaluation for Garage 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**	Proctor Street – Garage Unit			
Building Location ID	PRO 0589 B002			**Multiple Building Site**	Y
Building Address	64 Proctor Place			**No. of residential units**	NA
Soil Technical Category	TC2	**Importance Level**	2	**Approximate Year Built**	1991
Foot Print (m²)	58	**Storeys above ground**	1	**Storeys below ground**	0
Type of Construction	Light weight roof consisting of timber trusses, a ground floor with a slab-on-grade and the foundation is a continuous perimeter wall on timber piles.				
Quantitative L5 Report Results Summary					
Building Occupied	Y	The garage is currently used.			
Suitable for Continued Occupancy	Y	The garages are suitable for continued use.			
Key Damage Summary	Y	Refer to summary of building damage Section 3.1 report body.			
Critical Structural Weaknesses (CSW)	N	No critical structural weaknesses were identified.			
Levels Survey Results	Y	Survey shows floor levels are within MBIE guideline limits.			
Building %NBS From Analysis	62	Based on analysis of bracing and capacity.			
Approval					
Author Signature		Approver Signature			
Name	Manoochehr Ardalany	Name	Lee Howard		
Title	Structural Engineer	Title	Senior Structural Engineer		

1 Introduction

1.1 General

On 27 January 2014 Aurecon engineers visited the Proctor Place to undertake a quantitative building damage assessment on behalf of the 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 Proctor Place 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.

2 Description of the Building

2.1 Building Age and Configuration

The Proctor Place is a two storey residential property which was constructed in 1991. The building is a mix of concrete and timber construction. The building has a light weight roof made of timber trusses, a first floor consisting of precast post-tensioned concrete slab bearing on precast concrete tilt-up wall panels and a slab-on-grade for the ground floor. The foundations are made of a foundation wall supported by concrete pile caps on timber piles as per structural drawings.

The building has an approximate floor area of 266 square metres. It is considered as an importance level 2 structure in accordance with AS/NZS 1170.0:2002.

The complex also includes a separate garage, which has an approximate floor area of 58 square metres consisting of timber trusses bearing on timber-framed walls. The foundations are made of a perimeter concrete wall on timber piles.

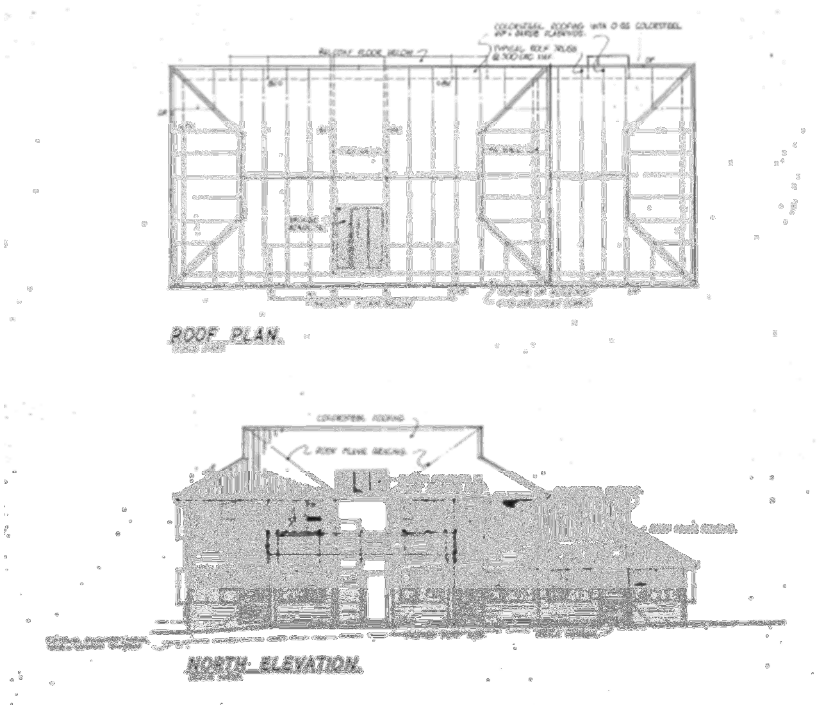


Figure 1: Roof plan and typical elevation of residential units.

2.2 Building Structural Systems Vertical and Horizontal

The Proctor Place is of concrete and timber construction. The gravity loads from the timber framed roof are transferred to the first storey via timber framed walls. The first storey consists of precast concrete panels bearing on concrete precast tilt-up panel walls. The loads from the ground floor are resisted by the concrete floor slab supported on piles.

The lateral load resisting system is simple. The lateral loads in both principal directions are resisted by concrete walls.

For the separate garage building, the timber framed walls resist both vertical and lateral loads. The loads are resisted by the concrete floor slab on piles.

2.3 Reference Building Type

The Proctor Place is of concrete tilt-up panel construction typical of the 1980s and 1990s. A general overview of the reference building type, construction era and likely earthquake risk is presented in Figure 2. The Proctor Place is a tilt panel multi-storey building from 1991 and according to Figure 2 may have some issues.

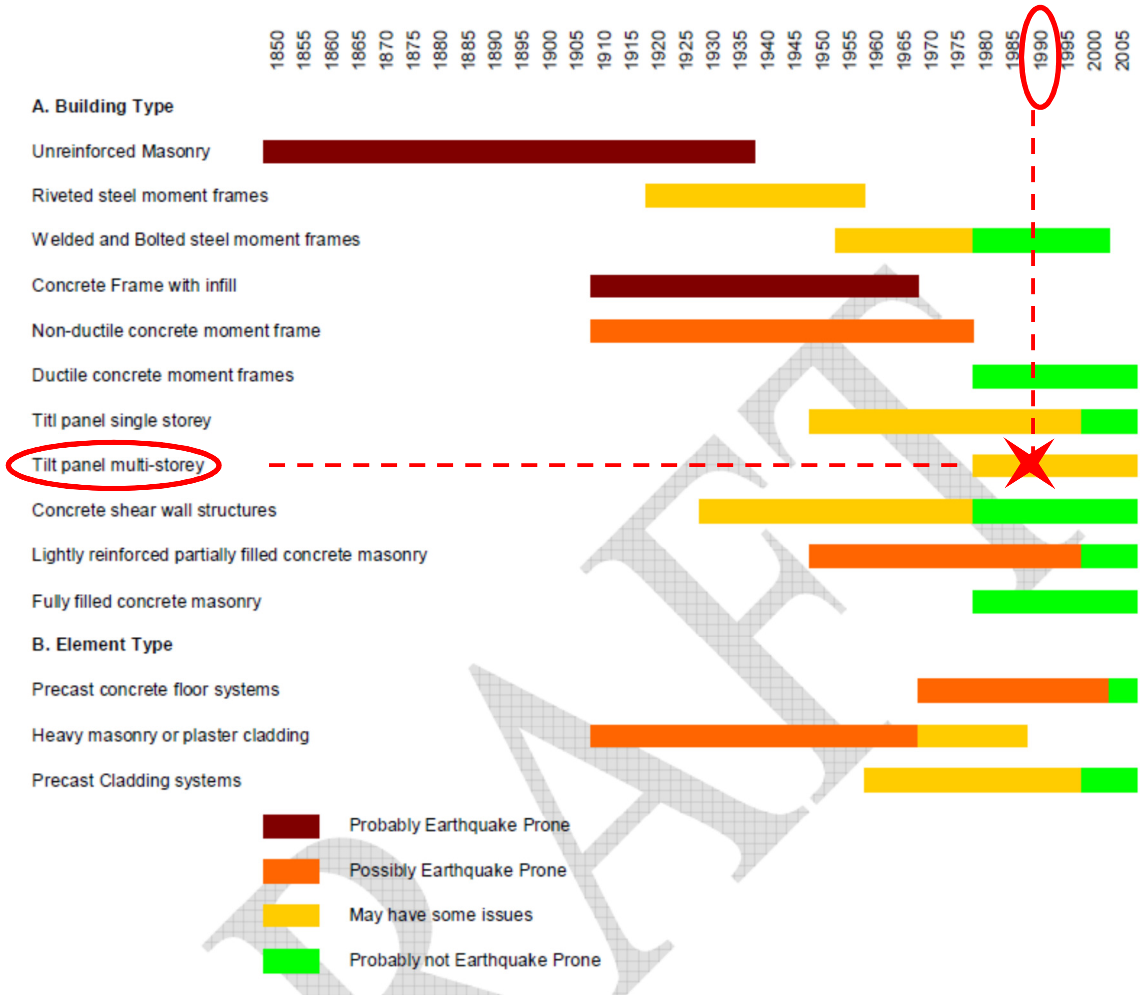


Figure 2: Timeline showing the building types, approximate time of construction and likely earthquake risk. (From the Draft Guidance on DEEs of non-residential buildings by the Engineering Advisory Group)

2.4 Building Foundation System and Soil Conditions

The land at 64 Proctor Street, Papanui based on Canterbury Geotechnical Database is classified as Technical Category 2 (TC2), which is characterized as “minor to moderate land damage from liquefaction is possible in future significant earthquakes”.

Bore holes which were carried out before the construction of the housing unit show that the natural soil is comprised of approximately 0.3m of top soil, 0.5m of clay and from 0.8m to the end of the bore hole at a depth of 4m the soil is a mix of pug and peat. During construction the topsoil was removed and replaced with backfill which consisted of compacted pitrun. The building foundations for both the garage and the housing units consist of 350mm isolated cast in place concrete piles caps which are bearing on a series of 150 SED H5D timber piles. The ground floor consists of a concrete slab-on-grade reinforced with reinforcement mesh.

2.5 Available Structural Documentation and Inspection Priorities

Fully detailed architectural and structural drawings including the separate garage building were available for 64 Proctor Street.

The inspection priorities included; exterior walls, timber structure of roof, structural slab of first floor, slabs on grade, brickwork, interior linings and all architectural elements in order to identify potential structural weaknesses.

2.6 Available Survey Information

A floor level survey was undertaken to establish the level of unevenness across the floors. The results of the survey are presented on the attached drawing 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 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 re-building 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.

The floor levels for the Proctor Place are considered to be acceptable, the tolerance were exceeded in some areas where it was due to either floor coverings or where a floor was intentionally sloping towards a drain.

The floor levels also for garages were within acceptable limits.

3 Structural Investigation

3.1 Summary of Building Damage

Both building and garages suffered limited damage following the earthquakes of 2011, with the overall buildings conditions remaining almost the same as before the earthquakes. The observations that were made during Aurecon’s visit on 27 January 2014 are as follows:-

Buildings:

- Minor cracks in the interior linings, mainly around doors and windows.
- Cracks in the exterior concrete foundation wall.
- Cracks in concrete slab on grade.
- Previous report by OPUS (see Appendix F) revels that some voids exists under the floor slab of the building and the soil around the building has dropped by 100 mm.

Note: we were not able to inspect all of the units.

Garages:

- Minor cracks in the concrete floor.
- The pavement in front of the garage has settled approximately 50 mm creating a step when entering the garage.

3.2 Record of Intrusive Investigation

There was limited damage to the building and therefore, an intrusive investigation was neither warranted nor undertaken for Proctor Place.

3.3 Damage Discussion

Minor seismic related damage as addressed in section 3.1 was noted in the damage assessment.

4 Building Review Summary

4.1 Building Review Statement

As noted above no intrusive investigations were carried out for the Proctor Place. It was not deemed necessary to do so, as fully detailed architectural and structural drawings were available.

4.2 Critical Structural Weaknesses

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

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

5.1 General

The Proctor Place is a concrete tilt-up panel construction with a timber truss roof. The building has well distributed walls in Across direction, which improves the behaviour of the building in Across direction. The building has performed well in Canterbury earthquake despite minor damaged which explained in section 3.

The separate garage building is of standard timber construction. The garage has well distributed walls in both principal directions and it has performed well in the Canterbury earthquake.

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 pre-earthquake condition of the buildings. Selected assessment parameters are presented in Table 1.

Table 1: Parameters used in the Seismic Assessment for housing complex

Seismic Parameter	Quantity	Comment/Reference
Site Soil Class	D	NZS 1170.5:2004, Clause 3.1.3, Deep or Soft Soil
Site Hazard Factor, Z	0.30	DBH Info Sheet on Seismicity Changes (Effective 19 May 2011)
Return period Factor, R_u	1.00	NZS 1170.5:2004, Table 3.5, Importance Level 2 Structure with a Design Life of 50 years
Ductility Factor (μ)	1.25	Concrete pre-cast panel, SESOC recommendation no 8, September 2012
Ductility Factor (μ)	2.0	Gib braced wall (AS/NZS 1170.4, Table (6.5(A))

The seismic demand for 64 Proctor Street, Papanui 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 the walls present for both the along and across directions. These values were compared with the calculated seismic demand. The %NBS results are summarized in Table 2.

Table 2: Calculated %NBS values

Label	Direction	NBS (%)	Comments
Residential units	Along	32	Given by capacity of the concrete panel
Residential units	Across	64	Given by capacity of the plasterboard walls
Garages	Along	62	Given by capacity of the plasterboard walls
Garages	Across	100	Given by capacity of the shear walls

Note: Along and Across directions are shown in Appendix A.

5.3 Comparison with Results of the Qualitative Assessment

At the request of the council a qualitative assessment of the building strength was carried out at an earlier stage with the report issued on 14 March 2013. This qualitative report identified the strength of the building based on the Initial Evaluation Procedure (IEP).

The qualitative report for Proctor place indicated a strength of 84%NBS. At the time this was carried out it was decided that the %NBS was in correlation with the minimal damage noted on site and therefore a L5 Quantitative assessment was not recommended. This is significantly higher than the strength in the Along direction stated above and the discrepancy is due to a lack of shear walls to carry the horizontal loads in the Along direction. In the Across direction there are significantly more shear walls and therefore the strength is much closer to the value obtained in the IEP.

The IEP process can often give inaccurate answers in circumstances like this (see IEP process description below). Detailed calculation will always give a more accurate answer as the process investigates the building strength in significantly more detail. It is also of note that some of the parameters used in the qualitative assessment could be considered non-conservative following updated information from SESOC since the qualitative assessment was carried out.

<u>IEP Process</u>

The IEP procedure was developed by the New Zealand Society for Earthquake Engineering (NZSEE) in 2006 as a tool to assign a percentage of New Building Standard (*%NBS*) score and associated grade to a building to facilitate an initial coarse screening of existing buildings.

The IEP process enables territorial authorities, building owners and managers to review their building stock as part of an overall risk management process.

Characteristics of the IEP process are: -

- It is a relatively quick first-stage review that is generally considered to establish a lower bound performance level. Buildings or specific issues which the IEP process flags as being problematic, need further detailed investigation and evaluation.
- It tends to be somewhat conservative identifying some buildings as earthquake prone, or having a lower *%NBS* score, which a subsequent detailed investigation may indicate is less than actual performance. However, there can be exceptions, particularly when critical structural weaknesses (CSWs) are present or there is a lack of seismic resiting systems that are not discovered during the IEP process or cannot be recognised from what is largely a visual assessment of the building.
- It assumes the buildings have been designed and built in accordance with the building standard and good practice current at the time. In some instances, a building may include design features ahead of its time - leading to better than predicted performance. Conversely, some unidentified design or construction issues not picked up by the IEP process may result in the building performing not as well as predicted.
- It is a largely qualitative process, and is assumed to be undertaken by an experienced engineer. It involves considerable knowledge of the earthquake behaviour of buildings, and judgement as

to key attributes and their effect on building performance. Consequently, it is possible that the *%NBS* derived for a building by independent experienced engineers may differ.

- Experience to date is that the IEP is a useful tool to identify potential issues and to identify buildings worthy of further investigation.
- An IEP does not take into account the seismic performance of secondary structural items such as ceilings, equipment restraints, services supports or glazing systems.

6 Conclusions and Recommendations

Building at 64 Proctor Street, Papanui have been assessed as having a capacity of 32% NBS and no critical structural weaknesses were found. It is considered that the building is **suitable for continued occupancy**. Strengthening is recommended for the building in the along direction. We recommend strengthening to 67% NBS or 100% NBS if possible. Strengthening works would most likely involve design and installation of shear walls or portal frames for the building in the along direction.

In addition to strengthening, repair works should include:

- Cracks in the perimeter concrete foundation should be repaired by epoxy injection.
- Cracks in the perimeter concrete slab on grade should be repaired by epoxy injection.
- Cracks in internal walls and ceiling fibrous plaster linings should be repaired similar to that used for Gib linings in accordance with “Gib guidelines for preparing Gib plasterboard linings in wind and earthquake damaged properties”.
- In line with the previous report by OPUS (see Appendix F) we recommend a geotechnical report is obtained for the building, the ground around the building be built up again and possible voids under floor to be filled. The Geotechnical engineer should comment on the procedure and different options for filing the voids.

The garages have been assessed as having a capacity of 62% and no critical structural weaknesses were found. Therefore, it is considered that the garages are **suitable for continued occupation**. Strengthening is recommended to 67% NBS or 100% NBS if possible for the garages. Strengthening works would likely involve installation of a diaphragm in the roof of the garage.

In addition to strengthening, repair works should include:

- Cracks in the concrete floor should be repaired by epoxy injection.

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.

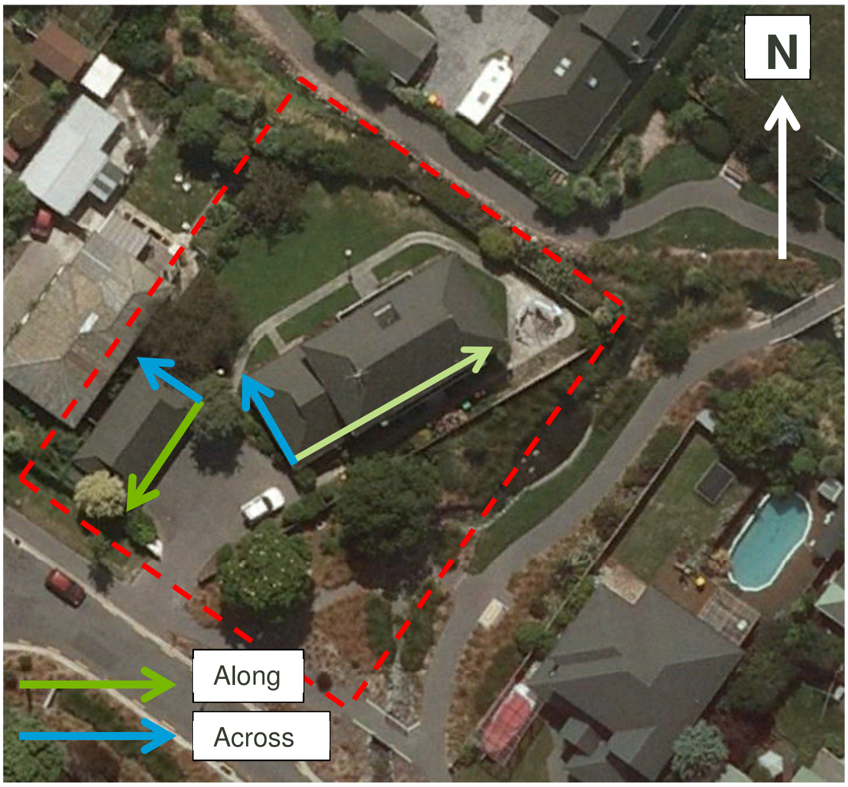
This review has been prepared by Aurecon at the request of its client and is exclusively for the client's use. It is not possible to make a proper assessment of this review without a clear understanding of the terms of engagement under which it has been prepared, including the scope of the instructions 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
Site Location, Photos and Levels Survey

27 January 2014 – Proctor Place Site Photographs



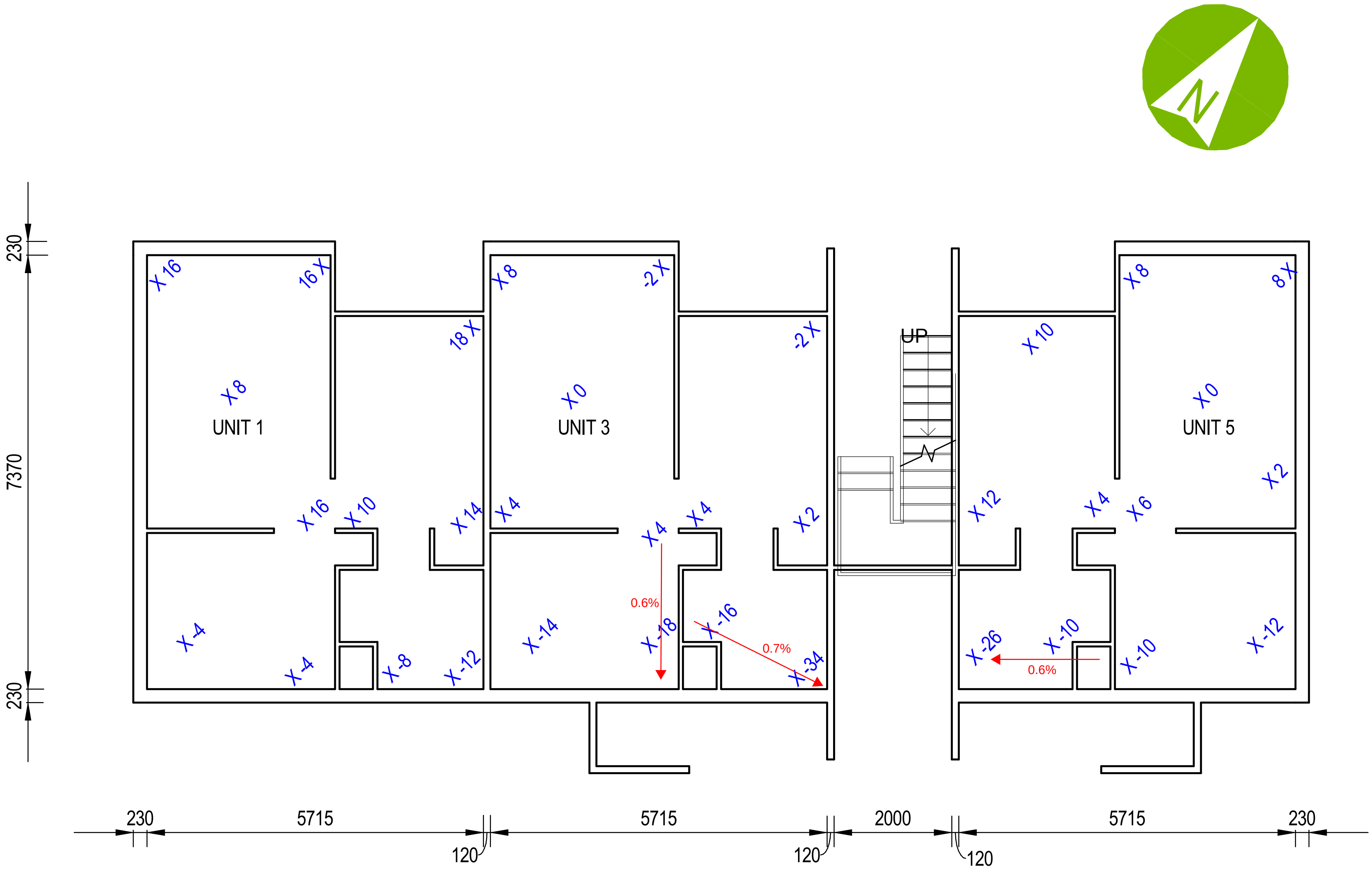
Builing location and north elevation of the building

Building units	
Cracks in interior lining around window.	
Cracks in interior lining around window.	
Cracks in exterior concrete foundation.	

Cracks in concrete slab-on-grade.	
Cracks in concrete slab in the ground floor.	
Cracks in concrete slab in the garage.	

Garages	
View of the garage trusses.	
View of the garage roof bracings.	
View of pavement which has sustained some differential settlements.	

Cracks in the concrete floor of the garages.	



NOTE:
ALL VALUES ARE IN mm
ALL SLOPES ARE APPROXIMATE

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DRAWN	DESIGNED
D.HUNIA	I.OLECHNOWICZ
CHECKED	
L.CASTILLO	
APPROVED	DATE
L.CASTILLO	

PROJECT: PROCTOR PLACE HOUSING

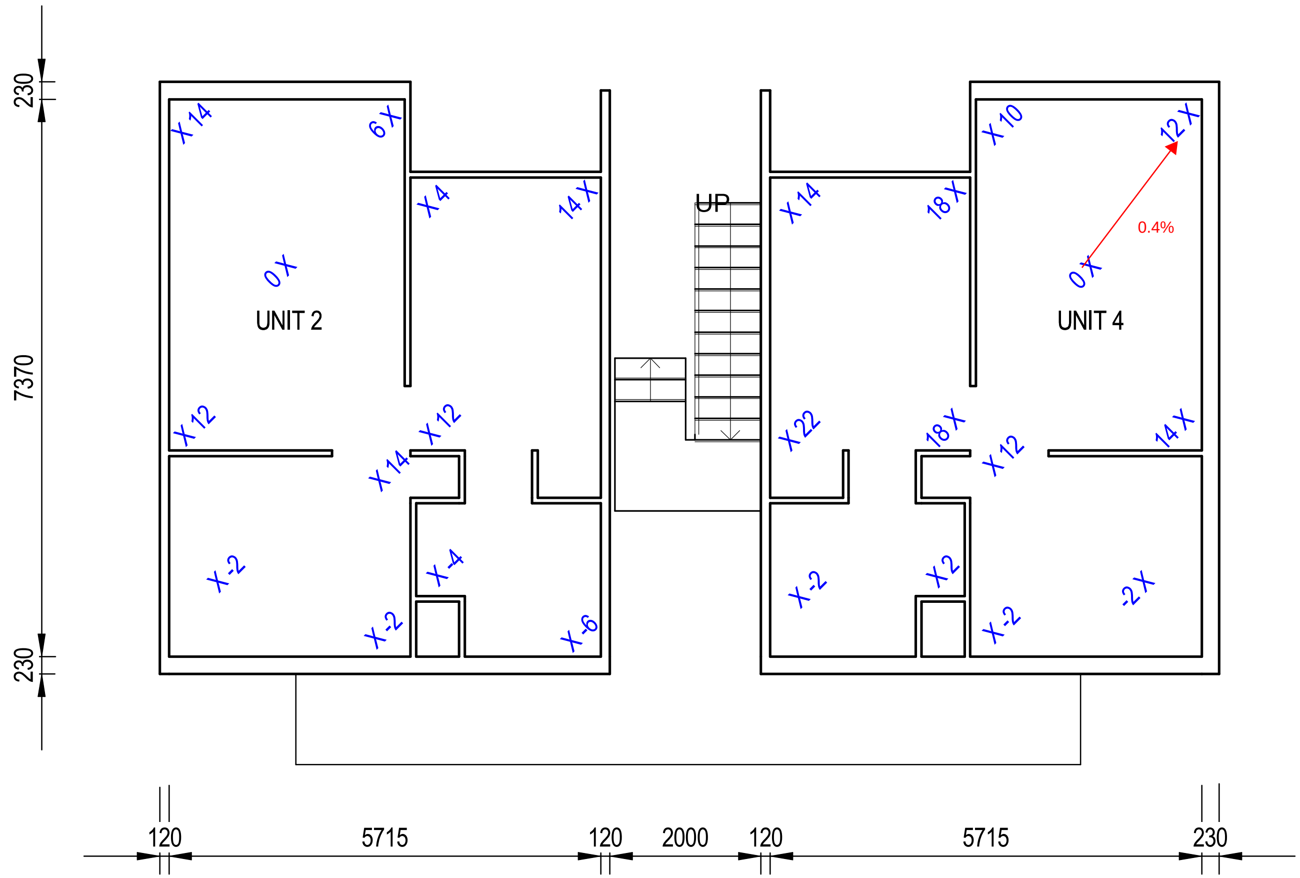
TITLE: FLOOR LEVEL SURVEY
UNIT 1, 3 AND 5

PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT No.: 232538

SCALE: 1 : 100 | SIZE: A4

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



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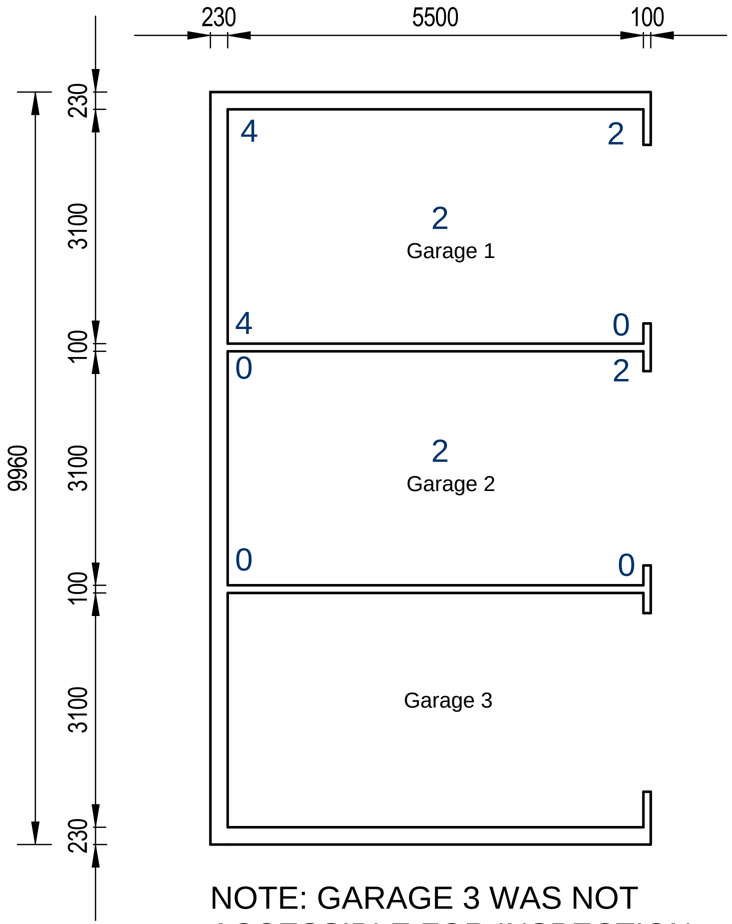
DRAWN: D.HUNIA
DESIGNED: I.OLECHNOWICZ
CHECKED: L.CASTILLO
APPROVED: L.CASTILLO
DATE

PROJECT: PROCTOR PLACE HOUSING
TITLE: FLOOR LEVEL SURVEY UNITS 2 AND 4

PRELIMINARY
NOT FOR CONSTRUCTION
PROJECT No.: 232538
SCALE: 1 : 100
SIZE: A4
DRAWING No.: S-01-01
REV



NOTE: GARAGE 3 WAS NOT ACCESSIBLE FOR INSPECTION

NOTE:
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DESIGNED: I.OLECHNOWICZ
CHECKED: L.CASTILLO
APPROVED: L.CASTILLO
DATE

PROJECT: PROCTOR PLACE HOUSING
TITLE: GARAGE MEASURE UP

PRELIMINARY
NOT FOR CONSTRUCTION
PROJECT No.: 232538
SCALE: 1 : 100
SIZE: A4
DRAWING No.: S-01-02
REV

Appendix B
References

1. Ministry of Business, Innovation, and Employment (MBIE) version 3, December 2013.
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. SESOC recommendation, no 8, September 2012

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

PRO 0589 B001 – Proctor Place Housing Unit

PRO 0589 B002 – Proctor Place Garage Unit

Detailed Engineering Evaluation Summary Data V1.9

Location

Building Name:	Proctor Place Housing	Reviewer:	Lee Howard
	Unit / No: 64 / Street: Proctor Street	CPEng No:	108889
Building Address:	64 Proctor Street	Company:	Aurecon
Legal Description:		Company project number:	232538
		Company phone number:	03 375 0761
GPS south:	Degrees 43, Min 29, Sec 43.60	Date of submission:	17-Apr-14
GPS east:	Degrees 172, Min 36, Sec 46.00	Inspection Date:	27-Jan-14
		Revision:	1
Building Unique Identifier (CCC):		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):	10.00

Building

No. of storeys above ground:	2 (single storey = 1)	Ground floor elevation (Absolute) (m):	10.00
Ground floor split?	yes	Ground floor elevation above ground (m):	0.20
Storeys below ground	0		
Foundation type:	PILES	if Foundation type is other, describe:	Timber piles
Building height (m):	8.10	height from ground to level of uppermost seismic mass (for IEP only) (m):	8.1
Floor footprint area (approx):	266		
Age of Building (years):	23	Date of design:	1976-1992
Strengthening present?	no	If so, when (year)?	
		And what load level (%g)?	
Use (ground floor):	multi-unit residential	Brief strengthening description:	
Use (upper floors):	multi-unit residential		
Use notes (if required):			
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber truss	truss depth, purlin type and cladding	2400, timber, brickwork & weatherboard
Floors:	precast concrete with topping	unit type and depth (mm), topping	
Beams:	precast concrete	overall depth (mm)	
Columns:			
Walls:	load bearing concrete	#N/A	

Lateral load resisting structure

East-west	Lateral system along:	concrete shear wall	note total length of wall at ground (m):	6.5
	Ductility assumed, μ:	1.25	wall thickness (m):	0.12
	Period along:	0.40 (0.49 from parameters in sheet)	estimate or calculation?	estimated
	Total deflection (ULS) (mm):		estimate or calculation?	
	maximum interstorey deflection (ULS) (mm):		estimate or calculation?	
North-south	Lateral system across:	concrete shear wall	note total length of wall at ground (m):	34
	Ductility assumed, μ:	1.25	wall thickness (m):	0.12
	Period across:	0.40 (0.05 from parameters in sheet)	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:	cast insitu	notes	
Wall cladding:	exposed structure	describe	concrete shear walls
Roof Cladding:	Metal	describe	
Glazing:	timber frames		
Ceilings:	plaster, fixed		
Services(list):			

Available documentation

Architectural	full	original designer name/date	City works
Structural	full	original designer name/date	City works
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:	None
Settlement:	none observed	notes (if applicable):	
Differential settlement:	none observed	notes (if applicable):	
Liquefaction:	none apparent	notes (if applicable):	
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	none apparent	notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	zero	Describe how damage ratio arrived at:	no damage
	Describe (summary):	none		
Across	Damage ratio:	0%		
	Describe (summary):	none		
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	yes	Describe:	minor

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

Recommendations

Level of repair/strengthening required:	significant structural	Describe:	shear wall/portal frame for longitudinal direction
Building Consent required:	yes	Describe:	
Interim occupancy recommendations:	full occupancy	Describe:	

Along	Assessed %NBS before:	32%	##### %NBS from IEP below
	Assessed %NBS after:	32%	
Across	Assessed %NBS before:	64%	##### %NBS from IEP below
	Assessed %NBS after:	64%	

IEP

Age of Building (from above): 1976-1992

h_n from above: 8.1m

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 buildings designed prior to 1976 as public buildings, to code at time, use 1.25
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

Near Fault scaling factor, from NZS1170.5, Table 3.3):

	along	across
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 3.3)		
Ductility scaling factor (if pre-1976):		
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:

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
Date:

Detailed Engineering Evaluation Summary Data V1.9

Location

Building Name:	Proctor Place Garage	Reviewer:	Lee Howard
	Unit No: Street	CPEng No:	108889
Building Address:	64 Proctor Street	Company:	Aurecon
Legal Description:		Company project number:	232538
		Company phone number:	03 375 0761
	Degrees / Min / Sec		
GPS south:	43 / 29 / 43.60	Date of submission:	17-Apr-14
GPS east:	172 / 36 / 46.00	Inspection Date:	27-Jan-14
		Revision:	2
Building Unique Identifier (CCC):		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):	10.00

Building

No. of storeys above ground:	1	single storey = 1 / Ground floor elevation (Absolute) (m):	10.00
Ground floor split?	yes	Ground floor elevation above ground (m):	
Storeys below ground	0		
Foundation type:	Slab on piles	if Foundation type is other, describe:	Timber piles
Building height (m):	2.40	height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	58		
Age of Building (years):	23	Date of design:	1976-1992
Strengthening present?	no	If so, when (year)?	
		And what load level (%g)?	
Use (ground floor):	other (specify)	Brief strengthening description:	
Use (upper floors):	other (specify)		
Use notes (if required):			
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber truss	truss depth, purlin type and cladding	2400, timber
Floors:	concrete flat slab	slab thickness (mm)	200
Beams:			
Columns:			
Walls:			

Lateral load resisting structure

East-west

Lateral system along:	lightweight timber framed walls	note typical wall length (m)	5.8
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?	

North-south

Lateral system across:	lightweight timber framed walls	note typical wall length (m)	10
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:	brick or tile	describe (note cavity if exists)	
Roof Cladding:	Metal	describe	
Glazing:			
Ceilings:			
Services(list):			

Available documentation

Architectural	full	original designer name/date	City works
Structural	full	original designer name/date	City works
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:	None
Settlement:	none observed	notes (if applicable):	
Differential settlement:	none observed	notes (if applicable):	
Liquefaction:	none apparent	notes (if applicable):	
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	none apparent	notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	zero	Describe how damage ratio arrived at:	no damage
	Describe (summary):	none		
Across	Damage ratio:	0%		
	Describe (summary):	none		
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	yes	Describe:	minor

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

Recommendations

Level of repair/strengthening required:	none	Describe:	
Building Consent required:	no	Describe:	
Interim occupancy recommendations:	full occupancy	Describe:	

Along	Assessed %NBS before:	62%	##### %NBS from IEP below
	Assessed %NBS after:	62%	
Across	Assessed %NBS before:	100%	##### %NBS from IEP below
	Assessed %NBS after:	100%	

IEP

Age 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 buildings designed prior to 1976 as public buildings, to code at time, use 1.25
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

Near Fault scaling factor, from NZS1170.5, Table 3.3:

	along	across
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 3.3)		
Ductility scaling factor (if pre-1976):		
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, $(NBS\%)_b = (\%NBS)_{nom}$ x A x B x C x D x 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:

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
Date:

Appendix F

Report by OPUS

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29 November 2013

Christchurch City Council

Proctor Street Social Housing Inspection

The Proctor Street Social Housing complex was inspected by Opus International Consultants on Friday 29th November 2013.

Our findings differed to those indicated in the original report:

1. The ground was found to have lowered by approximately 100mm on the western end of the complex and up to 200mm on the eastern end. Voids were located under the floor which were large enough to fit an arm under, refer to the photo below.

2. It is probable that a crack found in the foundations goes through unit 3 and is evident on the slab under the stairs.
3. Upon entering units 3 and 5, a hollow sound was created when tapping a line in the kitchen and bathroom. This indicates a void under the floor slab.
4. A stream flows around along Eastern and Southern sides of the complex. It is possible that two springs may exist, as evident by the surrounding surface water during a dry weather period.
5. There is evidence of extensive damage to surrounding paths as they have recently been rebuilt. Some are showing signs of cracks due to inadequate foundations.

It is considered that the building in its current state has a significant loss of passive soil resistance which should be reinstated.

We recommend that an investigation be carried out to fully document these findings but for the purposes of determining a likely repair cost then the following should be priced:-

1. The foundation on the east side and half way along the north and south sides have the footing extended as shown on the attached sketch 1.

2. The ground around the buildings be built up again to the level shown on the original plans.
3. The voids under the slab are filled with an impermeable low viscosity concrete.
4. The springs are investigated by a geotechnical engineer and may form part of a land claim.

Regards

Mary Ann Halliday

Senior Structural Engineer

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