Allison Courts

Quantative Engineering Evaluation

Reference: 233414

Prepared for:

Christchurch City Council

Functional Location ID: BU 1113 EQ2

Address: 40 Brougham Street

Revision: 1

Date: 27 November 2015

Document Control Record

Document prepared by:

Aurecon New Zealand Limited
Level 2, 518 Colombo Street
Christchurch 8011

PO Box 1061
Christchurch 8140
New Zealand

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

Document control						aurecon
Report Title		Quantative Engineering Evaluation				
Functional Location ID		**BU 1113 EQ2**	**Project Number**		233414	
File Path		P:\ 233414 - Allison Courts.docx				
Client		Christchurch City Council	**Client Contact**		Simon Wadey	
Rev	**Date**	**Revision Details/Status**	**Prepared**	**Author**	**Verifier**	**Approver**
1	**27 November 2015**	Final	J. Bruins	J. Bruins	L. Howard	L. Howard
Current Revision	**1**					

Approval			
Author Signature		Approver Signature	
Name	J. Bruins	Name	L. Howard
Title	Structural Engineer	Title	Senior Structural Engineer

Contents

Appendices

Executive Summary – Block A

This is a summary of the Quantative Engineering Evaluation for the Allison Courts buildings 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**	Allison Courts – Two Storey Building Block A			
Building Location ID	BU 1113 EQ2			**Multiple Building Site**	Y
Building Address	40 Brougham Street			**No. of residential units**	3
Soil Technical Category	TC2	**Importance Level**	2	**Approximate Year Built**	1975
Foot Print (m²)	92	**Storeys above ground**	2	**Storeys below ground**	0
Type of Construction	Mixed system of Concrete blockwork walls and Timber Framed walls with light weight roof and suspended concrete floor slab.				

Quantative L5 Report Results Summary		
Building Occupied	Y	The two storey residential buildings are currently occupied.
Suitable for Continued Occupancy	Y	The two storey residential buildings are suitable for continued use.
Key Damage Summary	Y	Refer to summary of building damage Section 3.1 of the report body.
Critical Structural Weaknesses (CSW)	N	No critical structural weaknesses were identified.
Levels Survey Results	Y	Survey shows floor levels are within MBIE guidance limits.
Building %NBS From Analysis	>67%	Based on demand/capacity calculations. See Table 2 on Section 5.3

Quantative L5 Report Recommendations		
Geotechnical Investigation Required	N	Geotechnical investigation not required due to lack of observed ground damage on site.

Approval			
Author Signature		Approver Signature	
Name	J. Bruins	Name	L. Howard
Title	Structural Engineer	Title	Senior Structural Engineer

Executive Summary – Block B

This is a summary of the Quantative Engineering Evaluation for the Allison Courts buildings 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**	Allison Courts – Two Storey Building – Block B			
Building Location ID	BU 1113 EQ2			**Multiple Building Site**	Y
Building Address	40 Brougham Street			**No. of residential units**	6
Soil Technical Category	TC2	**Importance Level**	2	**Approximate Year Built**	1975
Foot Print (m^2)	184	**Storeys above ground**	2	**Storeys below ground**	0
Type of Construction	Mixed system of Concrete blockwork walls and Timber Framed walls with light weight roof and suspended concrete floor slab.				

Qualitative L5 Report Results Summary		
Building Occupied	Y	The two storey residential building is currently occupied.
Suitable for Continued Occupancy	Y	The two storey residential building is suitable for continued use.
Key Damage Summary	Y	Refer to summary of building damage Section 3.1 of the report body.
Critical Structural Weaknesses (CSW)	N	No critical structural weaknesses were identified.
Levels Survey Results	Y	Survey shows floor levels are within MBIE guidance limits.
Building %NBS From Analysis	>67%	Based on demand/capacity calculations. See Table 2 on Section 5.3

Qualitative L5 Report Recommendations		
Geotechnical Investigation Required	N	Geotechnical investigation not required due to lack of observed ground damage on site.

Approval			
Author Signature		Approver Signature	
Name	Joshua Bruins	Name	L. Howard
Title	Structural Engineer	Title	Structural Engineer

Executive Summary – Garages

This is a summary of the Quantative Engineering Evaluation for the Allison Courts buildings 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**	Allison Courts – Garages			
Building Location ID	BU 1113 EQ2			**Multiple Building Site**	Y
Building Address	40 Brougham Street			**No. of residential units**	NA
Soil Technical Category	TC2	**Importance Level**	1	**Approximate Year Built**	1975
Foot Print (m²)	18	**Storeys above ground**	1	**Storeys below ground**	0
Type of Construction	Concrete block work walls with light weight timber truss roof.				
Quantative L5 Report Results Summary					
Building Occupied	Y	The garages are 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 of the report body.			
Critical Structural Weaknesses (CSW)	N	No critical structural weaknesses were identified.			
Building %NBS From Analysis	100%	Based on demand/capacity calculations. See Table 2 on Section 5.3			
Quantative L5 Report Recommendations					
Geotechnical Investigation Required	N	Geotechnical Investigation not required due to lack of observed ground damage on site.			
Approval					
Author Signature		Approver Signature			
Name	Joshua Bruins	Name	L. Howard		
Title	Structural Engineer	Title	Senior Structural Engineer		

1 Introduction

1.1 General

On 4 December 2012 Aurecon engineers visited the Allison Courts to undertake a qualitative building damage assessment on behalf of Christchurch City Council. Detailed visual inspections were carried out to assess the damage caused by the earthquakes on 4 September 2010, 22 February 2011, 13 June 2011, 23 December 2011 and related aftershocks.

A qualitative report was issued dated 27 May 2013.

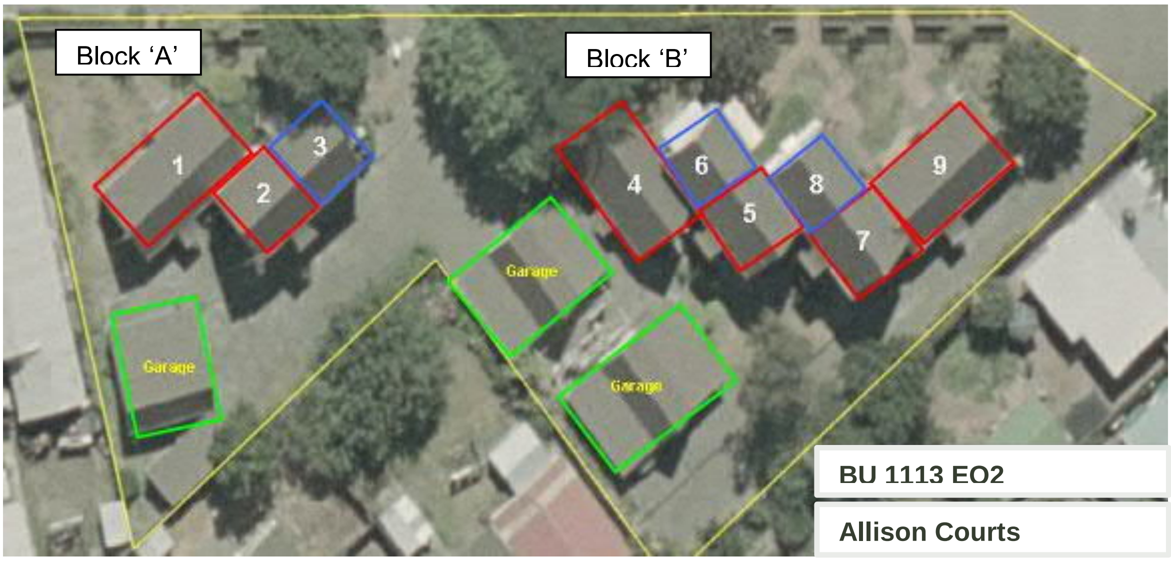
On 18 November 2015 Aurecon engineers re-visited Allison Courts to confirm the findings of the qualitative report in order to provide a quantative building damage assessment on behalf of the Christchurch City Council.

This report outlines the results of our quantative assessment of damage to the Allison 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.

2 Description of the Building

2.1 Building Age and Configuration

The Allison Courts are residential properties consisting of two building blocks: Block 'A' (units 1 - 3), and Block 'B' (units 4 - 9) and separate garage modules. They were all built in 1975.



Both blocks are of similar construction type; a mix of partially filled and reinforced concrete masonry blockwork and timber framed walls. The roof is of light weight corrugated metal sheeting supported by timber trusses. On the two storey sections the first level is a concrete precast slab with insitu topping. The foundations are shown on the drawings as slab on grade concrete floor with shallow concrete perimeter wall footings. Block 'A' has an approximate floor area of 92m² and Block 'B' has an approximate floor area of 184m².

The garages are made of partially filled and reinforced concrete masonry blockwork with a corrugated metal roof on timber trusses, a slab on grade concrete floor with shallow concrete perimeter wall footings. Each garage has an approximate floor area of the 18m².

Blocks 'A' and 'B' are considered to be importance level 2 structures in accordance with AS/NZS 1170 Part 0:2002, and garages are considered importance level 1 structures.

2.2 Building Structural Systems Vertical and Horizontal

For the one-storey sections of Block A and B the load from the timber framed roof is transferred to timber framed walls and to the foundations. The lateral load resistance is provided by the gypsum lining on the timber framed walls in both directions. For the two-storey sections, the lateral load resistance, for both directions, is provided on the first floor by the gypsum lining on the timber framed walls and by the concrete masonry blockwork walls at the ground floor. The blockwalls have a comparatively greater stiffness than the timber framed walls and attract lateral load through the diaphraghm provided by the concrete suspended slab. It follows that the one storey sections of both Block A and B do not attract load from the two storey portion of the building.

For the separate garage buildings, the concrete masonry blockwork walls resist both vertical and lateral loads which come from the roof structure.

2.3 Building Foundation System and Soil Conditions

The Allison Courts buildings are used for residential purposes on Technical Category 2 (TC2) land. According to CERA, TC2 land is considered to "incur minor to moderate land damage from liquefaction". No land damage was observed during the visual inspection.

The foundations for the three types of buildings are shown on the drawings as shallow concrete perimeter wall footings with concrete slab-on-grade.

2.4 Available Structural Documentation and Inspection Priorities

Partial architectural and structural drawings for Allison Courts buildings including the separate garage buildings were available. These drawings were dated December 1975 and prepared by the Christchurch City Council.

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

2.5 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 "Technical Guidance on Repairing and Rebuilding Houses Affected by the Canterbury Earthquake Sequence" in December 2012, which recommends some form of re-levelling or rebuilding of the floor if:

1. the slope is greater than 0.5% for any two points more than 2m apart;
2. the variation in level over the floor plan is greater than 50mm, or;
3. there is significant cracking of the floor.

The floor levels for the Allison Courts are considered to be acceptable and there is no evidence of strain induced damage to the superstructure as a result of differential foundation settlement.

Refer Appendix A for level surveys of the buildings.

3 Structural Investigation

3.1 Summary of Building Damage

The extent of the damages observed was limited and the nature of the damages observed minor. Given the above, the current condition of the buildings appears to be similar to the likely as-built condition. A brief summary of the observations that were made during Aurecon's visit on 4 December 2012 are as follows:-

- A floor level survey using the zip level was carried out on the slab-on-grade and at the first floor when applicable. It has shown that the levels do not exceed MBIE guidelines limits – refer Appendix A for details.
- Minor damage to internal wall linings, mainly around doors and windows - refer pictures 1 and 2 – Appendix A).
- The roof structure was inspected locally by accessing a trap tile and appeared to be in good condition in the area inspected (picture 4).

No additional damage was observed during Aurecons visit on 18 November 2015.

3.2 Record of Intrusive Investigation

No intrusive investigations were carried out for the Allison Courts as it was deemed unnecessary to do so since partial architectural and structural drawings were available with sufficient detail to get the information needed to perform the capacity/demand calculations.

3.3 Damage Discussion

The visual inspections indicate the building were good condition and performed well during the recent series of Canterbury Earthquakes. There was no evidence of damage to the blockwalls which, as the main lateral load resisting elements, indicate the design loadpath through the building to the foundations has not been compromised. Given the lack of observed differential settlement it is likely the capacity of the foundation was not exceeded during the series of Canterbury earthquakes.

4 Building Review Summary

4.1 Building Review Statement

There was limited damage to the buildings and therefore, as noted above an intrusive investigation was neither warranted nor undertaken for Allison Courts.

4.2 Critical Structural Weaknesses

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

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

5.1 General

The Allison Courts Blocks 'A' and 'B' have a timber truss roofs with timber framed walls or partially reinforced concrete masonry blockwork to resist the lateral loads induced as wind and earthquake loads. The separate garages buildings are also partially reinforced concrete masonry blockwork constructions. With effective bracing provided through walls and good detailing, all three buildings have performed well in the Canterbury earthquake sequence as evidenced by the limited damage described in Section 3 above.

5.2 Initial %NBS Assessment

5.2.1 Parameters used in the seismic assessment

Table 1: Parameters used in the Seismic Assessment

Seismic Parameter	Quantity	Comment/Reference
Site Soil Class	D	NZS 1170.5:2004, Clause 3.1.3, Deep or Soft Soil
Site Hazard Factor, Z	0.30	DBH Info Sheet on Seismicity Changes (Effective 19 May 2011)
Return period Factor, R_u	1.00	NZS 1170.5:2004, Table 3.5, Importance Level 2 Structure with a Design Life of 50 years
Ductility Factor for timber walls, μ	2.0	Timber walls system. (AS 1170.4 – 2007 Table 6.5A)
Ductility Factor for blockwork walls, μ	2.0	Unreinforced Masonry Walls (Assessment and Improvement of Unreinforced Masonry Buildings for Earthquake Resistance; Clause 4.3.2.4).

5.2.2 Lateral load resistance systems in Blocks 'A' and 'B'

The two building blocks in Allison Courts have the same lateral load resisting system. Both buildings have one-storey and two-storey sections and rely on the walls for bracing. The one storey sections rely on the gib lined timber framed walls for bracing. The two storey sections have internal timber walls but given the rigid diaphraghm and the comparatively greater stiffness of the blockwork walls the majority of the bracing function is performed by the blockwork walls. Consequently the bracing demand on the timber framed walls is reduced.

A detailed bracing check was carried out in accordance with NZS3604 to determine the buildings bracing demand. As discussed the one storey portion of the blocks do not attract loads from the two storey portion of the walls because they are not stiff enough compared to the firewalls and the diaphraghm in the one storey section is considered flexible and therefore has limited capacity to distribute loads. The initial qualitative assessment took a more conservative approach which attributed more load to the timber walls which resulted in some elements with a %NBS rating below 67% despite the observed good performance of the structure. Following the more refined consideration of loadpaths carried out as part of the quantative assessment the %NBS ratings were above 67% for all elements.

5.2.3 Lateral load resistance systems in Garages

In the garages, the lateral loads are distributed to the concrete masonry blockwork walls which were found to be partially filled and reinforced providing effective loadpaths to the foundation

5.3 Assessment Results

The building strength assessment was carried out using detailed demand and capacity analysis as described above. The following table presents the result form this assessment:

Table 2: Summary of results fromSeismic Assessment

Blocks	Direction	%NBS	Comments
A	X	>67%	Limited by Timber Framed Walls located on Gridline 3; between A and C
	Y	>67%	Limited by Timber Framed Walls located on Gridline C; between 2 and 3
B	X	>67%	Limited by Timber Framed Walls located on Gridline 8, between A and B
	Y	>67%	Limited by Timber Framed Walls located on Gridline E, between 1 and 3
Garages	X	100%	Given by the Concrete blockwork walls
	Y	100%	Given by the Concrete blockwork walls

6 Conclusions and Recommendations

Given the good performance of the Allison Courts buildings and separate garages in the Canterbury earthquake sequence and the fact the differential floor levels are considered to be within acceptable limits, **a geotechnical investigation is currently not considered necessary**.

Additionally, the buildings have suffered no loss of functionality and in our opinion the Allison Courts buildings and garages **are considered suitable for continued occupation on the following basis**:

- As the general strength for Block 'A' and Block 'B" is above 67%NBS, it is not deemed to be earthquake prone.
- There have been no critical structural weaknesses or collapse risks identified.
- There is minimal damage to the buildings.

We recommend any damaged linings be repaired.

In our opinion no repair works are required for the garages.

Explanatory Statement

The inspections of the building discussed in this report have been undertaken to assess structural earthquake damage. No analysis has been undertaken to assess the strength of the building or to determine whether or not it complies with the relevant building codes, except to the extent that Aurecon expressly indicates otherwise in the report. Aurecon has not made any assessment of structural stability or building safety in connection with future aftershocks or earthquakes – which have the potential to damage the building and to jeopardise the safety of those either inside or adjacent to the building, except to the extent that Aurecon expressly indicates otherwise in the report.

This report is necessarily limited by the restricted ability to carry out inspections due to potential structural instabilities/safety considerations, and the time available to carry out such inspections. The report does not address defects that are not reasonably discoverable on visual inspection, including defects in inaccessible places and latent defects. Where site inspections were made, they were restricted to external inspections and, where practicable, limited internal visual inspections.

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

While this report may assist the client in assessing whether the building should be repaired, strengthened, or replaced that decision is the sole responsibility of the client.

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

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

Appendices

Appendix A

Site Map, Photos, Levels surveys and Marked-up drawings for location of structural elements.

4 December 2012 – Allison Courts Site Photographs

Site Map

Typical exterior façade of Residential units at Allison Courts

Ref	Description	Photograph
1.	Typical minor damage cracking to interior wall lining around windows.	
2.	Typical minor damage cracking to interior wall lining around windows.	
3.	Typical garage at Allison Courts.	
4.	Locally inspected roof structure	

12/02/2013 11:04:07 a.m.

aurecon

CLIENT

Christchurch City Council

REV	DATE	REVISION DETAILS	APPROVAL

DRAWN: D.HUNIA
DESIGNED: A.WILLARD
CHECKED: L.CASTILLO
APPROVED: L.CASTILLO
DATE

PROJECT: ALLISON COURTS 40 BROUGHAM STREET

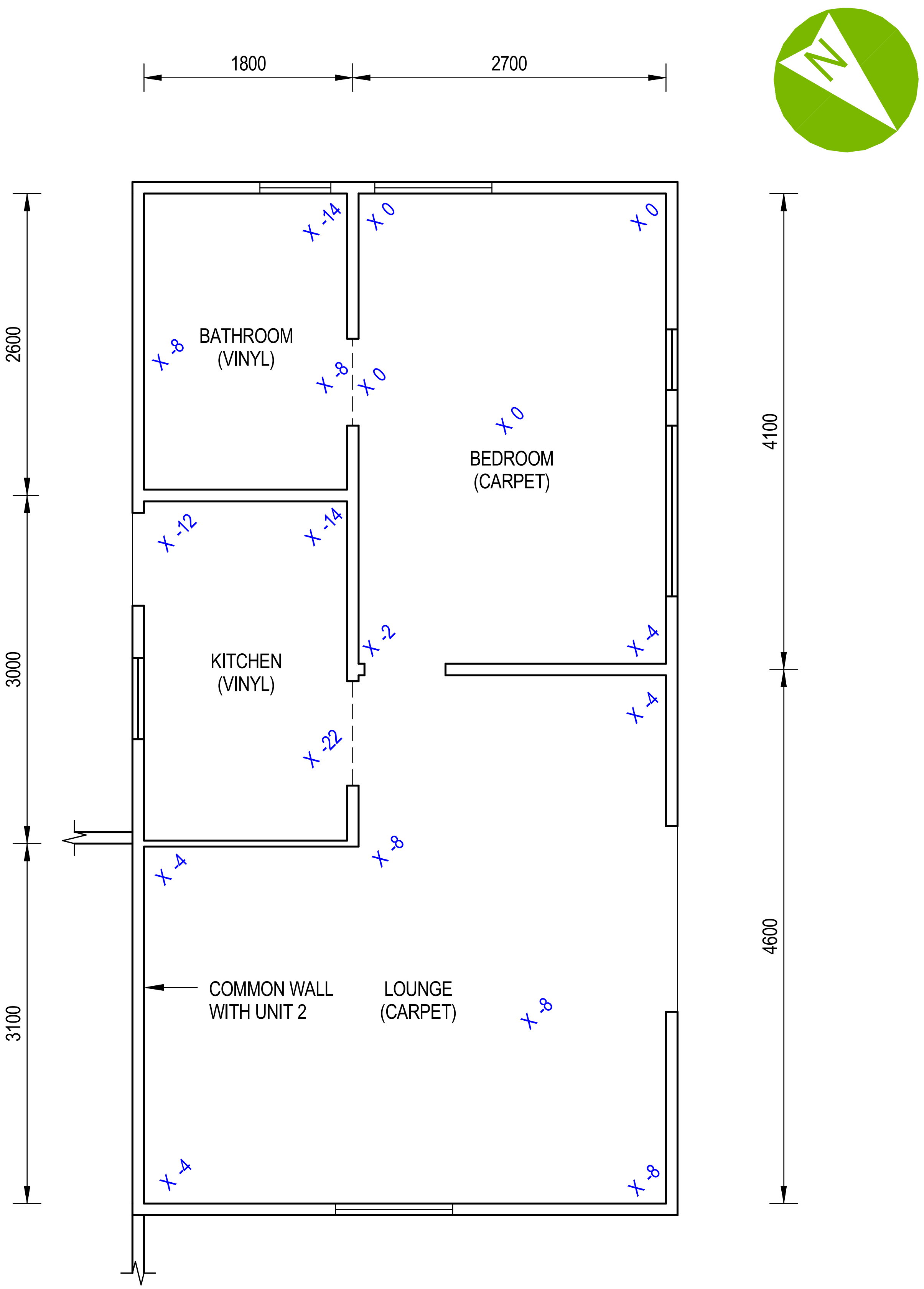
TITLE: SITE PLAN

PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT No.: 233414

SCALE: NTS
SIZE: A4

DRAWING No.: SK-00-01
REV



12/02/2013 11:04:07 a.m.

aurecon

CLIENT: Christchurch City Council

REV	DATE	REVISION DETAILS	APPROVAL

DRAWN	DESIGNED
D.HUNIA	A.WILLARD

CHECKED: L.CASTILLO

APPROVED: L.CASTILLO DATE

PROJECT: ALLISON COURTS
40 BROUGHAM STREET

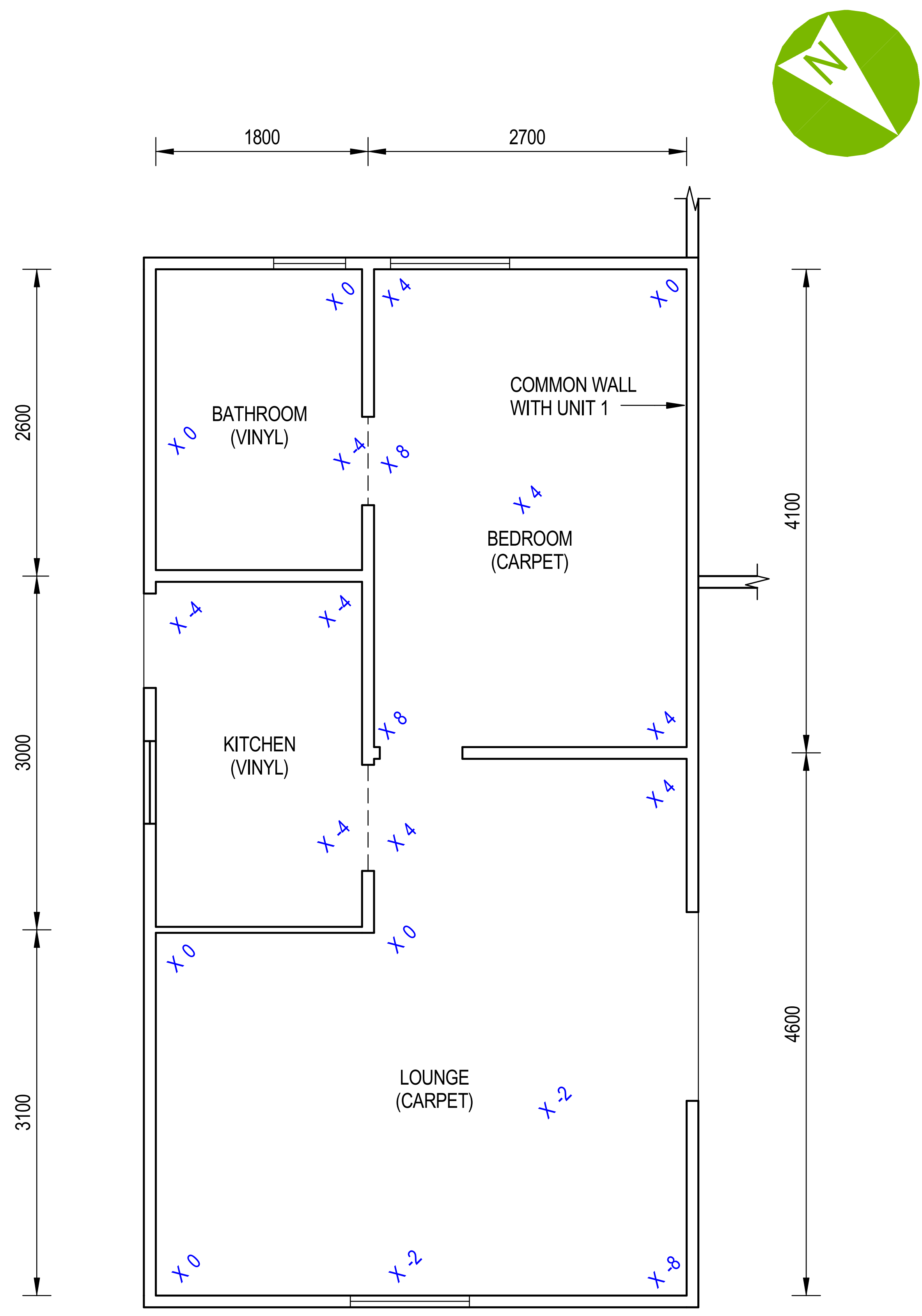
TITLE: LEVEL SURVEY
UNIT 1

PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT No.: 233414

SCALE: 1 : 50 SIZE: A4

DRAWING No.: SK-01-01 REV



12/02/2013 11:04:07 a.m.

aurecon

CLIENT
Christchurch City Council

REV	DATE	REVISION DETAILS	APPROVAL

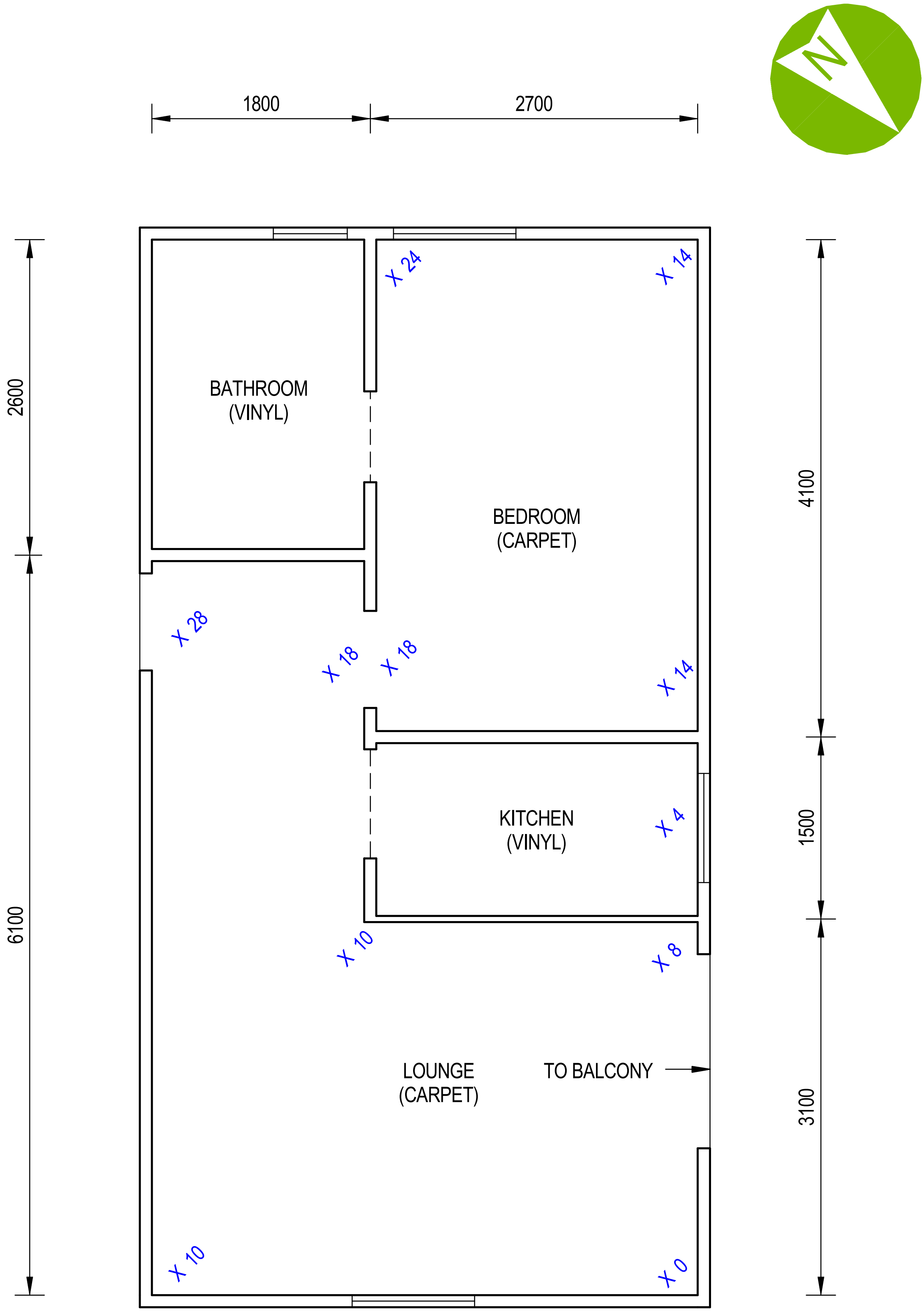
DRAWN: D.HUNIA
DESIGNED: A.WILLARD
CHECKED: L.CASTILLO
APPROVED: L.CASTILLO
DATE

PROJECT: ALLISON COURTS
40 BROUGHAM STREET

TITLE: LEVEL SURVEY
UNIT 2

PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT No.: 233414
SCALE: 1 : 50
SIZE: A4
DRAWING No.: SK-01-02
REV



12/02/2013 11:04:08 a.m.

aurecon

CLIENT

Christchurch City Council

REV	DATE	REVISION DETAILS	APPROVAL

DRAWN	DESIGNED
D.HUNIA	A.WILLARD
CHECKED	
L.CASTILLO	
APPROVED	
DATE	
L.CASTILLO	

PROJECT
ALLISON COURTS
40 BROUGHAM STREET

TITLE
LEVEL SURVEY
UNIT 3

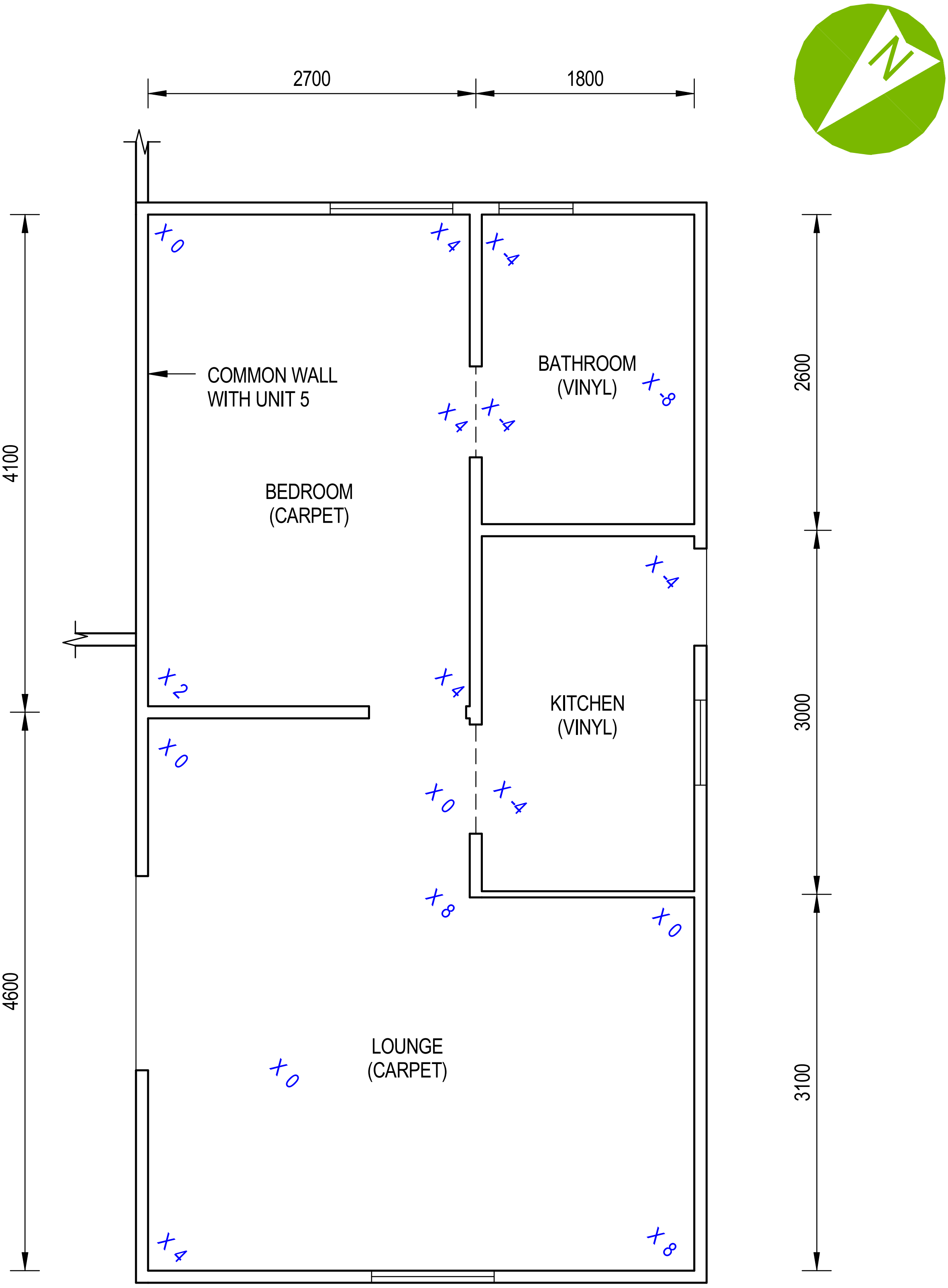
PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT No.
233414

SCALE 1 : 50
SIZE A4

DRAWING No.
SK-01-03

REV



12/02/2013 11:04:08 a.m.

aurecon

CLIENT
Christchurch City Council

REV	DATE	REVISION DETAILS	APPROVAL

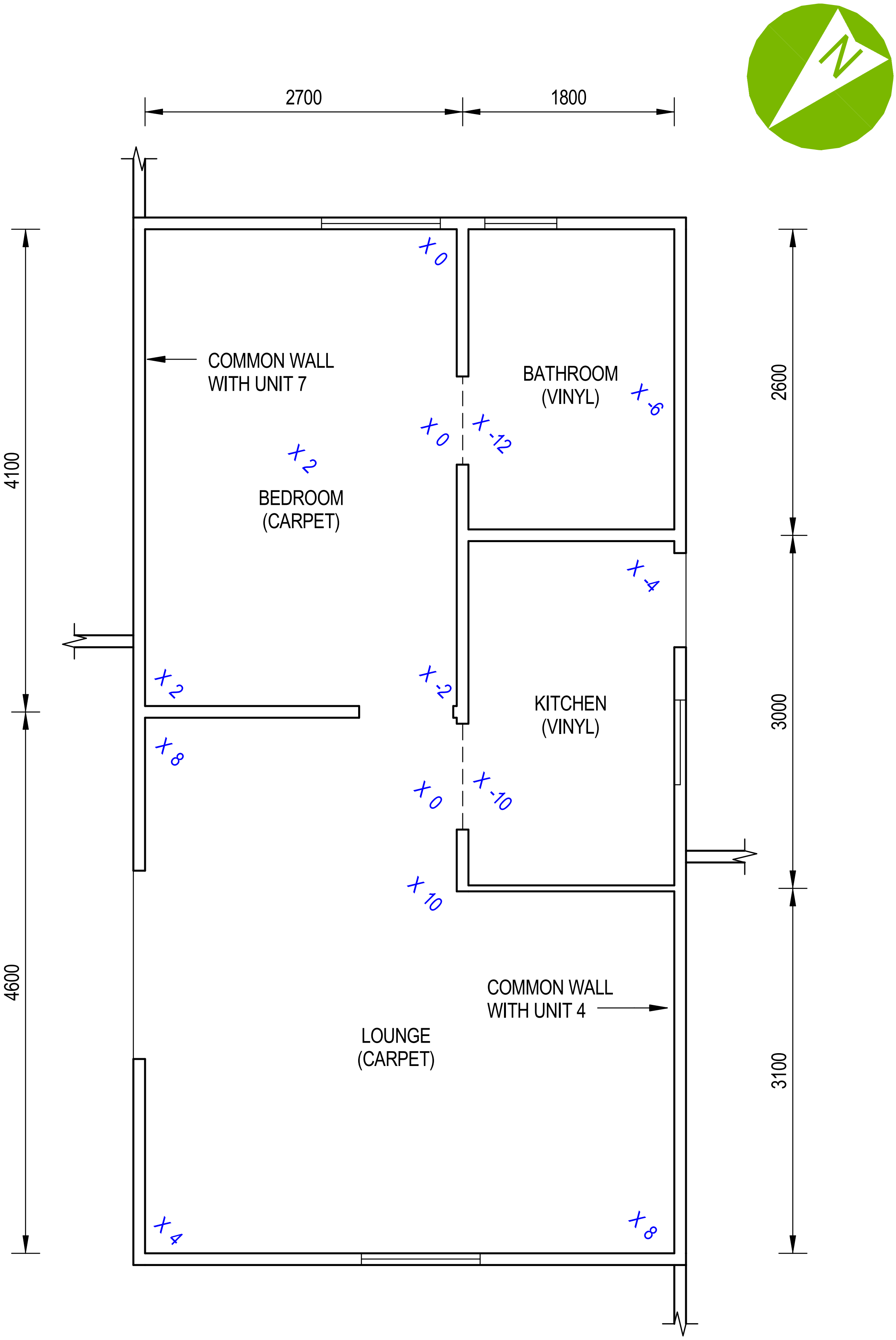
DRAWN: D.HUNIA
DESIGNED: A.WILLARD
CHECKED: L.CASTILLO
APPROVED: L.CASTILLO
DATE

PROJECT
ALLISON COURTS
40 BROUGHAM STREET

TITLE
LEVEL SURVEY
UNIT 4

PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT No.: 233414
SCALE: 1 : 50
SIZE: A4
DRAWING No.: SK-01-04
REV



12/02/2013 11:04:08 a.m.

aurecon

CLIENT
Christchurch City Council

REV	DATE	REVISION DETAILS	APPROVAL

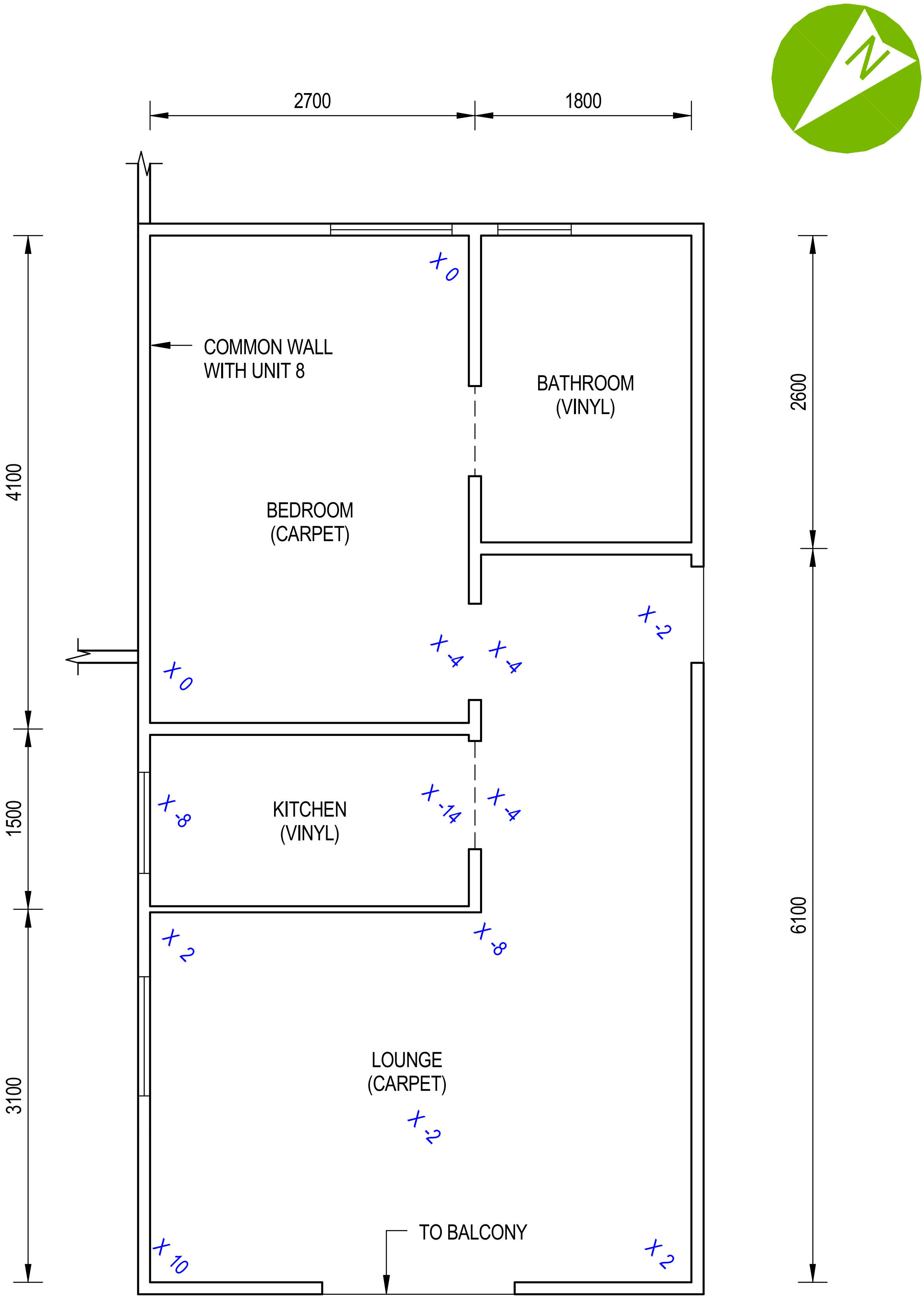
DRAWN: D.HUNIA
DESIGNED: A.WILLARD
CHECKED: L.CASTILLO
APPROVED: L.CASTILLO
DATE

PROJECT
ALLISON COURTS
40 BROUGHAM STREET

TITLE
LEVEL SURVEY
UNIT 5

PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT No.: 233414
SCALE: 1 : 50
SIZE: A4
DRAWING No.: SK-01-05
REV



12/02/2013 11:04:09 a.m.

aurecon

CLIENT
Christchurch City Council

REV	DATE	REVISION DETAILS	APPROVAL

DRAWN	DESIGNED
D.HUNIA	A.WILLARD

CHECKED: L.CASTILLO

APPROVED: L.CASTILLO DATE

PROJECT
ALLISON COURTS
40 BROUGHAM STREET

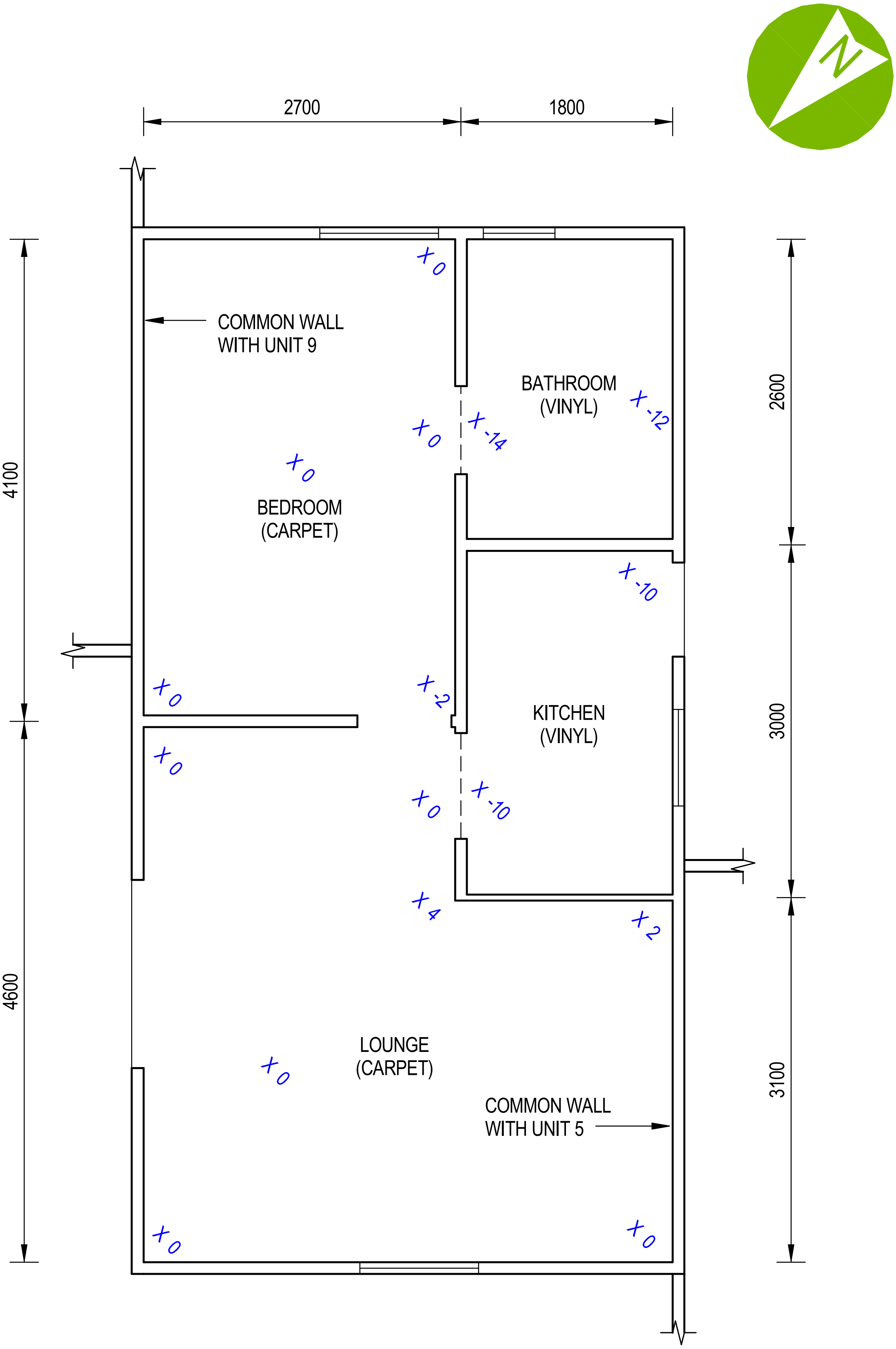
TITLE
LEVEL SURVEY
UNIT 6

PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT No. 233414

SCALE 1 : 50 | SIZE A4

DRAWING No. SK-01-06 | REV



12/02/2013 11:04:09 a.m.

aurecon

CLIENT
Christchurch City Council

REV	DATE	REVISION DETAILS	APPROVAL

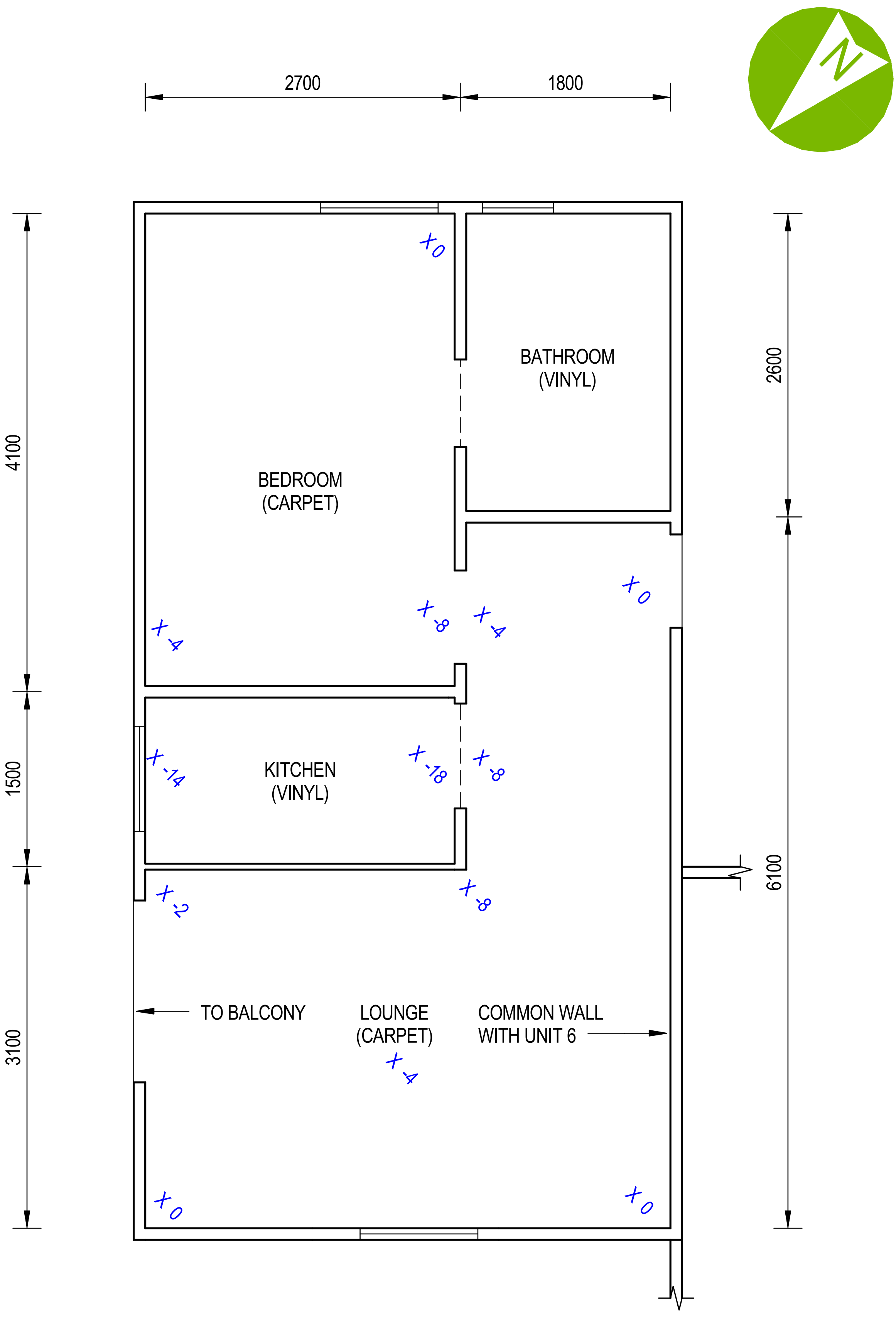
DRAWN: D.HUNIA
DESIGNED: A.WILLARD
CHECKED: L.CASTILLO
APPROVED: L.CASTILLO
DATE

PROJECT: ALLISON COURTS
40 BROUGHAM STREET

TITLE: LEVEL SURVEY
UNIT 7

PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT No.: 233414
SCALE: 1 : 50
SIZE: A4
DRAWING No.: SK-01-07
REV



12/02/2013 11:04:10 a.m.

aurecon

CLIENT
Christchurch City Council

REV	DATE	REVISION DETAILS	APPROVAL

DRAWN	DESIGNED
D.HUNIA	A.WILLARD

CHECKED: L.CASTILLO

APPROVED: L.CASTILLO DATE

PROJECT: ALLISON COURTS, 40 BROUGHAM STREET

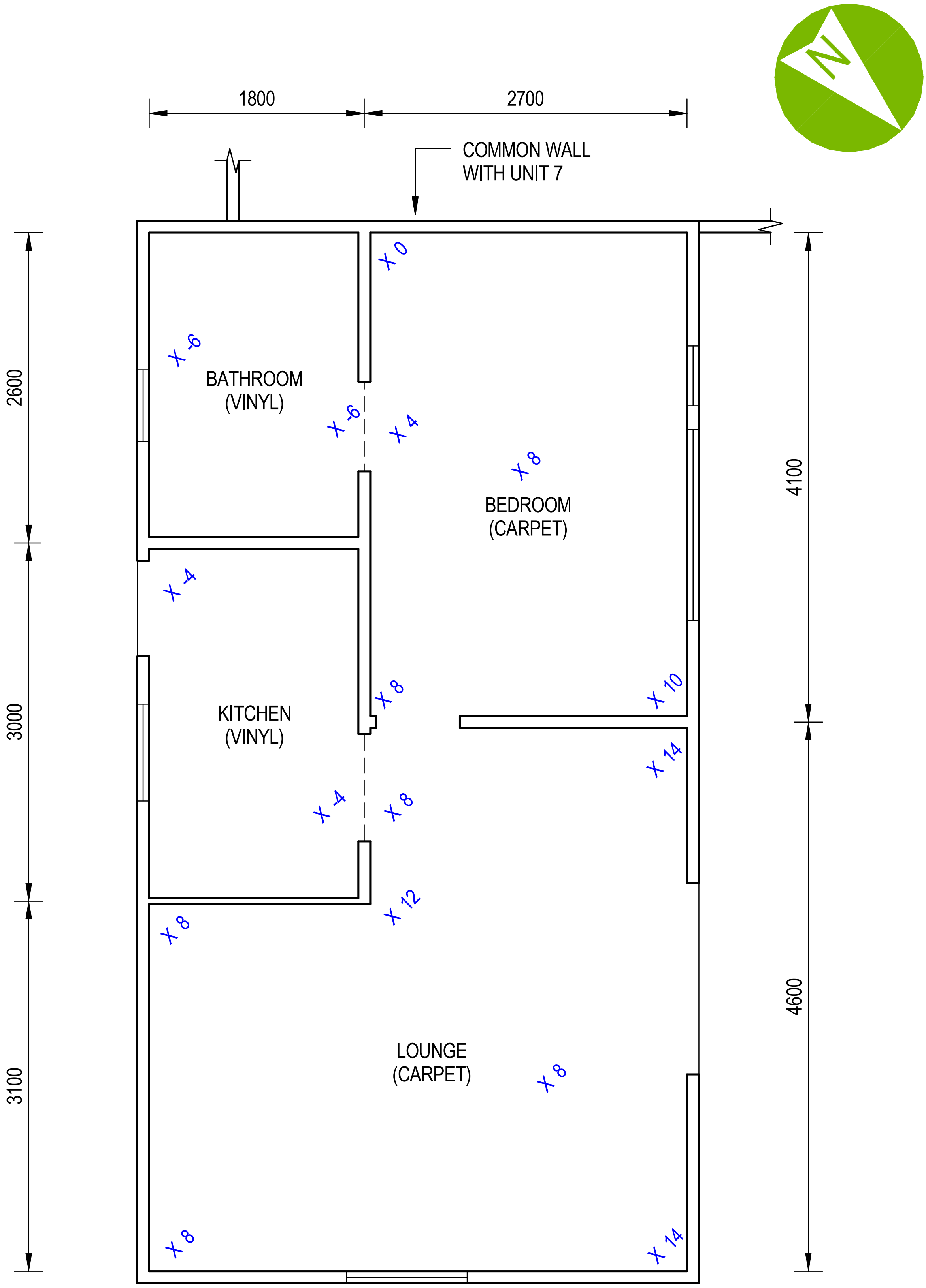
TITLE: LEVEL SURVEY UNIT 8

PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT No.: 233414

SCALE	SIZE
1 : 50	A4

DRAWING No.	REV
SK-01-08	



12/02/2013 11:04:10 a.m.

aurecon

CLIENT: Christchurch City Council

REV	DATE	REVISION DETAILS	APPROVAL

DRAWN	DESIGNED
D.HUNIA	A.WILLARD

CHECKED: L.CASTILLO

APPROVED: L.CASTILLO DATE

PROJECT: ALLISON COURTS
40 BROUGHAM STREET

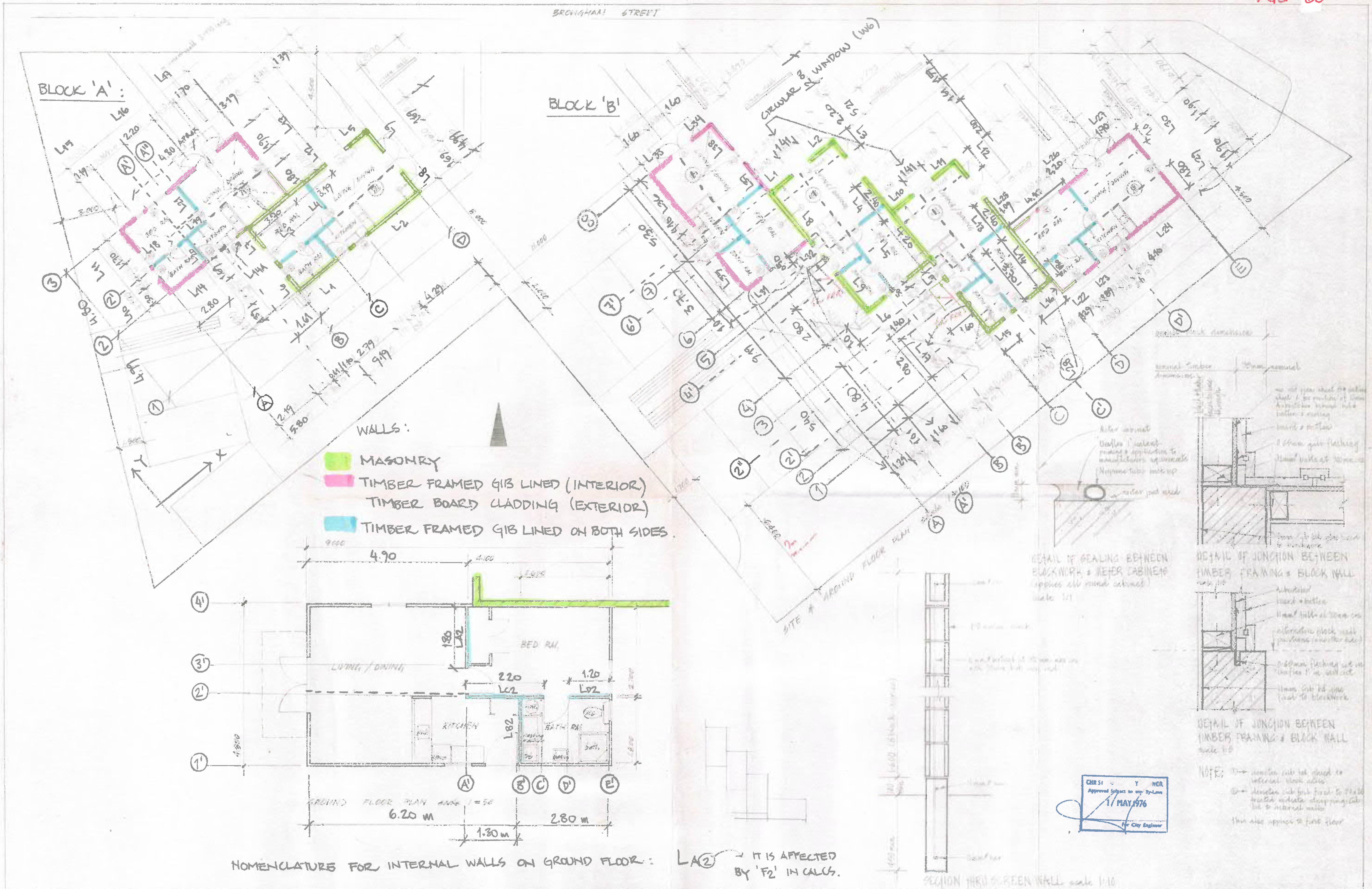
TITLE: LEVEL SURVEY
UNIT 9

PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT No. 233414

SCALE	SIZE
1 : 50	A4

DRAWING No.	REV
SK-01-09	



CITY ARCHITECT'S DIVISION

CHRISTCHURCH CITY COUNCIL

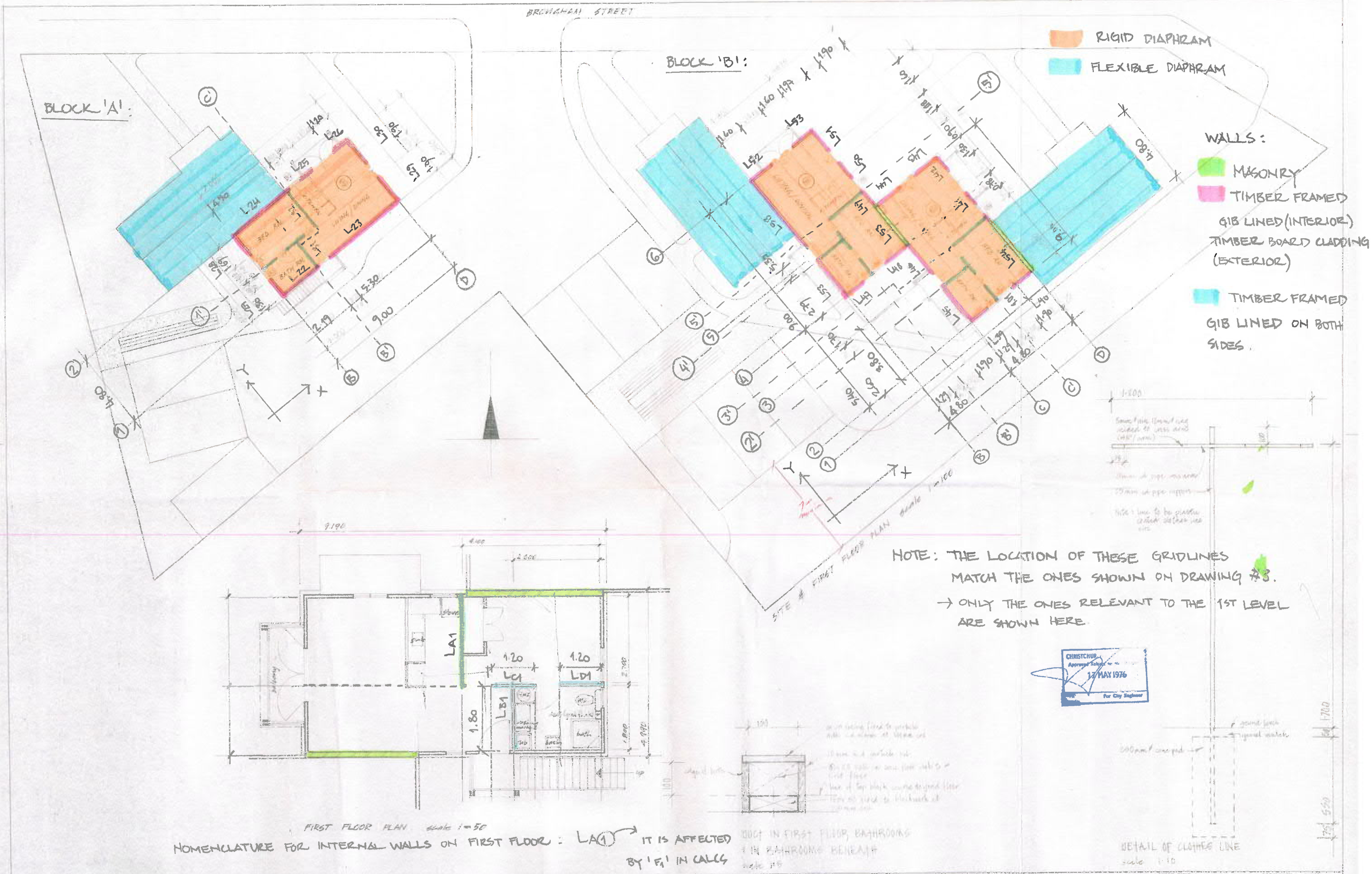
CITY ENGINEER'S DEPARTMENT

COMMUNITY HOUSING · BROUGHAM STREET

GROUND FLOOR PLANS

CONTRACTOR SHALL VERIFY ALL DIMENSIONS BEFORE STARTING WORK

8



CITY ARCHITECT'S DIVISION	CONSULTANT			
CHRISTCHURCH CITY COUNCIL		COMMUNITY HOUSING · BROUGHAM STREET	SHEET TITLE: FIRST FLOOR PLANS	SHEET 4
CITY ENGINEER'S DEPARTMENT			CONTRACTOR SHALL VERIFY ALL DIMENSIONS BEFORE STARTING WORK	

Appendix B
References

1. Ministry of Building Environment and Innovation (MBIE), “Technical Guidance on Repairing and Rebuilding Houses Affected by the Canterbury Earthquake Sequence”, Revision 3, December 2012

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

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

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

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

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 Quantative 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 quantative assessment involves inspection of the building and analytical calculation of the buildings strength and may require non-destructive or destructive material testing, geotechnical testing and intrusive investigation.

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 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

- ✓ Block ‘A’
- ✓ Block ‘B’
- ✓ Garages

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Block A
Building Address:	CCC Residential appartment
Unit / No: / Street	40 Brougham Street
Legal Description:	Lot 1 CB16F/45
GPS south (Degrees / Min / Sec):	43 / 32 / 51.55
GPS east (Degrees / Min / Sec):	172 / 37 / 10.44
Building Unique Identifier (CCC):	BE1061 EQ2
Reviewer:	Lee Howard
CPEng No:	1008889
Company:	Aurecon
Company project number:	233415
Company phone number:	03-366-8021
Date of submission:	27/11/2015
Inspection Date:	18/11/2015
Revision:	1
Is there a full report with this summary?	yes

Site

Site slope:	flat
Soil type:	mixed
Site Class (to NZS1170.5):	D
Proximity to waterway (m, if <100m):	
Proximity to clifftop (m, if < 100m):	
Proximity to cliff base (m,if <100m):	
Max retaining height (m):	0
Soil Profile (if available):	
If Ground improvement on site, describe:	
Approx site elevation (m):	10.00

Building

No. of storeys above ground:	1 (single storey = 1)
Ground floor split?	no
Storeys below ground	0
Foundation type:	mat slab
Building height (m):	7.00
Floor footprint area (approx):	92
Age of Building (years):	37
Ground floor elevation (Absolute) (m):	8.50
Ground floor elevation above ground (m):	0.00
if Foundation type is other, describe:	
height from ground to level of uppermost seismic mass (for IEP only) (m):	
Date of design:	1965-1976
Strengthening present?	no
If so, when (year)?	
And what load level (%g)?	
Brief strengthening description:	
Use (ground floor):	multi-unit residential
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 framed
Floors:	concrete flat slab
Beams:	timber
Columns:	load bearing walls
Walls:	partially filled concrete masonry
rafter type, purlin type and cladding	
slab thickness (mm)	
type	
typical dimensions (mm x mm)	
thickness (mm)	

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	other (note)
describe system	gib lined walls
Ductility assumed, μ:	2.00
Period along:	0.40 (0.00)
estimate or calculation?	estimated
Total deflection (ULS) (mm):	
estimate or calculation?	
maximum interstorey deflection (ULS) (mm):	
estimate or calculation?	
Lateral system across:	other (note)
describe system	Partially filled masonry walls / timber framed gib lined walls
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:

leave blank if not relevant

north (mm):	
east (mm):	
south (mm):	
west (mm):	

Non-structural elements

Stairs:	timber
Wall cladding:	other light
Roof Cladding:	Metal
Glazing:	aluminium frames
Ceilings:	fibrous plaster, fixed
Services(list):	
describe supports	
describe	
describe	

Available documentation

Architectural	partial	original designer name/date: Christchurch City Council
Structural	partial	original designer name/date: Christchurch City Council
Mechanical	none	original designer name/date:
Electrical	none	original designer name/date:
Geotech report	none	original designer name/date:

Damage

Site: (refer DEE Table 4-2)

Site performance:	Good	Describe damage:
Settlement:	none observed	notes (if applicable):
Differential settlement:	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%
Along – Describe (summary):	
Describe how damage ratio arrived at:	
Across – Damage ratio:	0%
Across – Describe (summary):	
Diaphragms – Damage?:	no
CSWs – Damage?:	no
Pounding – Damage?:	no
Non-structural – Damage?:	yes
Non-structural – Describe:	Minor linings cracking

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

Recommendations

Level of repair/strengthening required:	none
Building Consent required:	no
Interim occupancy recommendations:	full occupancy
Along – Assessed %NBS before e'quakes:	67% (#### %NBS from IEP below)
Along – Assessed %NBS after e'quakes:	67%
Across – Assessed %NBS before e'quakes:	67% (#### %NBS from IEP below)
Across – Assessed %NBS after e'quakes:	67%
If IEP not used, please detail assessment methodology:	detailed calculations

IEP

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

Period of design of building (from above):	1965-1976
h_n from above:	m
Seismic Zone, if designed between 1965 and 1992:	
not required for this age of building	
not required for this age of building	

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

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

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, cl 3.1.6:

	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:	0.30
Z_{1992}, from NZS4203:1992	0.8
Hazard scaling factor, **Factor B:**	3.333333333

2.4 Return Period Scaling Factor

Building Importance level (from above):	2
Return Period Scaling factor from Table 3.1, **Factor C**:	0.80

2.5 Ductility Scaling Factor

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

2.6 Structural Performance Scaling Factor:

	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
%NBSb:	**#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:	significant	0.7
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
3.5. Site Characteristics	insignificant	1

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

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

3.6. Other factors, Factor F

	Along	Across
For ≤ 3 storeys, max value =2.5, otherwise max valule =1.5, no minimum	2.0	2.0
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

	along	across
3.7. Overall Performance Achievement ratio (PAR)	**1.40**	**1.40**
4.3 PAR x (%NBS)b: 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:	Block B	Reviewer:	Lee Howard
	Unit / No: 40 / Street	CPEng No:	1008889
Building Address:	CCC Residential appartment / 40 / Brougham Street	Company:	Aurecon
Legal Description:	Lot 1 CB16F/45	Company project number:	233415
		Company phone number:	03-366-8021
	Degrees / Min / Sec		
GPS south:	43 / 32 / 51.78	Date of submission:	27/11/2015
GPS east:	172 / 37 / 12.12	Inspection Date:	18/11/2015
		Revision:	1
Building Unique Identifier (CCC):	BE1061 EQ2	Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	0
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):	8.50

Building

No. of storeys above ground:	1 (single storey = 1)	Ground floor elevation (Absolute) (m):	8.50
Ground floor split?	no	Ground floor elevation above ground (m):	0.00
Storeys below ground	0		
Foundation type:	mat slab	if Foundation type is other, describe:	
Building height (m):	7.00	height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	184		
Age of Building (years):	37	Date of design:	1965-1976
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 framed	rafter type, purlin type and cladding	
Floors:	concrete flat slab	slab thickness (mm)	
Beams:	timber	type	
Columns:	load bearing walls	typical dimensions (mm x mm)	
Walls:	partially filled concrete masonry	thickness (mm)	

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	other (note)		Partially filled masonry walls
Ductility assumed, μ:	2.00	describe system	
Period along:	0.40 (0.00)	estimate or calculation?	estimated
Total deflection (ULS) (mm):		estimate or calculation?	
maximum interstorey deflection (ULS) (mm):		estimate or calculation?	
Lateral system across:	other (note)		Partially filled masonry walls / timber lined walls
Ductility assumed, μ:	2.00	describe system	
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: (leave blank if not relevant)

north (mm):	
east (mm):	
south (mm):	
west (mm):	

Non-structural elements

Stairs:	timber	describe supports	
Wall cladding:	other light	describe	
Roof Cladding:	Metal	describe	
Glazing:	aluminium frames		
Ceilings:	light tiles		
Services(list):			

Available documentation

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

Damage

Site: (refer DEE Table 4-2)

Site performance:	Good	Describe damage:	
Settlement:	none observed	notes (if applicable):	
Differential settlement:	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?:	yes	Describe:	Minor cracking

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

Recommendations

	Level of repair/strengthening required:	none	Describe:	
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before e'quakes:	67% (#### %NBS from IEP below)	If IEP not used, please detail assessment methodology:	detailed calculations
	Assessed %NBS after e'quakes:	67%		
Across	Assessed %NBS before e'quakes:	67% (#### %NBS from IEP below)		
	Assessed %NBS after e'quakes:	67%		

IEP

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

Period of design of building (from above):	1965-1976	h_n from above:	m
Seismic Zone, if designed between 1965 and 1992:		not required for this age of building	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 buildings 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, cl 3.1.6:

	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):
Return Period Scaling factor from Table 3.1, **Factor C**:

2.5 Ductility Scaling Factor

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

2.6 Structural Performance Scaling Factor:

	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:	insignificant	1
3.2. Vertical irregularity, Factor B:	significant	0.7
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	insignificant	1

3.6. Other factors, Factor F

	Along	Across
For ≤ 3 storeys, max value =2.5, otherwise max valule =1.5, no minimum	2.0	2.0
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

	along	across
3.7. Overall Performance Achievement ratio (PAR)	**1.40**	**1.40**
4.3 PAR x (%NBS)b: 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:	Garages	Reviewer:	Lee Howard
		CPEng No:	1008889
Building Address:	CCC Residential appartment (Unit: / No: 40 / Street: Brougham Street)	Company:	Aurecon
Legal Description:	Lot 1 CB16F/45	Company project number:	233415
		Company phone number:	03-366-8021
GPS south:	Degrees 43, Min 32, Sec 52.09	Date of submission:	27/11/2015
GPS east:	Degrees 172, Min 37, Sec 11.82	Inspection Date:	18/01/2015
		Revision:	1
Building Unique Identifier (CCC):	BE1061 EQ2	Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	0
Soil type:	mixed	Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
Proximity to waterway (m, if <100m):		If Ground improvement on site, describe:	
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	5.00

Building

No. of storeys above ground:	1 (single storey = 1)	Ground floor elevation (Absolute) (m):	5.00
Ground floor split?	no	Ground floor elevation above ground (m):	0.00
Storeys below ground	0		
Foundation type:	mat slab	if Foundation type is other, describe:	
Building height (m):	5.00	height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	54		
Age of Building (years):	37	Date of design:	1965-1976
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 framed	rafter type, purlin type and cladding	
Floors:	concrete flat slab	slab thickness (mm)	
Beams:	timber	type	
Columns:	load bearing walls	typical dimensions (mm x mm)	
Walls:	partially filled concrete masonry	thickness (mm)	

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	other (note)		Partially filled masonry walls
Ductility assumed, μ:	2.00	describe system	
Period along:	0.40 (0.00)	estimate or calculation?	estimated
Total deflection (ULS) (mm):		estimate or calculation?	
maximum interstorey deflection (ULS) (mm):		estimate or calculation?	
Lateral system across:	other (note)		Partially filled masonry walls / timber lined walls
Ductility assumed, μ:	2.00	describe system	
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: (leave blank if not relevant)

north (mm):	
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	partial	original designer name/date	Christchurch City Council
Structural	partial	original designer name/date	Christchurch City Council
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

Damage

Site: (refer DEE Table 4-2)

Site performance:	Good	Describe damage:	
Settlement:	none observed	notes (if applicable):	
Differential settlement:	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?:	yes	Describe:	Minor cracking

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

Recommendations

	Level of repair/strengthening required:	none	Describe:	
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before e'quakes:	100% (#### %NBS from IEP below)	If IEP not used, please detail assessment methodology:	detailed calculations
	Assessed %NBS after e'quakes:	100%		
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):	1965-1976	h_n from above:	m
Seismic Zone, if designed between 1965 and 1992:		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

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

	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):
Return Period Scaling factor from Table 3.1, **Factor C**:

2.5 Ductility Scaling Factor

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

2.6 Structural Performance Scaling Factor:

	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
%NBSb:	**#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: significant 0.7

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 insignificant 1

3.6. Other factors, Factor F

	Along	Across
For ≤ 3 storeys, max value =2.5, otherwise max valule =1.5, no minimum	2.0	2.0
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

	along	across
3.7. Overall Performance Achievement ratio (PAR)	**1.40**	**1.40**
4.3 PAR x (%NBS)b: PAR x Baselline %NBS:	**#DIV/0!**	**#DIV/0!**
4.4 Percentage New Building Standard (%NBS), (before)		**#DIV/0!**

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

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