Bryndwr Courts Housing Complex
Qualitative Engineering Evaluation

Functional Location ID: BE 0581 EQ2

Address: 26 Lees Road, Strowan

Reference: 232881

Prepared for:
Christchurch City Council

Revision: 2

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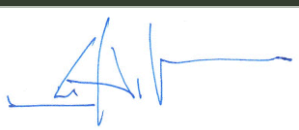
Author Signature		Approver Signature	
Name	Luis Castillo	Name	Lee Howard
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Appendices

Executive Summary - Block A

This is a summary of the Qualitative Engineering Evaluation for the Bryndwr Courts Housing Complex 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**	Bryndwr Courts Housing Complex – Block A			
Building Location ID	BE 0581 EQ2			**Multiple Building Site**	Y
Building Address	26 Lees Road, Strowan			**No. of residential units**	3
Soil Technical Category	TC2	**Importance Level**	2	**Approximate Year Built**	1980
Foot Print (m²)	140 m²	**Storeys above ground**	1	**Storeys below ground**	0
Type of Construction	Monier concrete tile roofing supported by timber trusses on reinforced masonry walls and load bearing timber framed walls. The floor is a slab-on-grade with conventional shallow foundations.				
Qualitative L4 Report Results Summary					
Building Occupied	Y	Block A is currently occupied.			
Suitable for Continued Occupancy	Y	Block A 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 DBH guideline limits.			
Building %NBS From Analysis	100%	Based on demand and capacity calculations.			
Qualitative L4 Report Recommendations					
Geotechnical Survey Required	N	Geotechnical survey not required due to lack of observed ground damage on site.			
Proceed to L5 Quantitative DEE	N	A quantitative DEE is not required for this structure.			
Approval					
Author Signature			Approver Signature		
Name	Luis Castillo		Name	Lee Howard	
Title	Senior Structural Engineer		Title	Senior Structural Engineer	

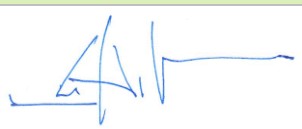
Executive Summary - Blocks B and F

This is a summary of the Qualitative Engineering Evaluation for the Bryndwr Courts Housing Complex 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**	Bryndwr Courts Housing Complex – Blocks B and F			
Building Location ID	BE 0581 EQ2			**Multiple Building Site**	Y
Building Address	26 Lees Road, Strowan			**No. of residential units**	Block B (4), Block F (4),
Soil Technical Category	TC2	**Importance Level**	2	**Approximate Year Built**	1980
Foot Print (m²)	Block B (185 m²), Block F (185 m²),	**Storeys above ground**	1	**Storeys below ground**	0
Type of Construction	Monier concrete tile roofing supported by timber trusses on reinforced masonry walls and load bearing timber framed walls. The floor is a slab-on-grade with conventional shallow foundations.				

Qualitative L4 Report Results Summary		
Building Occupied	Y	The buildings are currently occupied.
Suitable for Continued Occupancy	Y	Blocks B and F 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 DBH guideline limits.
Building %NBS From Analysis	100%	Based on demand and capacity calculations.

Qualitative L4 Report Recommendations		
Geotechnical Survey Required	N	Geotechnical survey not required due to lack of observed ground damage on site.
Proceed to L5 Quantitative DEE	N	A quantitative DEE is not required for this structure.

Approval			
Author Signature		Approver Signature	
Name	Luis Castillo	Name	Lee Howard
Title	Senior Structural Engineer	Title	Senior Structural Engineer

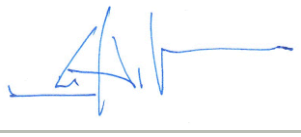
Executive Summary - Blocks C

This is a summary of the Qualitative Engineering Evaluation for the Bryndwr Courts Housing Complex 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**	Bryndwr Courts Housing Complex – Blocks C			
Building Location ID	BE 0581 EQ2			**Multiple Building Site**	Y
Building Address	26 Lees Road, Strowan			**No. of residential units**	8
Soil Technical Category	TC2	**Importance Level**	2	**Approximate Year Built**	1980
Foot Print (m²)	285 m²	**Storeys above ground**	2	**Storeys below ground**	0
Type of Construction	Monier concrete tile roofing supported by timber trusses, reinforced concrete slab as first floor supported on reinforced masonry walls, slab-on-grade for ground floor, and conventional shallow foundations.				

Qualitative L4 Report Results Summary		
Building Occupied	Y	Block C is currently occupied.
Suitable for Continued Occupancy	Y	Block C 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 DBH guideline limits.
Building %NBS From Analysis	42%	Based on demand and capacity calculations.

Qualitative L4 Report Recommendations		
Geotechnical Survey Required	N	Geotechnical survey not required due to lack of observed ground damage on site.
Proceed to L5 Quantitative DEE	N	A quantitative DEE is not required for this structure.

Approval			
Author Signature		Approver Signature	
Name	Luis Castillo	Name	Lee Howard
Title	Senior Structural Engineer	Title	Senior Structural Engineer

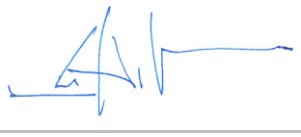
Executive Summary - Blocks D

This is a summary of the Qualitative Engineering Evaluation for the Bryndwr Courts Housing Complex 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**	Bryndwr Courts Housing Complex – Block D			
Building Location ID	BE 0581 EQ2			**Multiple Building Site**	Y
Building Address	26 Lees Road, Strowan			**No. of residential units**	7
Soil Technical Category	TC2	**Importance Level**	2	**Approximate Year Built**	1980
Foot Print (m²)	240 m²	**Storeys above ground**	2	**Storeys below ground**	0
Type of Construction	Monier concrete tile roofing supported by timber trusses, reinforced concrete slab as first floor supported on reinforced masonry walls, slab-on-grade for ground floor, and conventional shallow foundations.				

Qualitative L4 Report Results Summary		
Building Occupied	Y	The building is currently occupied.
Suitable for Continued Occupancy	Y	Block D 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 DBH guideline limits.
Building %NBS From Analysis	37%	Based on demand and capacity calculations.

Qualitative L4 Report Recommendations		
Geotechnical Survey Required	N	Geotechnical survey not required due to lack of observed ground damage on site.
Proceed to L5 Quantitative DEE	N	A quantitative DEE is not required for this structure.

Approval			
Author Signature		Approver Signature	
Name	Luis Castillo	Name	Lee Howard
Title	Senior Structural Engineer	Title	Senior Structural Engineer

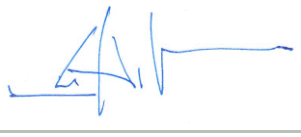
Executive Summary - Blocks E

This is a summary of the Qualitative Engineering Evaluation for the Bryndwr Courts Housing Complex 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**	Bryndwr Courts Housing Complex – Blocks E			
Building Location ID	BE 0581 EQ2			**Multiple Building Site**	Y
Building Address	26 Lees Road, Strowan			**No. of residential units**	6
Soil Technical Category	TC2	**Importance Level**	2	**Approximate Year Built**	1980
Foot Print (m²)	200 m²	**Storeys above ground**	2	**Storeys below ground**	0
Type of Construction	Monier concrete tile roofing supported by timber trusses, reinforced concrete slab as first floor supported on reinforced masonry walls, slab-on-grade for ground floor, and conventional shallow foundations.				

Qualitative L4 Report Results Summary		
Building Occupied	Y	The building is currently occupied.
Suitable for Continued Occupancy	Y	Block E 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 DBH guideline limits.
Building %NBS From Analysis	33%	Based on demand and capacity calculations.

Qualitative L4 Report Recommendations		
Geotechnical Survey Required	N	Geotechnical survey not required due to lack of observed ground damage on site.
Proceed to L5 Quantitative DEE	N	A quantitative DEE is not required for this structure.

Approval			
Author Signature		Approver Signature	
Name	Luis Castillo	Name	Lee Howard
Title	Senior Structural Engineer	Title	Senior Structural Engineer

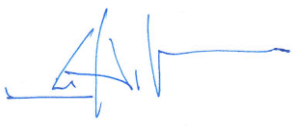
Executive Summary - Residents' Lounge

This is a summary of the Qualitative Engineering Evaluation for the Bryndwr Courts Housing Complex 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**	Bryndwr Courts Housing Complex – Residents' Lounge			
Building Location ID	BE 0581 EQ2			**Multiple Building Site**	N
Building Address	26 Lees Road, Strowan			**No. of residential units**	NA
Soil Technical Category	TC2	**Importance Level**	2	**Approximate Year Built**	1980
Foot Print (m²)	70	**Storeys above ground**	1	**Storeys below ground**	0
Type of Construction	Monier concrete tile roofing supported by timber trusses on reinforced masonry walls. The floor is a slab-on-grade with conventional shallow foundations.				

Qualitative L4 Report Results Summary		
Building Occupied	Y	The Residents' lounge is currently used.
Suitable for Continued Occupancy	Y	The Residents' lounge 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 DBH guideline limits.
Building %NBS From Analysis	100%	Based on demand and capacity calculations.

Qualitative L4 Report Recommendations		
Geotechnical Survey Required	N	Geotechnical survey not required due to lack of observed ground damage on site.
Proceed to L5 Quantitative DEE	N	A quantitative DEE is not required for this structure.

Approval			
Author Signature		Approver Signature	
Name	Luis Castillo	Name	Lee Howard
Title	Senior Structural Engineer	Title	Senior Structural Engineer

1 Introduction

1.1 General

On 28 November 2012 Aurecon engineers visited the Bryndwr Courts Housing Complex to undertake a qualitative 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 Qualitative Assessment of damage to the Bryndwr Courts Housing Complex 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 Buildings

2.1 Building Age and Configuration

The Bryndwr Courts Housing Complex consists of seven separate building blocks built in 1980. Six of them consist of similar residential units and have been identified using the letters A through F as shown in the image below.

Blocks A, B and F are single storey residential units, while blocks C, D and E are two storey residential units. The site has a total of 32 residential units. Furthermore, the site includes a Residents' lounge which serves as a meeting area.

2.1.1 Blocks A, B and F

Blocks A, B and F were built with Monier concrete tile roofing supported by timber trusses on reinforced masonry walls and load bearing timber framed walls. The floor is a slab-on-grade with conventional shallow foundations. Block A consists of three residential units separated by the reinforced masonry walls and the approximated area is 140 m². Blocks B and F are of similar construction, but comprise four residential units; each of these blocks have a footprint of 185 m².

2.1.2 Blocks C, D and E

Blocks C, D and E comprise a nearly identical two storey high section containing four residential units beside a one storey high section. The difference between each block is the amount of residential units found in the one storey section. Block C contains four residential units in this one storey high section with an overall approximate foot print of 285 m² including the two storey high one. Block D comprises three residential units in the one storey section and a 240 m² foot print while Block E includes only two residential units which reduce the area to 200 m².

2.1.3 Residents' Lounge

The Residents' lounge is used as a meeting area and is also made of Monier concrete tile roofing supported by timber trusses on reinforced masonry walls. The floor is a slab-on-grade with conventional shallow foundations. Like the other blocks, the Residents' lounge was built in 1980.

2.2 Building Structural Systems Vertical and Horizontal

An incomplete set of architectural drawings for each block were available and helped to identify some structural systems that could not be observed. Since no structural drawings were available at the time of this assessment, a metal detector was used on masonry walls to verify the presence of reinforcement. Due to this reason there was no real need of undertaking intrusive investigations (see 3.2).

2.2.1 Blocks A, B and F

The roofing consists of heavy Monier concrete tiles on timber trusses that are supported by 190 mm reinforced masonry walls running in the transversal direction of the buildings. However, the end walls are timber-framed load-bearing walls with 90 mm block veneer as most walls running in the longitudinal directions. The rest of the walls are timber-framed with "weather board" cladding. The horizontal loads are resisted in the longitudinal direction by the internal and external timber-framed walls. In the transverse direction, the horizontal loads are resisted by the reinforced masonry walls. The loads from the ground floor are resisted by a concrete slab-on-grade and the foundations are assumed to be conventional and shallow with a perimeter wall footing.

2.2.2 Blocks C, D and E

The overall structure of Block C, D and E is very similar from the previous ones. The first floor of the two storey high section is a one way reinforced concrete slab bearing on reinforced masonry walls. In the two storey high section, two reinforced masonry walls located at the front side of the building are contributing to the horizontal load resisting system in the longitudinal direction. The rest of the two storey high and one storey high structure is almost identical, including the horizontal load resisting systems.

2.2.3 Residents' lounge

As the steel detector confirmed that the exterior masonry walls were reinforced, it has been assumed that the 90mm block contributes to the vertical and horizontal loading systems. In other words, the Residents' lounge has a heavy Monier concrete tile roofing with timber trusses supported by reinforced masonry walls. The loads from the ground floor are resisted by a concrete slab-on-grade and presumably shallow foundations.

2.3 Building Foundation System and Soil Conditions

Bryndwr Courts Housing Complex is used for residential purposes. The Ministry of Business, Innovation and Employment (formally the Department of Building and Housing or DBH) does not currently have a technical classification for the land in the immediate vicinity of the Bryndwr Courts Housing Complex, however the area surrounding the buildings consist primarily of Technical Category 2 (TC2) land. According to Canterbury Earthquake Repair Authority (CERA), TC2 land is considered to "incur minor to moderate land damage from liquefaction".

2.4 Available Structural Documentation and Inspection Priorities

Partial architectural drawings of each block were available from Ian Krause Associates dated October 1978 and approved by the City Council on 9 February 1979 (drawing s No: 1, 3, 4 and 5). No structural drawings were available. The inspection priorities included exterior walls, the timber structure of the roof, structural slab of first floor, slabs on grade, blockworks, interior linings and all architectural elements in order to identify potential structural weaknesses.

2.5 Available Survey Information

A floor level survey was undertaken for all accessible units to establish the level of unevenness across the floors. The results of the survey are presented on the attached drawings 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 Department of Building and Housing (DBH) published the "Revised Guidance on Repairing and Rebuilding Houses Affected by the Canterbury Earthquake Sequence" in November 2011, which recommends some form of re-levelling or rebuilding of the floor

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

It is important to note that these figures are recommendations and are only intended to be applied to residential buildings. However, they provide useful guidance in determining acceptable floor level variations.

The floor levels for the Bryndwr Courts Housing Complex are considered to be acceptable. The tolerance was exceeded in some areas however this was due to either floor coverings or construction errors.

3 Structural Investigation

3.1 Summary of Building Damage

The buildings suffered very limited damage following the Canterbury earthquake sequence, with the overall building conditions remaining almost the same as before the earthquakes. The following observations were made during the site visit on 28 November 2012.

Since the damage observed repeats itself in different units an example photograph is taken into consideration as a general case.

3.1.1 General

- Some cracks were found along the sidewalk used to access each block (Photo #12).

3.1.2 Block A

- Cracks were observed along the joints between the reinforced masonry wall and the ceiling or other linings (Photo #1).
- A few cracks were found in the interior plaster lining (Photos #2 and 3).
- A floor level survey using the zip level was carried out on the slab-on-grade and structural slab and has shown that the levels do not exceed the DBH guidelines limits (see Appendix A).

3.1.3 Block B

- Cracks were observed along the joints between the reinforced masonry wall and the ceiling or other linings (Photo #1).
- A few cracks were found in the interior plaster lining (Photos #2 and 3).
- A floor level survey using the zip level was carried out on the slab-on-grade and structural slab and has shown that the levels do not exceed the DBH guidelines limits (see Appendix A).

3.1.4 Block C

- Cracks were observed along the joints between the reinforced masonry wall and the ceiling or other linings (Photo #1).
- A few cracks were found in the interior plaster lining (Photos #2 and 3).
- Some cracks were found in the exterior veneer (Photo #5).
- Cracking was observed along the mortar joint between the two storey high section and the one storey high section (Photo #6).
- A few cracks were found at the joint between structural elements and architectural (including 90 mm block veneer) (Photos #7 and 8).
- A floor level survey using the zip level was carried out on the slab-on-grade and structural slab and has shown that the levels exceed slightly the DBH guidelines limits (see Appendix A); the unevenness has been detected on the floor of the first level (unit 12). However, the ground floor (unit 13) stays within acceptable limits. This fact explains why it has been assumed that a construction error caused the level differences.

3.1.5 Block D

- Cracks were observed along the joints between the reinforced masonry wall and the ceiling or other linings (Photo #1).
- A few cracks were found in the interior plaster lining (Photos #2 and 3).
- Some cracks were found in the exterior veneer (Photo #5).
- A floor level survey using the zip level was carried out on the slab-on-grade and structural slab and has shown that the levels do not exceed the DBH guidelines limits (see Appendix A).

3.1.6 Block E

- A few cracks were found in the interior plaster lining (Photos #2 and 3).
- Some cracks were found in the exterior veneer (Photo #5).
- A few cracks were found at mortar joint between the two bottom rows of block, at the end of the wall (Photos #9).
- Cracking was observed to the window block sill continuing through the block wall (Photo #10).
- A floor level survey using the zip level was carried out on the slab-on-grade and structural slab and has shown that the levels do not exceed the DBH guidelines limits (see Appendix A).

3.1.7 Block F

- A few cracks were found in the interior plaster lining (Photos #2 and 3).
- A floor level survey using the zip level was carried out on the slab-on-grade and structural slab and has shown that the levels exceed the DBH guidelines limits for one measured slope (see Appendix A). As no other reading taken on the ground floor exceeded the tolerances, it has been assumed that the unevenness was caused by the floor covering.

3.1.8 Residents' lounge

- There is a visible gab between the primary and secondary timber rafters (Photo #2).
- A crack was found on the plaster lining over an opening at mid span (Photo #4).
- Cracking was observed to the exterior slab (Photo #11)
- A floor level survey using the zip level was carried out on the slab-on-grade and structural slab and has shown that the levels do not exceed the DBH guidelines limits (see Appendix A).

3.2 Record of Intrusive Investigation

There was limited damage to the building and therefore, an intrusive investigation was neither warranted nor undertaken for Bryndwr Courts Housing Complex. A metal detector was used on masonry walls to verify the reinforcement.

3.3 Damage Discussion

Minor seismic related damages were noted in the damage assessment and most of them were found to be on wall and ceiling linings. This is not surprising given that most of the horizontal load is distributed to the ceiling and timber-framed walls in the longitudinal direction. However, the reinforced masonry walls that run across the building provide a good resistance to torsion and horizontal load in the transversal direction.

4 Building Review Summary

4.1 Building Review Statement

As noted in section 3.2, no intrusive investigations were carried out for the Bryndwr Courts Housing Complex.

4.2 Critical Structural Weaknesses

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

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

5.1 General

The Bryndwr Courts Housing Complex consists of seven blocks constructed using reinforced masonry blocks, timber and block veneer. With sufficient walls and good detailing, all buildings have performed well in the Canterbury earthquake sequence as evidenced by the limited damage described in Section 3.

5.2 Initial %NBS Assessment

5.2.1 Blocks A, B and F

Table 1: Parameters used in the Seismic Assessment for blocks A and B

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 in the Longitudinal Direction, μ	2.0	Timber braced frames (with ductile connections) (AS 1170.4 – 2007 Table 6.5A).
Ductility Factor in the Transverse Direction, μ	1.5	Wide spaced reinforced masonry (AS 1170.4 – 2007 Table 6.5A).

The building strength assessment for the blocks A, B and F was carried out through detailed demand and capacity analysis. In the transverse direction where the lateral load capacity is carried through the reinforced masonry walls, the building strength has been calculated to be 100% of the new building standard (NBS). In the longitudinal direction, the lateral load carrying capacity of the timber-braced frames and the capacity was also found to be 100% NBS. The results of the calculations are in agreement with the lack of important damage observed in both directions.

5.2.2 Blocks C, D, E

Table 2: Parameters used in the Seismic Assessment for blocks C, D, E

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 in the Longitudinal Direction, μ	2.0	Timber braced frames (with ductile connections) (AS 1170.4 – 2007 Table 6.5A).
Ductility Factor in the Transverse Direction, μ	1.5	Wide spaced reinforced masonry (AS 1170.4 – 2007 Table 6.5A).

In regards to the blocks C, D and E two storey high section, the strength assessment has been based on the lateral load carrying capacity of reinforced masonry in the transversal direction and the combination of the timber-framed walls and two reinforced masonry walls in the longitudinal direction, from roof to ground. As the two masonry walls located at the front side of the building were considered in the longitudinal direction, it has been assumed that the two systems had compatible stiffness. However, only timber-framed walls were considered in the same direction for the one storey high section. The capacity was found to be limited in this direction as the calculation gave 33% NBS (Block E). The results are surprisingly low as very minor damage was observed.

5.2.3 Residents' lounge

Table 3: Parameters used in the Seismic Assessment for Residents' lounge

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 in the Along Direction, μ	1.5	Wide spaced reinforced masonry (AS 1170.4 – 2007 Table 6.5A).
Ductility Factor in the Across Direction, μ	1.5	Wide spaced reinforced masonry (AS 1170.4 – 2007 Table 6.5A).

For the Residents' lounge the strength assessment has been based on the lateral load carrying capacity of the reinforced masonry walls has shown a building strength of 100% NBS for both principal directions. The results of the calculations are in agreement with the observations of the damage assessment

6 Conclusions and Recommendations

Given the good performance of the buildings of Bryndwr Courts Housing Complex in the Canterbury earthquake sequence, the limited foundation damage and the floor levels considered to be within acceptable limits, **a geotechnical investigation is currently not considered necessary**.

Additionally, the building has suffered no loss of functionality and in our opinion the Bryndwr Courts Housing Complex buildings **are considered suitable for continued occupation on the following basis**:

- The strength of the building is equal to the minimum of 33% earthquake prone limit.
- There are no critical structural weaknesses.
- There is minimal damage.

There is no legislative requirement to strengthen the building; however we recommend that the building undergoes the following repairs/strengthening:

1. All cracks in the exterior cladding should be repaired.
2. Cracks in exterior patio concrete slabs of blocks should be repaired.
3. Plaster cracking should be repaired according to plaster specifications wherever applicable.
4. Blocks C,D, and E should be reinforced above 67% NBS in the longitudinal direction and if economically feasible 100% to NBS.

7 Explanatory Statement

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

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

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

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

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

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

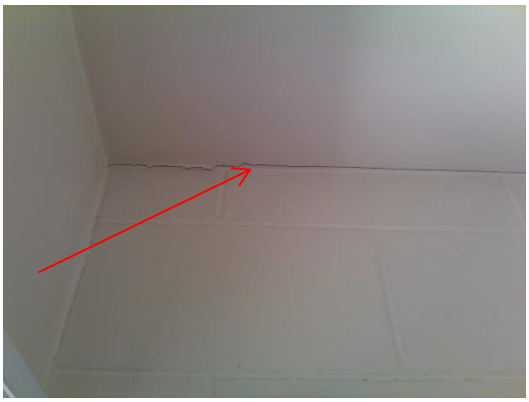
Appendices

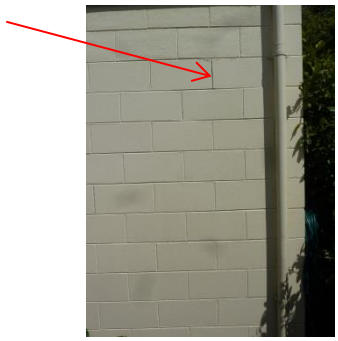
Appendix A

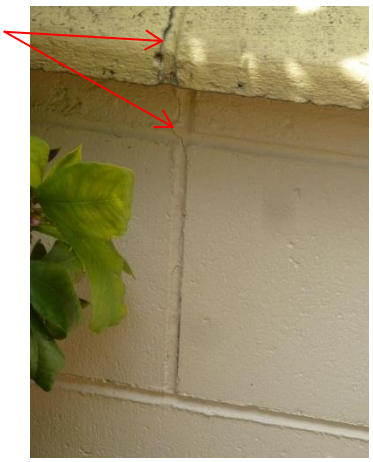
Site Map, Photos and Levels survey

28 November 2012 – Bryndwr Courts Housing Complex Site Photographs

Aerial view showing Brydwr Courts Housing Complex

#1.	Cracking at joint between the reinforced masonry wall and the ceiling or other linings. Block A Units #1, 2, 3, Block B Units #6, 7, 9, Block C Unit #11, Block D Units #16, 20.	
#2.	Cracking in plaster starting at the corner of door or window. Block A Units #1, 2, 3, Block B Units #4, 5, 6, 7, Block C Unit #12, Block D Unit #20, Block E Unit #26, 27, Block F Unit #32, Residents' Lounge.	
#3.	Cracking of the ceiling linings. Block A Unit #3, Block B Unit #7, Block C Units #10,12, Block D Unit #20, Block E Units #26, 28, Residents' Lounge.	
#4.	Cracking of linings over an opening, at mid span. Residents' Lounge.	

#5.	Cracking at mortar joint on exterior 90mm block veneer. Block C, Block D.	
#6.	Cracking at the mortar joint between the two storey high section and the one storey high section. Block C.	
#7.	Cracking at the joint between the 190mm block wall in the transversal direction and architectural elements. Block C.	
#8.	Cracking at the joint between the 190mm block wall and the 90mm block veneer in the transversal direction. Block C.	

#9.	Cracking at mortar joint between the two bottom rows of blocks. Block E.	
#10.	Cracking of the window block sill continuing through the block wall. Block E.	
#11.	Cracked exterior slab of the Residents' Lounge.	
#12.	Cracked exterior concrete sidewalk.	

Level Survey every measure is in mm

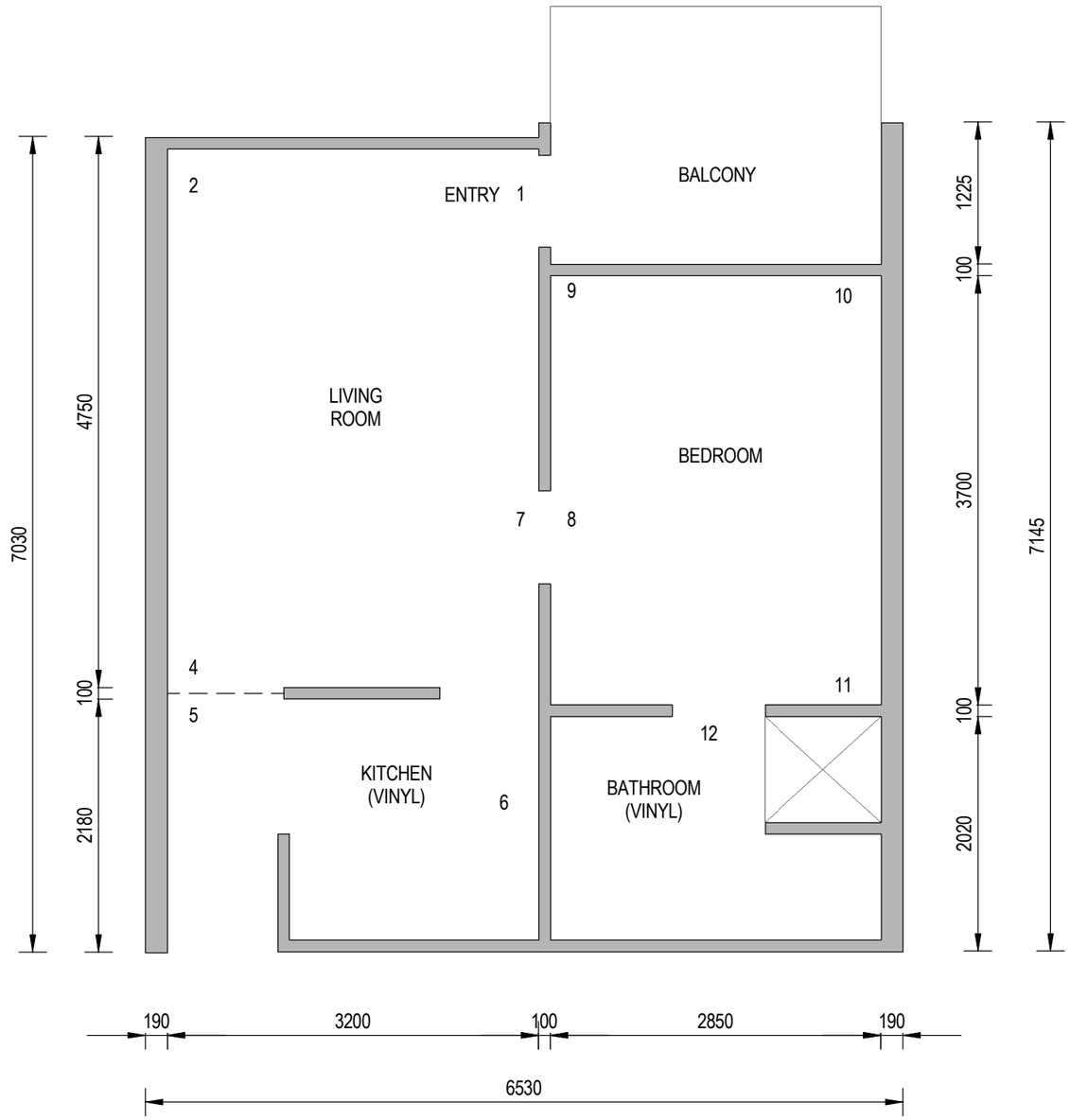
	Unit:	1	2	3	4	5	6	7	8	9	10	11	12	13	14
		actual	actual	actual	actual	actual	actual	actual	actual	actual	actual	actual	actual	actual	actual
	point														
	1	0	0		0		0	0	0	0	0	0	-4	0	-4
	2	-8	6		4		2	4	-4	-4	-4	8	4	0	16
	3	-8	4		8		2	4	-2	-4	-2	-4	-2	0	2
	4	-8	6		12		4	8	-4	-12	-4	4	2	-4	10
carpet vs.	5up	-2	0		18		8	10	0	0	-2	0	0	0	0
tiles	5dwn	-14	-4		8		0	-2	-14	-20	-14		0		
	6	-8	4		4		-4	-8	-14	-18	-16		0		
	7	8	14		0		4	0	-2	-4	-8	-2	-8	0	-6
	8	10	20		-8		4	0	0	-2	-4	0	-8	-4	-6
	9	10	0		4		6	x	-4	6	0	4	4		-6
	10	0	10		-2		8	8	x	12	-2	0	0		-6
	11	0	8		-4		18	16	4	4	-4	0	10	0	-2
carpet vs.	12up	0	12		0		16	14	-4	0	0	0	-4	-4	-6
tiles	12dwn	0	0		-10		4	4	-14	-14	-16	-8	-14	-8	-20
	13	0	0		-8		6	6	-14	-12	-14	-8	-10	-12	-20

Level Survey every measure is in mm

	Unit:	16	17	18	19	20	21	22 (access (don't)	23	24	25	26	27	28	29	30	31	32	3 (Unlocked later)	5 (Unlocked later)	15 (Unlocked later)
		actual	actual	actual	actual	actual	actual	actual	actual	actual	actual	actual	actual	actual	actual	actual	actual	actual	actual	actual	actual
	point																				
	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	-16	8	12	14	4	2	x	-2	4	6	4	2	16	2	0	8	2	-2	4	
	3	-8	18	4	10	-2	6	x	0	6	4	-4	14	2	0	6	2	0	-2	8	14
	4	-14	6	2	12	-2	14	x	2	-10	-2	4	-2	-2	0	-2	-10	-2	-2	12	2
carpet vs.	5up	-14	12	2	10	8	10	x	-4	-4	-4	-6	-2	-12	0	-4	-18	-2	4	12	-6
tiles	5dwn	-26	-2	-8	0	-2	0	x	-18	-14	-14	-18	-14	-12	-12	-14	-28	-10	-2	4	-22
	6	-8	8	-12	0	-2	-2	x	-14	-12	-20	-18	-6	-14	-12	-18	-28	-4	0	12	-18
	7	6	12	0	10	-2	6	x	-8	4	-2	-6	8	0	4	-2	-4	10	14	22	2
	8	8	12	0	10	8	12	x	-6	4	2	-8	8	-8	0	4	0	18	14	24	-4
	9	4	12	2	6	8	2	x	-2	12	8	1	14	4		18	8	14	-4	18	-4
	10	4	14		12	12	16	x	2			1		6	6			10	12	18	
	11	-4	8	-8	4	12	16	x	2	-2	-8	-4	4	0	6	12	2	12	18	22	
carpet vs.	12up	4	14	-12	10	0	16	x	-2	-4	-8	-12	0	-2	6	14	-6	6	18	28	2
tiles	12dwn	-4	8	-22	0	-12	4	x	-14	-14	-24	-26	-14	-12	-8	4	-24	-4	6	14	-10
	13	-12	4	-22	-4	0	4	x	-12	-12	-22	-22	-6	0	-12	-14	-28	-14	6	12	-16

NOTE:

FOR LEVELS IN EACH UNIT REFER TO LEVELS TABLE



GROUND FLOOR- UNITS 1-11, 16-18, 23-24, 29-32

1 : 50

1/03/2013 2:39:44 p.m.

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www.aurecongroup.com

CLIENT: Christchurch City Council

REV	DATE	REVISION DETAILS	APPROVAL
A	01.03.13	LEVEL SURVEY	APP

DRAWN	DESIGNED
N.Stanojevic	N/A

CHECKED: L.Castillo

APPROVED: DATE L.Castillo

PROJECT: 26 Lees Road, Strowan

TITLE: LEVEL SURVEY-SINGLE UNIT

PRELIMINARY
NOT FOR CONSTRUCTION

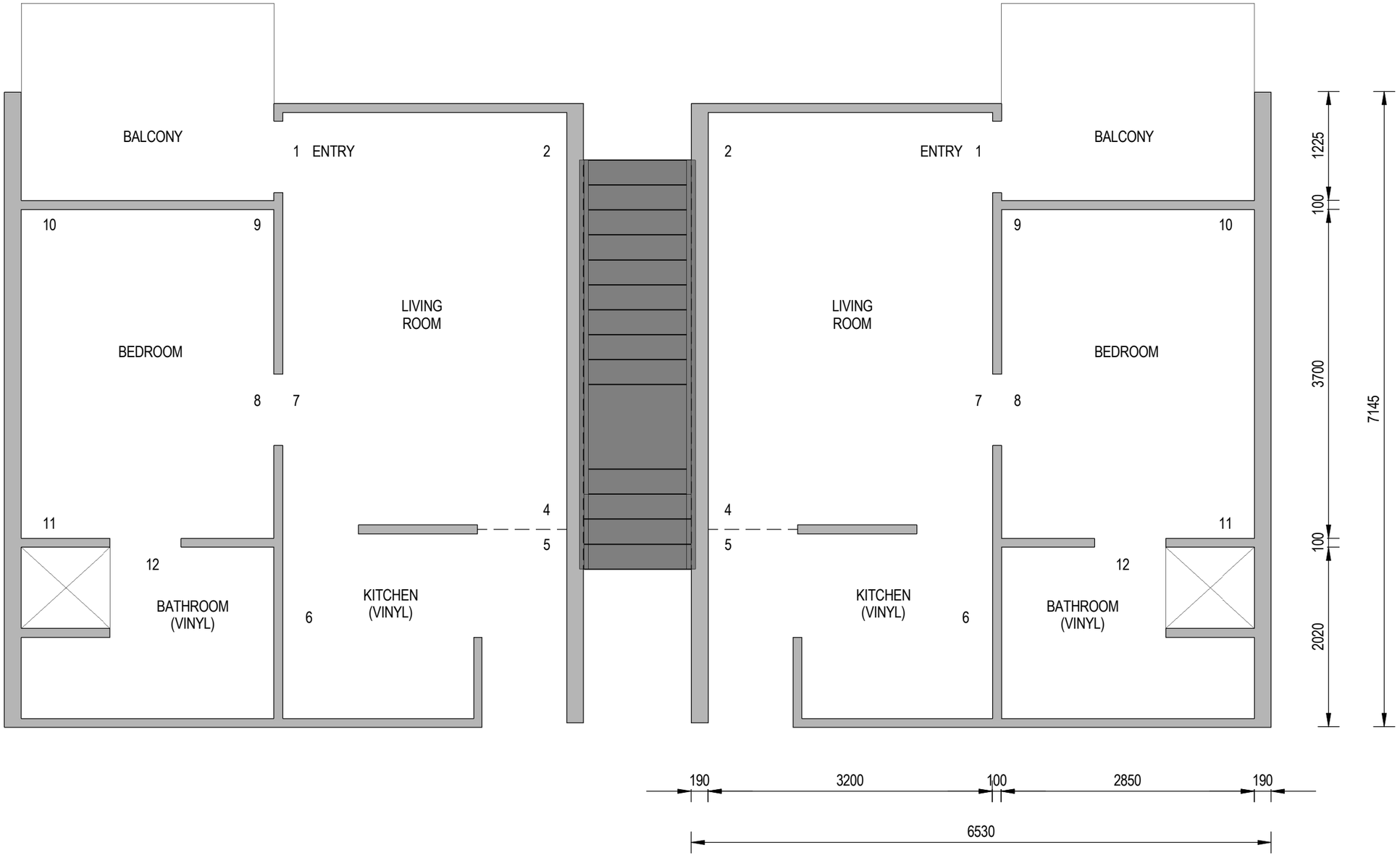
PROJECT No.: 232881

SCALE: 1 : 50 | SIZE: A3

DRAWING No.: SK-001 | REV: A

NOTE:

FOR LEVELS IN EACH UNIT REFER TO LEVELS TABLE



GROUND FLOOR- UNITS 13, 15, 19, 21, 25 & 27

1 : 50

1/03/2013 2:39:44 p.m.

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CLIENT: Christchurch City Council

REV	DATE	REVISION DETAILS	APPROVAL
A	01.03.13	LEVEL SURVEY	APP

DRAWN	DESIGNED
N.Stanojevic	N/A

CHECKED: L.Castillo

APPROVED: DATE: L.Castillo

PROJECT: 26 Lees Road, Strowan

TITLE: LEVEL SURVEY - GROUND LEVEL

PRELIMINARY
NOT FOR CONSTRUCTION

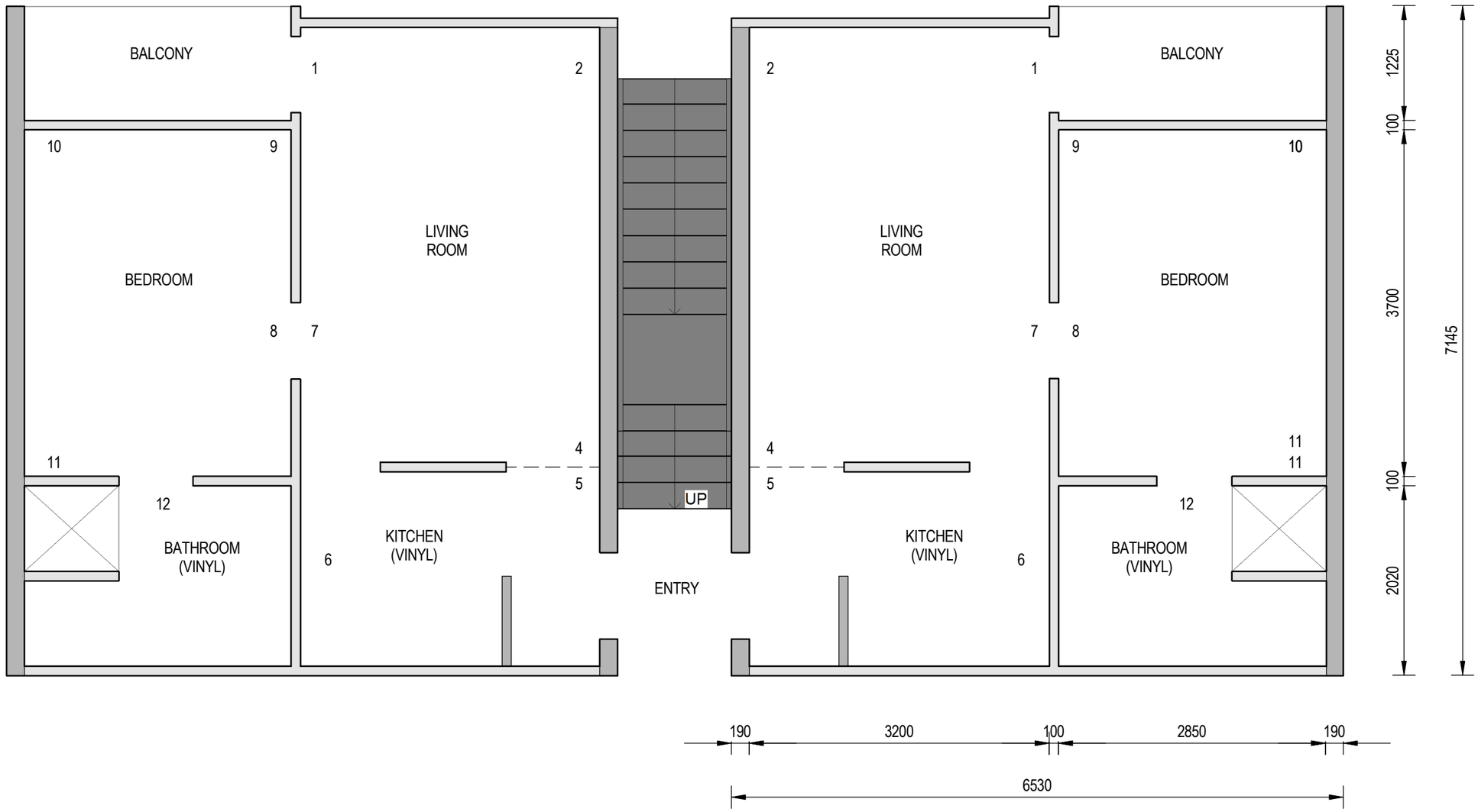
PROJECT No.: 232881

SCALE	SIZE
1 : 50	A3

DRAWING No.	REV
SK-002	A

NOTE:

FOR LEVELS IN EACH UNIT REFER TO LEVELS TABLE



LEVEL 2- UNITS 12, 14, 20, 22, 26 & 28

1 : 50

1/03/2013 2:39:45 p.m.

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CLIENT: Christchurch City Council

REV	DATE	REVISION DETAILS	APPROVAL
A	01.03.13	LEVEL SURVEY	APP

DRAWN	DESIGNED
N.Stanojevic	N/A

CHECKED: L.Castillo

APPROVED: DATE L.Castillo

PROJECT: 26 Lees Road, Strowan

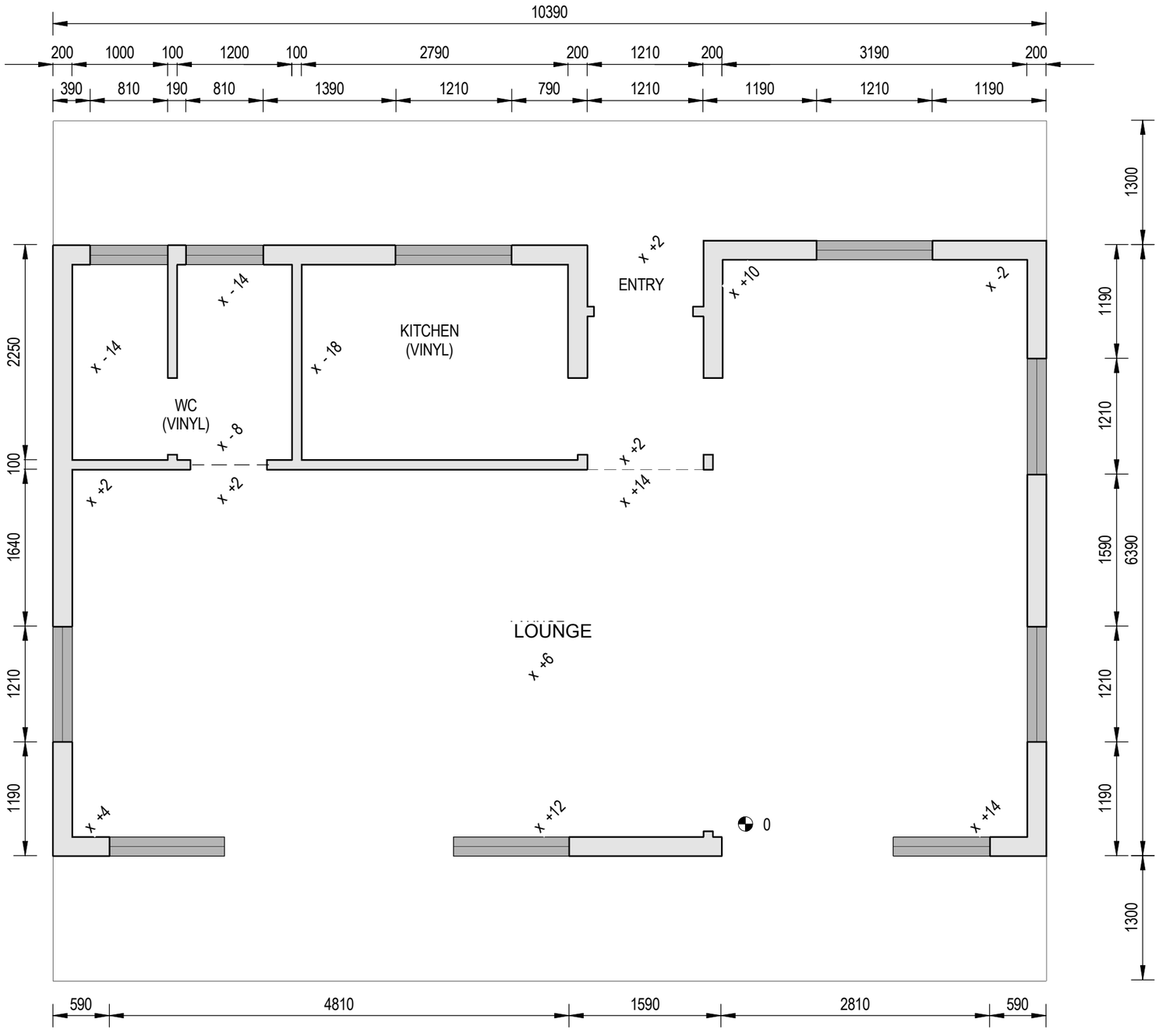
TITLE: LEVEL SURVEY - LEVEL 2

PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT No.: 232881

SCALE	SIZE
1 : 50	A3

DRAWING No.	REV
SK-003	A



RESIDENTS LOUNGE

1 : 50

1/03/2013 2:39:45 p.m.

aurecon
www.aurecongroup.com

CLIENT: Christchurch City Council

REV	DATE	REVISION DETAILS	APPROVAL
A	01.03.13	LEVEL SURVEY	APP

DRAWN	DESIGNED
N.Stanojevic	N/A

CHECKED: L.Castillo

APPROVED: DATE L.Castillo

PROJECT: 26 Lees Road, Strowan

TITLE: SURVEY PLAN RESIDENTS LOUNGE

PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT No.: 232881

SCALE	SIZE
1 : 50	A3

DRAWING No.	REV
SK-004	A

Appendix B
References

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

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

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

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

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

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

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

8. Standards New Zealand, “NZS 3603, Timber Structures Standard”, 1993

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

Appendix C
Strength Assessment Explanation

New building standard (NBS)

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

Earthquake Prone Buildings

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

Christchurch City Council Earthquake Prone Building Policy 2010

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

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

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

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

Christchurch Seismicity

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

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

The likely capacity of this building has been derived in accordance with the New Zealand Society for Earthquake Engineering (NZSEE) guidelines 'Assessment and Improvement of the Structural Performance of Buildings in Earthquakes' (AISPBE), 2006. These guidelines provide an Initial Evaluation Procedure that assesses a buildings capacity based on a comparison of loading codes from when the building was designed

and currently. It is a quick high-level procedure that can be used when undertaking a Qualitative analysis of a building. The guidelines also provide guidance on calculating a modified Ultimate Limit State capacity of the building which is much more accurate and can be used when undertaking a Quantitative analysis.

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

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

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

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

Table C1: Relative Risk of Building Failure In A

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

Appendix D
Background and Legal Framework

Background

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

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

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

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

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

- ✓ Blocks A, B and F - 1 Storey
- ✓ Blocks C, D and E - 2 Storeys
- ✓ Resident's Lounge

Detailed Engineering Evaluation Summary Data V1.9

Location

Building Name:	Brydwr Courts (1-storey: Block A, B, F)				Reviewer:	Lee Howard
	Unit	No:	Street		CPEng No:	108889
Building Address:		26	Lees Road		Company:	
Legal Description:	Lot 4 DP10469				Company project number:	
					Company phone number:	
	Degrees	Min	Sec			
GPS south:	43	30	29.46		Date of submission:	27-Feb-13
GPS east:	172	36	15.14		Inspection Date:	28-Nov-12
					Revision:	
Building Unique Identifier (CCC):	BE_0581_EQ2 - Bryndwr Court				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):	9.00

Building

No. of storeys above ground:	1	single storey = 1		Ground floor elevation (Absolute) (m):	9.00
Ground floor split?	no			Ground floor elevation above ground (m):	0.15
Storeys below ground	0				
Foundation type:				if Foundation type is other, describe:	
Building height (m):	3.90			height from ground to level of uppermost seismic mass (for IEP only) (m):	6.5
Floor footprint area (approx):	140				
Age of Building (years):	33			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	timber, brickwork & weatherboard
Floors:			
Beams:	timber	type	
Columns:	load bearing walls	typical dimensions (mm x mm)	
Walls:	partially filled concrete masonry	thickness (mm)	190

Lateral load resisting structure

East-west	Lateral system along:	lightweight timber framed walls			note typical wall length (m)	
	Ductility assumed, μ:	2.00				
	Period along:	0.35	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:	partially filled CMU			note total length of wall at ground (m):	34
	Ductility assumed, μ:	1.50			wall thickness (m):	0.19
	Period across:	0.35	0.40	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:			
Wall cladding:	plaster system	describe	concrete shear walls
Roof Cladding:	Profiled fibre cement	describe	Monier tiles
Glazing:	timber frames		
Ceilings:	plaster, fixed		
Services(list):			

Available documentation

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

Damage

Site: (refer DEE Table 4-2)

Site performance:	Good	Describe damage:	minor cracks to veneer and linings
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:		Describe how damage ratio arrived at:	no damage
Along — Describe (summary):	none		
Across — Damage ratio:	0%	$Damage\_Ratio = \frac{(\%NBS(before) - \%NBS(after))}{\%NBS(before)}$	
Across — Describe (summary):	none		
Diaphragms — Damage?:	no	Describe:	
CSWs: — Damage?:	no	Describe:	
Pounding: — Damage?:	no	Describe:	
Non-structural: — Damage?:	yes	Describe:	minor

Recommendations

Level of repair/strengthening required:	none		Describe:	
Building Consent required:	no		Describe:	
Interim occupancy recommendations:	full occupancy		Describe:	
Along — Assessed %NBS before:	100%	0% %NBS from IEP below		
Along — Assessed %NBS after:	100%			
Across — Assessed %NBS before:	100%	0% %NBS from IEP below		

Assessed %NBS after: 100%

IEP

Age of Building (from above): 1976-1992

h_n from above: 6.5m

Seismic Zone, if designed between 1965 and 1992: C

not required for this age of building: C shallow soil

not required for this age of building: b) Intermediate

	along	across
Period (from above):	0.35	0.35
(%NBS)nom from Fig 3.3:	17.1%	21.7%
Note:1 for buildings designed prior to 1976 as public buildings, to code at time, use 1.25		1.00
Note 2: for RC buildings designed between 1976-1984, use 1.2		1.0
Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0)		1.0
	along	across
Final $(\%NBS)_{nom}$:	**17%**	**22%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, Table 3.3): 1.00

	along	across
Near Fault scaling factor (1/N(T,D), **Factor A**:	1	1

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3: 0.30

Z_{1992}, from NZS4203:1992:

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**: 1.00

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.3)	2.00	2.00
Ductility scaling factor (if pre-1976):	1.00	1.00
Ductiity Scaling Factor, **Factor D**:	1.00	1.00

2.6 Structural Performance Scaling Factor:

Sp:	0.700	0.700
Structural Performance Scaling Factor **Factor E**:	1.428571429	1.428571429

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

$\%NBS_b$:	**81%**	**103%**

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

3.1. Plan Irregularity, factor A: 1

3.2. Vertical irregularity, Factor B: 1

3.3. Short columns, Factor C: 1

3.4. Pounding potential

Pounding effect D1, from Table to right: 1.0

Height Difference effect D2, from Table to right: 1.0

Therefore, Factor D: 1

3.5. Site Characteristics 1

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

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

Height difference 2 to 4 storeys	0.7	0.9	1
Height difference < 2 storeys	1	1	1

		Along	Across
3.6. Other factors, Factor F	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:	**0%**	**0%**
4.4 Percentage New Building Standard (%NBS), (before)			**0%**

Detailed Engineering Evaluation Summary Data V1.9

Location

Building Name:	Brydwr Courts (2-storey: Block C, D, E)			Reviewer:	Lee Howard	
	Unit	No:	Street	CPEng No:	108889	
Building Address:		26	Lees Road	Company:		
Legal Description:	Lot 4 DP10469			Company project number:		
				Company phone number:		
	Degrees	Min	Sec			
GPS south:	43	30	29.46	Date of submission:	22-Jan-13	
GPS east:	172	36	15.14	Inspection Date:	28-Nov-12	
				Revision:		
Building Unique Identifier (CCC):	BE_0581_EQ2 - Bryndwr Court			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):	9.00

Building

No. of storeys above ground:	2	single storey = 1	Ground floor elevation (Absolute) (m):	9.00
Ground floor split?	no		Ground floor elevation above ground (m):	0.15
Storeys below ground	0			
Foundation type:			if Foundation type is other, describe:	
Building height (m):	6.50		height from ground to level of uppermost seismic mass (for IEP only) (m):	6.5
Floor footprint area (approx):	200			
Age of Building (years):	33		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	timber, brickwork & weatherboard
Floors:	concrete flat slab	slab thickness (mm)	
Beams:	cast-insitu concrete	overall depth x width (mm x mm)	
Columns:	load bearing walls	typical dimensions (mm x mm)	
Walls:	partially filled concrete masonry	thickness (mm)	190

Lateral load resisting structure

East-west	Lateral system along:	lightweight timber framed walls		note typical wall length (m)	
	Ductility assumed, μ:	2.00			
	Period along:	0.35	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:	partially filled CMU		note total length of wall at ground (m):	34
	Ductility assumed, μ:	1.50		wall thickness (m):	0.19
	Period across:	0.35	0.40 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:			
Wall cladding:	plaster system	describe	concrete shear walls
Roof Cladding:	Profiled fibre cement	describe	Monier tiles
Glazing:	timber frames		
Ceilings:	plaster, fixed		
Services(list):			

Available documentation

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

Damage

Site:

Site performance:	Good	Describe damage:	minor cracks to veneer and linings

(refer DEE Table 4-2)

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:		Describe how damage ratio arrived at: no damage
	Describe (summary): none		
Across	Damage ratio: 0%	$Damage\_Ratio = \frac{(\%NBS\,(before) - \%NBS\,(after))}{\%NBS\,(before)}$	
	Describe (summary): none		
Diaphragms	Damage?: no	Describe:	
CSWs:	Damage?: no	Describe:	
Pounding:	Damage?: no	Describe:	
Non-structural:	Damage?: yes	Describe:	minor

Recommendations

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

Along	Assessed %NBS before:	33%	0% %NBS from IEP below
	Assessed %NBS after:	33%	
Across	Assessed %NBS before:	100%	0% %NBS from IEP below
	Assessed %NBS after:	100%	

IEP

Age of Building (from above): 1976-1992 h_n from above: 6.5m

Seismic Zone, if designed between 1965 and 1992:	C	not required for this age of building	C shallow soil
		not required for this age of building	b) Intermediate

	along	across
Period (from above):	0.35	0.35
(%NBS)nom from Fig 3.3:	17.1%	21.7%
Note:1 for buildings designed prior to 1976 as public buildings, to code at time, use 1.25		1.00
Note 2: for RC buildings designed between 1976-1984, use 1.2		1.0
Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0)		1.0
	along	across
Final $(\%NBS)_{nom}$:	**17%**	**22%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, Table 3.3):		1.00
	along	across
Near Fault scaling factor (1/N(T,D), **Factor A**:	1	1

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3:	0.30
Z_{1992}, from NZS4203:1992	
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**:	1.00

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.3)	2.00	2.00
Ductility scaling factor (if pre-1976):	1.00	1.00
Ductiity Scaling Factor, **Factor D**:	1.00	1.00

2.6 Structural Performance Scaling Factor:

Sp:	0.700	0.700
Structural Performance Scaling Factor **Factor E**:	1.428571429	1.428571429

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

$\%NBS_b$:	**81%**	**103%**

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

3.1. Plan Irregularity, factor A: 1

3.2. Vertical irregularity, Factor B: 1

3.3. Short columns, Factor C: 1

3.4. Pounding potential

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

3.5. Site Characteristics 1

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

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

3.6. Other factors, Factor F

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

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

3.7. Overall Performance Achievement ratio (PAR)	**0.00**	**0.00**

4.3 PAR x (%NBS)b:	PAR x Baselline %NBS:	**0%**	**0%**
4.4 Percentage New Building Standard (%NBS), (before)			**0%**

Detailed Engineering Evaluation Summary Data V1.9

Location

Building Name:	Brydwr Courts (Residents' Lounge)				Reviewer:	Lee Howard
		Unit	No:	Street	CPEng No:	108889
Building Address:			26	Lees Road	Company:	
Legal Description:	Lot 4 DP10469				Company project number:	
					Company phone number:	
		Degrees	Min	Sec		
GPS south:		43	30	29.46	Date of submission:	22-Jan-13
GPS east:		172	36	15.14	Inspection Date:	28-Nov-12
					Revision:	
Building Unique Identifier (CCC):	BE_0581_EQ2 - Bryndwr Court				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):	9.00

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m):	9.00
Ground floor split?	no		Ground floor elevation above ground (m):	0.15
Storeys below ground	0			
Foundation type:			if Foundation type is other, describe:	
Building height (m):	3.90		height from ground to level of uppermost seismic mass (for IEP only) (m):	6.5
Floor footprint area (approx):	140			
Age of Building (years):	33		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	timber, brickwork
Floors:			
Beams:	timber	type	
Columns:	load bearing walls	typical dimensions (mm x mm)	
Walls:	partially filled concrete masonry	thickness (mm)	90

Lateral load resisting structure

East-west	Lateral system along:	partially filled CMU		note total length of wall at ground (m):	
	Ductility assumed, μ:	1.50		wall thickness (m):	0.09
	Period along:	0.35	##### enter height above at H30	estimate or calculation?	estimated
	Total deflection (ULS) (mm):			estimate or calculation?	
	maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
North-south	Lateral system across:	partially filled CMU		note total length of wall at ground (m):	
	Ductility assumed, μ:	1.50		wall thickness (m):	0.09
	Period across:	0.35	##### enter height above at H30	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:	plaster system	describe	concrete shear walls
Roof Cladding:	Profiled fibre cement	describe	Monier tiles
Glazing:	timber frames		
Ceilings:	plaster, fixed		
Services(list):			

Available documentation

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

Damage

Site:

(refer DEE Table 4-2)			
Site performance:	Good	Describe damage:	
Settlement:	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:		Describe how damage ratio arrived at:	no damage
	Describe (summary):	none		
Across	Damage ratio:	0%	$Damage\_Ratio = \frac{(\%NBS(before) - \%NBS(after))}{\%NBS(before)}$	
	Describe (summary):	none		
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	yes	Describe:	minor

Recommendations

	Level of repair/strengthening required:	none	Describe:	
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before:	100%	0% %NBS from IEP below	
	Assessed %NBS after:	100%		
Across	Assessed %NBS before:	100%	0% %NBS from IEP below	
	Assessed %NBS after:	100%		

IEP

Age of Building (from above): 1976-1992 h_n from above: 6.5m

Seismic Zone, if designed between 1965 and 1992:	C	not required for this age of building	C shallow soil
		not required for this age of building	b) Intermediate

	along	across
Period (from above):	0.35	0.35
(%NBS)nom from Fig 3.3:	17.1%	21.7%
Note:1 for buildings designed prior to 1976 as public buildings, to code at time, use 1.25		1.00
Note 2: for RC buildings designed between 1976-1984, use 1.2		1.0
Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0)		1.0
	along	across
Final $(\%NBS)_{nom}$:	**17%**	**22%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, Table 3.3):		1.00
	along	across
Near Fault scaling factor (1/N(T,D), **Factor A**:	1	1

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3:	0.30
Z_{1992}, from NZS4203:1992	
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**:	1.00

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.3)	2.00	2.00
Ductility scaling factor (if pre-1976):	1.00	1.00
Ductiity Scaling Factor, **Factor D**:	1.00	1.00

2.6 Structural Performance Scaling Factor:

Sp:	0.700	0.700
Structural Performance Scaling Factor **Factor E**:	1.428571429	1.428571429

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

$\%NBS_b$:	**81%**	**103%**

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

3.1. Plan Irregularity, factor A: 1

3.2. Vertical irregularity, Factor B: 1

3.3. Short columns, Factor C: 1

3.4. Pounding potential

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

3.5. Site Characteristics 1

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

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

3.6. Other factors, Factor F

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

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

3.7. Overall Performance Achievement ratio (PAR)	**0.00**	**0.00**

4.3 PAR x (%NBS)b:	PAR x Baselline %NBS:	**0%**	**0%**
4.4 Percentage New Building Standard (%NBS), (before)			**0%**

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