Airedale Courts BE 1951 EQ2 Detailed Engineering Evaluation Quantitative Assessment Report



51-57 Salisbury Street, Christchurch 59-63 Salisbury Street, Christchurch 12-14 Airedale Place, Christchurch 16-18 Airedale Place, Christchurch 16 Conference Street, Christchurch 24-26 Conference Street, Christchurch 28-30 Conference Street, Christchurch

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Christchurch City Council

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Airedale Courts BE 1951 EQ2

Detailed Engineering Evaluation Quantitative Report - SUMMARY Final – Version 3

Background

This is a summary of the quantitative report for the building structure, and is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011, visual inspections, and available drawings.

Key Damage Observed

Key damage observed includes:

- 1. Moderate to severe ground subsidence has occurred throughout the site.
- 2. Major slab on grade damage in Blocks C, D, F, and G. Minor damage observed in Blocks A, B, and E.
- 3. Minor differential settlements were identified over all building floors, which imply wall settlement and building rotation. This is most significant at the west end of Block E.
- 4. Minor horizontal crack observed at the construction joint between the block walls and basement concrete wall in Blocks D and G.
- 5. Minor stepped cracks at openings in the block veneer in Blocks A, B, C, E and F.
- 6. Minor horizontal cracks in precast concrete fins in Blocks A and B.

Aside from the ground conditions, the superstructure performed well and the observed damage is consistent with the expected building performance, following our review of the structural drawings and site investigations.

Critical Structural Weaknesses

The main critical structural weaknesses are the block walls that are either discontinuous or that have large openings at the ground storey. These walls will impose large flexural demands on supporting beams (discontinuous walls) or large axial tension and compression forces in the small piers adjacent to the openings. These conditions occur in Blocks A, B, C and F.

Blocks D, E and G do not have any obvious critical structural weaknesses.

The seismic performance of primary components (partially or fully grouted reinforced block walls) is generally governed by flexural hinging (reinforcement yielding). In some cases, where walls have large openings at their base, the wall can be controlled by axial tension and reinforcement yielding.

Indicative Building Strength

Based on the information available, and from undertaking a quantitative assessment, the assessed buildings capacities are shown in the table below. Blocks A, C, D, E, F and G are considered a moderate risk in accordance with NZSEE guidelines as they have seismic capacities between 34%

and 67% NBS. Block B has a seismic capacity of less than 34% NBS and this therefore defined as an earthquake prone building in accordance with the Building Act 2004.

BU Number	CCC Building Name	Address	%NBS
BU 1951-001 EQ2	Block A	59-63 Salisbury Street	34%
BU 1951-004 EQ2	Block B	51-57 Salisbury Street	15%
BU 1951-005 EQ2	Block C	12-14 Airedale Place	44%
BU 1951-006 EQ2	Block D	16-18 Airedale Place	50%
BU 1951-003 EQ2	Block E	16 Conference Street	52%
BU 1951-008 EQ2	Block F	24-26 Conference Street	44%
BU 1951-009 EQ2	Block G	28-30 Conference Street	50%
BU 1951-002 EQ2		Public Rental	
BU 1951-010 EQ2		#9-12	
BU 1951-011 EQ2		#13-19	
BU 1951-012 EQ2	Caragoo	#20-31	1000/
BU 1951-013 EQ2	Garages	#32-40	~100%
BU 1951-015 EQ2		#41-43	
BU 1591-014 EQ2		#44-46	
BU 1591-007 EQ2		#47-52	

Recommendations

We recommend that further work is undertaken in order to develop the scope of the strengthening and repair options. This work should involve:

- 1. Developing a strengthening works scheme to increase the seismic capacity of the building to as near as practicable to 100%NBS, and at least 67%NBS. This will need to consider compliance with accessibility and fire requirements. It may be beneficial to engage a quantity surveyor to consider costs for strengthening options.
- 2. Perform a full geotechnical assessment of the site to determine the liquefaction potential and to identify conceptual foundation repair and strengthening works.

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1. Introduction

Opus International Consultants Limited has been engaged by Christchurch City Council (CCC) to undertake a detailed seismic assessment of Airedale Courts, located on Airedale Place in Christchurch (northeast of the intersection of Durham and Salisbury Streets) following the M6.3 Christchurch earthquake on 22 February 2011.

The purpose of the assessment is to determine if the building is classed as being earthquake prone in accordance with the Building Act 2004.

The seismic assessment and reporting have been undertaken based on the qualitative and quantitative procedures detailed in the Detailed Engineering Evaluation Procedure (DEEP) document (draft) issued by the Structural Engineering Society (SESOC) on 19 July 2011.

This report has been prepared by Opus International Consultants in conjunction with Simpson Gumpertz and Heger.

2. 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.

2.1 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 to 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 (DEEP) document (draft) issued by the Structural Engineering Society (SESOC) on 19 July 2011. This document sets out a methodology for both initial qualitative and detailed quantitative assessments.

It is anticipated that a number of factors, including the following, will determine the extent of evaluation and strengthening level required:



- 1. The importance level and occupancy of the building.
- 2. The placard status and amount of damage.
- 3. The age and structural type of the building.
- 4. Consideration of any critical structural weaknesses.

We anticipate that any building with a capacity of less than 34% of new building standard (including consideration of critical structural weaknesses) will need to be strengthened to a target of 67% as required by the CCC Earthquake Prone Building Policy.

2.2 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 the 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)) is satisfied that the building with a new use complies with the relevant sections of the Building Code 'as near as is reasonably practicable'.

This is typically interpreted by CCC as being 67% of the strength of an equivalent new building. This is also the minimum level recommended by the New Zealand Society for Earthquake Engineering (NZSEE).

Section 121 – Dangerous Buildings

This section was extended by the Canterbury Earthquake (Building Act) Order 2010, and defines a building as dangerous if:

- 1. 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
- 2. 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
- 3. 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
- 4. There is a risk that other property could collapse or otherwise cause injury or death; or



5. 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 loads 33% of those 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.

2.3 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 on 4 September 2010.

The 2010 amendment includes the following:

- 1. A process for identifying, categorising and prioritising Earthquake Prone Buildings, commencing on 1 July 2012;
- 2. A strengthening target level of 67% of a new building for buildings that are Earthquake Prone;
- 3. A timeframe of 15-30 years for Earthquake Prone Buildings to be strengthened; and,
- 4. 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.

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.

2.4 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.

On 19 May 2011, Compliance Document B1: Structure was amended to include increased seismic design requirements for Canterbury as follows:

- 36% increase in the basic seismic design load for Christchurch (Z factor increased from 0.22 to 0.3);
- Increased serviceability requirements.

2.5 Institution of Professional Engineers New Zealand (IPENZ) Code of Ethics

One of the core ethical values of professional engineers in New Zealand is the protection of life and safeguarding of people. The IPENZ Code of Ethics requires that:

Members shall recognise the need to protect life and to safeguard people, and in their engineering activities shall act to address this need.

- 1.1 Giving Priority to the safety and well-being of the community and having regard to this principle in assessing obligations to clients, employers and colleagues.
- 1.2 Ensuring that responsible steps are taken to minimise the risk of loss of life, injury or suffering which may result from your engineering activities, either directly or indirectly.

All recommendations on building occupancy and access must be made with these fundamental obligations in mind.

3. Earthquake Resistance Standards

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 loadings are in accordance with the current earthquake loading standard NZS1170.5 [1].

A generally accepted classification of earthquake risk for existing buildings in terms of %NBS that has been proposed by the NZSEE 2006 [2] is presented in Figure 1 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	100%NBS desirable. Improvement should achieve at least 67%NBS
Moderate Risk Building	B or C	Moderate	34 to 66	Acceptable legally. Improvement recommended		This is for each TA to decide. Improvement is not limited to 34%NBS.	Not recommended. Acceptable only in exceptional circumstances
High Risk Building	D or E	High	33 or Iower	Unacceptable (Improvement required under Act)	┝	Unacceptable	Unacceptable

Figure 1: NZSEE Risk Classifications Extracted from Table 2.2 of the NZSEE 2006 AISPBE Guidelines

Table 1 below compares the percentage NBS to the relative risk of the building failing in a seismic event with a 10% risk 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% risk of exceedance in the next year.

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

Table 1: %NBS compared to relative risk of failure

3.1 Minimum and Recommended Standards

Based on governing policy and recent observations, Opus makes the following general recommendations:

3.1.1 Occupancy

The Canterbury Earthquake Order¹ in Council 16 September 2010, modified the meaning of "dangerous building" to include buildings that were identified as being EPB's. As a result of this, we would expect such a building would be issued with a Section 124 notice, by the Territorial Authority, or CERA acting on their behalf, once they are made aware of our assessment. Based on information received from CERA to date, this notice is likely to prohibit occupancy of the building (or parts)



¹ This Order only applies to buildings within the Christchurch City, Selwyn District and Waimakariri District Councils authority

thereof) until its seismic capacity is improved to the point that it is no longer considered an EPB.

3.1.2 Cordoning

- Where there is an overhead falling hazard, or potential collapse hazard of the building, the areas of concern should be cordoned off in accordance with current CERA/Christchurch City Council guidelines.

3.1.3 Strengthening

- Industry guidelines (NZSEE 2006 [2]) strongly recommend that every effort be made to achieve improvement to at least 67%NBS. A strengthening solution to anything less than 67%NBS would not provide an adequate reduction to the level of risk.
- It should be noted that full compliance with the current building code requires building strength of 100%NBS.

3.1.4 Our Ethical Obligation

- In accordance with the IPENZ code of ethics, we have a duty of care to the public. This obligation requires us to identify and inform CERA of potentially dangerous buildings; this would include earthquake prone buildings.



4. Background Information

4.1 Building Description

The Airedale Courts, located at 51-63 Salisbury Street, 14-18 Airedale Place and 24-30 Conference Street, consists of seven 2-storey and 3-storey residential units (Blocks A through G) and eight single-storey garages. The buildings were constructed in the 1960's and 1970's. Refer to the site plan in Figure 2.



Figure 2: Site Plan (Source: Bing Maps)

Residential Units (Blocks A through G)

The CCC identification numbers and block names (A, B, C, etc.) are described in Table 2. The CCC building names differ from the building names denoted on the original design drawings. Both are shown in Table 2. The CCC names are used in this report.

BU Number	CCC Building Name	Original Drawing Building Name	Address
BU 1951-001 EQ2	Block A	Block B	59-63 Salisbury Street
BU 1951-004 EQ2	Block B	Block A	51-57 Salisbury Street
BU 1951-005 EQ2	Block C	Block C	12-14 Airedale Place
BU 1951-006 EQ2	Block D	Block E	16-18 Airedale Place
BU 1951-003 EQ2	Block E	Block G	16 Conference Street
BU 1951-008 EQ2	Block F	Block D	24-26 Conference Street
BU 1951-009 EQ2	Block G	Block F	28-30 Conference Street

Table 2: Building Names:



The seven residential buildings (Blocks A through G) are constructed in a similar manner. Table 3 summarises the geometry for each building and the dates of construction. The roofs are timber framing with corrugated metal deck. Elevated floors are in-situ concrete slabs, except in Block E which has concrete over metal deck. The roof and elevated slabs are supported by interior and exterior concrete block bearing walls (both partially and fully-grouted). The plan layout and the reinforcement in the block walls vary. The block walls divide the floor plan into individual units.

The ground floors are in-situ concrete slabs on grade. Foundations are continuous ground beams, which are in some cases supported by piles. See Table 4 for more detailed construction information on each building.

The lateral load resisting system relies on the elevated floor slabs and timber roof to act as a diaphragm to distribute loads to the block walls. The diaphragms do not have large spans given the number of walls in each direction. The walls are doweled into the slab and roof, and carry the seismic loads to the foundation system. Overturning is resisted by piles or by wall rocking and soil bearing.

There are conditions in Blocks A, B, C, and F where the block walls are either discontinuous or have large openings at the ground floor. These cases are discussed and evaluated later in this report.

The building geometry and construction dates are shown in Table 3.

Block	Approximate	No. of	Basement	No. of	Approx. overall dim.		Plan Area	Notes
BIOCK	Construction	Storeys	Basement	Units	Trans.	Long.		Notes
А	1966	3	No	18	9.8m	48.0m	1411 m ²	
В	1963	3	No	24	9.1m	53.8m	1468 m²	
С	1967	3	No	12	8.8m	34.9m	920 m ²	
D	1969	3 + PH	Yes, partial	22	16.8m	28.7m	1339 m ²	
E	1975	2	No	8	6.5m	30.0m	290 m ²	
F	1967	3	No	12	8.8m	34.9m	920 m ²	
G	1969	3 + PH	Yes, partial	22	16.8m	28.7m	1339 m ²	

Table 3: Building Geometry

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Block	Approximate Date of	No. of	Basement	ement No. of		prox. all dim. Plan Area		Notes
DIOOK	Construction	Storeys	200011011	Units	Trans.	Long.		
Garages (8 Total)	1966+	1	No	N/A	5.6m	15m to 41m	84 m ² to 230 m ²	Transverse walls at 3m centres

The building construction is described in Table 4.

Block	Exterior Walls	Interior Walls	Elevated Slabs	Foundation	Roof	Notes
A	140mm (15 series) concrete block, partial grout 12mm @ 600mm vertical reinforcement 12mm @ 800mm horizontal reinforcement 140mm veneer with vertical reinforcement @ 600mm and ties @ every second course.	200mm concrete block, full grout 12mm @ 600mm vertical reinforcement 16mm @ 800mm horizontal reinforcement	140mm in situ T&B reinforcing, both ways	Piles (inferred from architectural drawings)	Corrugated aluminium on 150mm x 25mm" close butted sarking supported by 200mm x 50mm" purlins @ 750mm" centres	
В	90mm concrete block, partial grout 10mm @ 600mm vertical reinforcement 12mm @ 800mm horizontal reinforcement. 90mm veneer w/ vertical reinforcement @ 600mm and ties @ 450mm	200mm concrete block, full grout 12mm @ 600mm vertical reinforcement 16mm @ 800mm horizontal reinforcement	Assumed same as Block A.	Piles (inferred from architectural drawings)	Corrugated aluminium on 150mm x 25mm diagonal sarking supported by 150mm x 50mm purlins @ 750mm centres	

Table 4: Building Construction

Block	Exterior Walls	Interior Walls	Elevated Slabs	Foundation	Roof	Notes
С	140mm concrete block, partial grout 12mm @ 600mm vertical reinforcement 12mm @ 800mm horizontal reinforcement 140mm veneer.	200mm concrete block, full grout 16mm @ 600mm vertical reinforcement 2-10mm @ 800mm horizontal reinforcement Weak grout discovered at testing locations	140mm in situ T&B reinforcing, both ways	Unknown	Corrugated aluminium on 150mm x 25mm close sarking supported by 150mm x 50mm purlins @ 750mm centres	
D	150mm concrete block, partial grout 12mm @ 600mm vertical reinforcement plus additional/larger bars at ends 12mm @ 600mm to 1000mm horizontal reinforcement 100mm veneer.	200mm concrete block, full grout 12mm @ 600mm vertical reinforcement plus additional/larger bars at ends 12mm @ 800mm horizontal reinforcement	140mm in situ T&B reinforcing, both ways	Concrete piles 6.7m to 10m deep	Aluminium Brown Built on T&G sarking supported by 100mm x 50mm and 150mm x 50mm purlins	
E	140mm concrete block, partial grout except bottom storey all cells at walls with door and window openings 12mm @ 600mm vertical reinforcement plus additional 12mm bars at ends No horizontal bars except bond beam w 2-12mm T&B of each wall 90mm veneer.	200mm concrete block, partial grout 12mm @ 600mm vertical reinforcement plus additional 10mm bars at ends No horizontal bars except bond beam w 2-12mm T&B top of upper storey wall and 1-12mm T&/B lower storey wall	Concrete fill on 50mm Diamond V metal trays. Total thickness 125mm. Reinforced with wire mesh. In situ reinforced stairs and landings.	Continuous foundation beams, 600mm deep with 100mm thick concrete slab on ground with wire mesh.	"Trimline" aluminium roofing over mesh backed building paper over 75mm x 50mm purlins over 150mm x 50mm rafters.	



Block	Exterior Walls	Interior Walls	Elevated Slabs	Foundation	Roof	Notes
F	Same as C					
G	Same as D					
Garages	100 thick precast concrete with wire mesh at ends and along back side	150mm Concrete block, partial grout. 4 – 12mm @ both ends of the walls. No horizontal bars	None	Continuous concrete ground beam	Corrugated aluminium on 50mm x 125mm wood joists	
Garages	Concrete block, reinforcing unknown	Concrete block, reinforcing unknown	None	Continuous concrete ground beam	Corrugated aluminium on 50mm x 125mm wood joists	

4.2 Survey

On 5 May 2011, a structural engineer and geotechnical engineer from Opus International Consultants performed a visual walkover inspection of the site and buildings.

On 2 February 2012, a structural engineer working with Opus performed a visual inspection of the exterior of all buildings and a partial inspection of the interiors.

On 8 May 2012, Opus performed a level survey of the ground floor slab in all buildings and a level survey of the exterior perimeter of each building. The survey results are included in the Appendices.

Over the period 10-21 September 2012, Opus undertook opening up works in Blocks A, B, C, D and E to confirm assumptions that were earlier used in order to complete the original quantitative seismic assessment. The results of this investigation are included in Table 4 below.

4.3 Original Documentation

Copies of the following drawings were provided by CCC:

- Garages Salisbury Street Reclamation Housing, Christchurch City Council City Engineers Department, Architectural Drawings, dated 25 November 1966, Sheets: A150-4/1, A150-4/2 and A150-4/3.
- Salisbury Street Reclamation Housing for the Christchurch City Council, by R. Bruce McGowan Architect, dated December 1966, Sheets: A150-5/1 thru A150-5/23.



- Conference Street Elderly Persons Housing, Christchurch City Council, last dated December 1974, Sheets 1 thru 11.
- Conference Street Reclamation Housing Elderly People Housing, Christchurch City Council City's Engineer's Department, dated November 1974, Sheets: D1822 -1 thru 6.
- Salisbury Street Reclamation Housing, Blocks E and F., Christchurch City Council, dated February 1969, Sheets 1 thru 15.
- Salisbury Street Reclamation Housing, Blocks E and F, Smith and Tyndall Consulting Engineers, dated January 1969, Structural Drawings Sheets: S1 thru S16.
- Reclamation Housing Salisbury Street Block A, Christchurch City Council, City Architects Section, Architectural Drawings, dated 1963, Sheets A150-1/1 thru A150-1/319, and A150-1/42.
- Salisbury Street Reclamation Housing Block B, Christchurch City Council, City Architects Section, Architectural Drawings, dated 1966, Sheets A150-2/1 thru A150-2/25, and A150-2/S1.
- Garages Salisbury Street Reclamation Housing, Christchurch City Council, City Engineer's Department, dated 1966, Sheets A150-4/1 thru A150-4/3.

Please note that we were not able to locate structural drawings for the following buildings:

- Block A other than a foundation plan and a roof framing plan shown in the architectural drawings;
- Block B other than a roof framing plan shown in the architectural drawings;
- Newer garages with exterior block walls.

The drawings have been used to confirm the structural systems, investigate potential critical structural weaknesses (CSW's) and identify details which required particular attention.

No calculations were available for review.

4.4 Qualitative Assessment

A qualitative assessment has not been performed for these buildings.



5. General Observations

The buildings at Airedale Courts have sustained minimal damage to structural elements, and some minor to damage to the masonry veneers. The ground floor slabs have sustained major settlement (over 100mm) in some units. The observed damage is consistent with the expected building performance, following a review of the structural drawings and site investigations.

Key damage observed to structural and non-structural elements includes:

	Observed Damage							
Block	Structural	Slab on Ground Settlements ¹	Veneer	Global Rotation	Stairs	Other		
A	None	Minor <22mm	Minor stepped cracks at joints. Minor horizontal crack in precast concrete fins adjacent to entries, at all 1 st and 2 nd floor lines.	Minor <43 mm down from south to north side	None			
В	None	Minor <22 mm	Minor stepped cracks at joints. Minor horizontal crack in precast concrete fins adjacent to entries, at all 1 st and 2 nd floor lines.	Minor <56 mm down from north to south side	None			
С	None	Major 96mm at SW corner unit	Minor stepped cracks at joints.	Minor <23 mm down from north to south side	None			
D	Negligible crack at construction joint where block walls bear on concrete basement walls	Major 116 to 156 mm in units at both ends	None	Minor <38 mm down from NE corner to midpoint along east side	None			
E	None	Minor <20 mm	Minor stepped cracks at joints	Minor <103 mm down from west end to east end	None			

Table 5: Observed Damage



Block	Observed Damage									
	Structural	Slab on Ground Settlements ¹	Veneer	Global Rotation	Stairs	Other				
F	None	Major 56 to 92mm at west end, moderate throughout other units	Minor stepped cracks at joints	Minor <22 mm down from NW corner to midpoint along north side	None					
G	Negligible crack at construction joint where block walls bear on concrete basement walls	Major 150 to 204 mm in units at both ends	Vertical cracks at corners above basement wall.	Minor <34 mm down from east side to west side	None					
Garages	None	Not surveyed	N/A	Not surveyed	N/A					

<u>Notes</u>

1. The settlements refer to depressions within a unit, not global rotation.

6. Detailed Seismic Assessment

The detailed seismic assessment has been based on the NZSEE 2006 [2] guidelines for the "Assessment and Improvement of the Structural Performance of Buildings in Earthquakes" together with the Detailed Engineering Evaluation Procedure [3] (DEEP) document (draft) issued by the Structural Engineering Society (SESOC) on 19 July 2011.

6.1 Critical Structural Weaknesses

The term Critical Structural Weakness (CSW) refers to a component of a building that could contribute to increased levels of damage or cause premature collapse of a building.

For Blocks A, B, C, and F the main critical structural weaknesses are the block walls that are either discontinuous or that have large openings at the ground storey. These walls will impose large flexural demands on supporting beams (discontinuous walls) or large axial tension and compression forces in the small piers adjacent to the openings.

Blocks D, E and G do not have any obvious critical structural weaknesses.

These conditions have been considered in the analysis of these buildings.

6.2 Quantitative Assessment Methodology

The assessment assumptions and methodology have been included in Appendix 3 of the report due to the technical nature of the content. A brief summary follows:

• 3D models of each unique building were created in ETABS, which is a finite element



structural analysis programme.

- The single-storey garages (9-12, 13-19, and 20-31) were checked by hand calculations.
- A linear equivalent static analysis was carried out using the spectral values established from NZS1170.5, with an updated Z factor of 0.3 (B1/VM1). This analysis was used to establish the actions on the structural elements.
- The buildings were assessed as Importance Level 2.
- Based on the actions determined from the analysis, demand to capacity ratios (DCR's) were determined for each component in question. The highest DCR was then converted to a %NBS for the structure.

6.3 Limitations and Assumptions in Results

The observed level of damage suffered by the buildings was deemed low enough to not reduce their capacity. Therefore the analysis and assessment of the buildings was based on them being in an undamaged state. There may have been damage to the buildings that was unable to be observed during assessments that could cause the capacity of the buildings to be reduced; therefore the current capacity of the buildings may be lower than that stated.

The results have been reported as a %NBS and the stated value is that obtained from our analysis and assessment. Despite the use of best national and international practice in this analysis and assessment, this value contains uncertainty due to the many assumptions and simplifications which are made during the assessment. These include:

- Simplifications made in the analysis, including boundary conditions such as foundation fixity.
- Assessments of material strengths based on drawings and site inspections.
- The normal variation in material properties which change from batch to batch.
- Approximations made in the assessment of the capacity of each element.

Drawings were only available for garages 9-12, 13-19 and 20-31. The calculations for these garages are assumed to be representative of the other garages given their similarities.

6.4 Quantitative Assessment

A summary of the structural performance of the buildings is shown in the tables below. Note that the values given represent the critical elements in the building, as these effectively define the building's capacity. As noted in Appendix A2.2 Analysis Parameters, the buildings were analysed using a ductility factor (μ) equal to 1.25 due to partially reinforced block walls being used to resist lateral loads.

Modes of failure that do not govern the building's performance are not included in the tables except as noted for cases where higher ductility factors have led to the component being

classified as non-critical.

Table 6: Summary of Seismic Performance for Block A – μ = 1.25 (unless noted otherwise)

Structural Element/System	Failure mode or description of limiting criteria based on displacement capacity of critical element.	Critical Structural Weakness and Collapse Hazard	% NBS based on calculated capacity
Primary Componen	ts (those that are required parts of the lateral res	isting system	
Longitudinal - Ground Storey Interior 200mm solid grouted concrete block around the stairwell (located in ground storey only)	Flexural hinging of block wall piers.	No	34%
Longitudinal - Ground Storey Exterior 200mm partially grouted concrete block at the southern side	Flexural hinging of block wall piers.	No	54%
Transverse – Ground, 1 st , and 2 nd Storey Interior 200mm solid grouted concrete block	Flexural hinging of block wall piers.	No	72%
Longitudinal – 1 st Storey Exterior partially grouted 200mm concrete block at the southern side	Shear failure of block wall piers.	No	136%
Transverse End Wall with Large Ground Floor Opening	The wall that divides Flats 7 & 13 and 12 & 18 has a large opening at the ground floor. The overturning demand imposes large tension and compression forces that need to be resisted thru the door jamb blocks and steel. We have assumed that there are 3 No. 16mm diameter vertical trimmer bars around the door for the upper bound capacity and 2 No. 12mm diameter bars for the lower bound capacity.	No	109% (μ = 1.0) Lower Bound: 41% (μ = 1.0)
Longitudinal Wall with Opening at Laundry Room	The wall at the laundry room entry has a large opening at the ground floor. The overturning demand imposes large tension in this wall and yields the reinforcement, assumed as 12mm bars at 600mm on centre.	No	41%
Out-of-Plane Loads on Typical Block Piers	The block wall and veneer are generally cantilevered off the second floor and must resist the inertial force from their own self weight. The wall and veneer are both reinforced and can resist these forces in bending down to second floor.	No	80%

Secondary Components (those that are not required parts of the lateral load resisting system but which must be able to maintain their gravity load capacity while the building under goes deformation due to earthquake loading)

Structural Element/System	Failure mode or description of limiting criteria based on displacement capacity of critical element.	Critical Structural Weakness and Collapse Hazard	% NBS based on calculated capacity
Stairs	The stair construction is not detailed on the architectural drawings. Our field investigations did not reveal any damage and they appeared to have performed well. This, coupled with the building's stiffness, suggests the stairs are not a life safety hazard.	No	NA
Exterior block veneer	Drawings indicate the veneer is tied back into the block walls. Based on observations from the field, there is some minor cracking but overall appears to have performed very well and therefore is not considered a hazard.	No	NA
Precast Concrete Fins	The precast concrete fins are architectural elements that are adequately tied into the block walls. While we observed some cracks in these elements, they do not pose a falling hazard.	No	NA

Table 7: Summary of Seismic Performance for Block B – μ = 1.25 (unless noted otherwise)

Structural Element/System	Failure mode or description of limiting criteria based on displacement capacity of critical element.	Critical Structural Weakness and Collapse Hazard	% NBS based on calculated capacity
Primary Componen	ts (those that are required parts of the lateral res	isting system)	
Longitudinal - Ground Storey Interior 200mm solid grouted concrete block around the stairwell (located in ground storey only)	Flexural hinging of block wall piers.	Yes	25%
Longitudinal - Ground Storey Exterior 90mm partially grouted concrete block at the southern side	Flexural hinging of block wall piers.	Yes	19%
Longitudinal - First Storey Exterior 90mm partially grouted concrete block at the southern side	Flexural hinging of block wall piers.	Yes	15%
Transverse – Ground, 1 st , and 2 nd Storey Interior 200mm solid grouted concrete block	Flexural hinging of block wall piers.	Yes	31%



Structural Element/System	Failure mode or description of limiting criteria based on displacement capacity of critical element.	Critical Structural Weakness and Collapse Hazard	% NBS based on calculated capacity
Longitudinal – 1 st Storey Exterior partially grouted 90mm concrete block at the southern side	Shear failure of block wall piers.	No	49%
Discontinuous Longitudinal Stair Wall	The wall adjacent to the stair landing has a partial offset at the ground floor. The upper two storey wall is supported half on a wall and a half on a 400x240mm concrete beam. We do not have the structural drawings that specify the reinforcement in this beam, but we have assumed it is reinforced with a minimum of 3 No.13mm diameter bars, which we believe is conservative. The portion of the wall that continues to the ground floor also has high demands. We have assumed three 12mm bars at approximately 600mm centres. This partial wall will form a flexural hinge with reinforcement yielding.	Yes	Beam: >68% (μ = 1.0) Partial Wall: 20% (μ = 1.25)
Discontinuous Transverse Stair Wall	The transverse stair wall that is partially discontinuous above the laundry room imposes a large tension/compression force that need to be resisted through the door jamb blocks and steel. We have assumed that there are 3 12mm diameter vertical trimmer bars around the door. The lower bound assessment assumed only 2 12mm bars.	No	80% (μ = 1.0) Lower Bound: 53% (μ = 1.0)
Out-of-Plane Loads on Typical Block Piers	The block wall and veneer are generally cantilevered off the second floor and must resist the inertial force from their own self weight. The wall and veneer are both reinforced and can resist these forces in bending down to second floor.	No	80%
Secondary Component must be able to main earthquake loading)	nents (those that are not required parts of the late tain their gravity load capacity while the building i	eral load resisting sys under goes deformat	tem but which ion due to
Stairs	The stair construction is not detailed on the architectural drawings. Our field investigations did not reveal any damage and they appeared to have performed well. This, coupled with the building's stiffness, suggests the stairs are not a life safety hazard.	No	NA
Exterior block veneer	Drawings indicate the veneer is tied back into the block walls. Based on observations from the field, there is some minor cracking but overall appears to have performed very well and therefore is not considered a hazard.	No	NA
Precast Concrete Fins	The precast concrete fins are architectural elements that are adequately tied into the block walls. While we observed some cracks in these elements, they do not pose a falling hazard.	No	NA

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Structural Element/System	Failure mode or description of limiting criteria based on displacement capacity of critical element.	Critical Structural Weakness and Collapse Hazard	% NBS based on calculated capacity
Primary Componen	ts (those that are required parts of the lateral res	isting system)	
Longitudinal - Exterior 150mm partially grouted concrete block	Flexural hinging of block wall piers.	No	61%
Transverse- Exterior 150mm partially grouted concrete block	Concrete block walls are adequate to resist code level forces.	No	100%
Longitudinal – Interior 200mm solid grouted concrete block	Flexural hinging of block wall piers.	No	53-90%
Transverse – Interior 200mm solid grouted concrete block	Flexural hinging of block wall piers.	No	79%
Longitudinal - Exterior 150mm partially grouted concrete block	Shear yielding of block wall piers.	No	61%
Transverse- Exterior 150mm partially grouted concrete block	Shear yielding of block wall piers.	No	80%
Transverse Discontinuous Stair Wall	The transverse wall north of the stairwells is discontinuous at the ground floor. This wall has flanges on both sides but the south flange adjacent to the stair has a large opening at the ground floor. The transverse discontinuous wall imposes large overturning forces on these piers. In addition, the in-plane forces on the south flange also impose large tension/compression couple in these piers. The upper two storeys are attached to each of the lower piers with two 13mm bars, which will yield in tension under the imposed loads.	No	44%
Out-of-Plane Loads on Typical Block Piers	The block wall and veneer are generally cantilevered off the second floor and must resist the inertial force from their own self weight. The wall and veneer are both reinforced and can resist these forces in bending down to second floor.	No	80%



Structural Element/System	Failure mode or description of limiting criteria based on displacement capacity of critical element.	Critical Structural Weakness and Collapse Hazard	% NBS based on calculated capacity
Secondary Components (those that are not required parts of the lateral load resisting system but which must be able to maintain their gravity load capacity while the building under goes deformation due to earthquake loading)			stem but which ion due to
Stairs	The stair construction is not detailed on the architectural drawings. Our field investigations did not reveal any damage and they appeared to have performed well. This, coupled with the building's stiffness, suggests the stairs are not a life safety hazard.	No	NA
Exterior block veneer	Drawings indicate the veneer is tied back into the block walls. Based on observations from the field, there is some minor cracking but overall appears to have performed very well and therefore is not considered a hazard.	No	NA

Table 9: Summary of Seismic Performance for Block D and G – μ = 1.25 (unless noted otherwise)

Structural Element/System	Failure mode or description of limiting criteria based on displacement capacity of critical element.	Critical Structural Weakness and Collapse Hazard	% NBS based on calculated capacity
Primary Componen	ts (those that are required parts of the lateral res	isting system)	
Longitudinal - Ground Storey – Exterior 150mm partially grouted concrete block	Flexural hinging of block wall piers.	No	51%
Longitudinal – Ground, 1 st , and 2 nd Storey – Interior 200mm solid grouted concrete block	Concrete block walls are adequate to resist code level forces.	No	100%
Transverse – Ground Storey – Interior 200mm solid grouted concrete block	Flexural hinging of block wall piers.	No	50%
Transverse – Ground Storey – Exterior 150mm partially grouted concrete block	Flexural hinging of block wall piers.	No	53%

Structural Element/System	Failure mode or description of limiting criteria based on displacement capacity of critical element.	Critical Structural Weakness and Collapse Hazard	% NBS based on calculated capacity
Transverse – 1 st Storey Exterior 150mm partially grouted concrete block	Shear yielding of block wall piers.	No	66%
Longitudinal– 1 st Storey Exterior 150mm partially grouted concrete block	Shear yielding of block wall piers.	No	77%
Out-of-Plane Loads on Typical Block Piers	The block wall and veneer are generally cantilevered off the second floor and must resist the inertial force from their own self weight. The wall and veneer are both reinforced and can resist these forces in bending down to second floor.	No	80%
Secondary Components (those that are not required parts of the lateral load resisting system but which must be able to maintain their gravity load capacity while the building under goes deformation due to earthquake loading)			
Stairs	The stair construction is not detailed on the architectural drawings. Our field investigations did not reveal any damage and they appeared to have performed well. This, coupled with the building's stiffness, suggests the stairs are not a life safety hazard.	No	NA
Exterior block veneer	Drawings indicate the veneer is tied back into the block walls. Based on observations from the field, there is some minor cracking but overall appears to have performed very well and therefore is not considered a hazard.	No	NA

Table 10: Summary of Seismic Performance for Block E – μ = 1.25 (unless noted otherwise)

Structural Element/System	Failure mode or description of limiting criteria based on displacement capacity of critical element.	Critical Structural Weakness and Collapse Hazard	% NBS based on calculated capacity
Primary Components (those that are required parts of the lateral resisting system)			
Longitudinal - Exterior 150mm partially grouted concrete block	Flexural hinging of block wall piers.	No	52%
Transverse- Exterior 150mm partially grouted concrete block	Concrete block walls are adequate to resist code level forces.	No	100%
Transverse – Interior 150mm partially grouted concrete block	Flexural hinging of block wall piers.	No	83%

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Structural Element/System	Failure mode or description of limiting criteria based on displacement capacity of critical element.	Critical Structural Weakness and Collapse Hazard	% NBS based on calculated capacity
Transverse – Interior 200mm solid grouted concrete block	Concrete block walls are adequate to resist code level forces.	No	100%
Longitudinal - Exterior 150mm partially grouted concrete block	Shear yielding of block wall piers.	No	62%
Out-of-Plane Loads on Typical Block Piers	Block wall and veneer are generally cantilevered off the second floor and must resist the inertial force from their own self weight. In addition, the roof rafters will impose a horizontal force at the top of the wall under gravity loading. The wall and veneer are both reinforced and can resist these forces in bending down to second floor.	No	60%
Secondary Components (those that are not required parts of the lateral load resisting system but which must be able to maintain their gravity load capacity while the building under goes deformation due to earthquake loading)			
Stairs	The stair construction is not detailed on the architectural drawings. Our field investigations did not reveal any damage and they appeared to have performed well. This, coupled with the building's stiffness, suggests the stairs are not a life safety hazard.	No	NA
Exterior block veneer	Drawings indicate the veneer is tied back into the block walls. Based on observations from the field, there is some minor cracking but overall appears to have performed very well and therefore is not considered a hazard.	No	NA

Table 11: Summary of Seismic Performance for the Garages – μ = 1.25 (unless noted otherwise)

Structural Element/System	Failure mode or description of limiting criteria based on displacement capacity of critical element.	Critical Structural Weakness and Collapse Hazard	% NBS based on calculated capacity
Primary Component	ts (those that are required parts of the lateral res	sting system)	
Transverse precast concrete panels and block walls	Concrete block walls are adequate to resist code level forces. The stresses in the walls are low.	No	100%
Longitudinal precast panels at back of garage	Precast and concrete block walls are adequate to resist code level forces. The stresses in the wall are low.	No	100%



6.5 Discussion

Based on our quantitative assessment, Blocks A and C to G possess capacities within the range 34% to 52% NBS. Block B is evaluated at 15% NBS. This is primarily due to flexural hinging of the reinforced block walls.

The components that limit each building's capacity are:

- Block A (34% NBS): Wall hinging at the ground floor near the central stairwell. This wall has large openings at the ground floor thereby making it susceptible to damage.
- Block B (15% NBS): The first floor piers along the south elevation experience tension-flexural hinging. This occurs over the entire elevation and can pose a collapse hazard. In addition, partially discontinuous walls at all four interior stairwells will hinge above the first floor and govern the building's response.
- Blocks C and F (both 44% NBS): Discontinuous shear walls north of two interior stairwells develop hinges in the longitudinal flange walls adjacent to the stair landings.
- Blocks D and G (both 50% NBS): Slender piers on the interior and exterior of the building develop flexural hinges.
- Block E (52% NBS): Slender piers on the building's perimeter wall develop flexural hinges.
- Garages (100% NBS): Garage walls and diaphragms are lightly stressed and acceptable for code level forces.

Blocks A, C, D, E, F and G are considered a moderate risk in accordance with NZSEE guidelines as they have seismic capacities between 34% and 67% NBS. Block B has a seismic capacity of less than 34% NBS and is therefore defined as an earthquake prone building in accordance with the Building Act 2004.

7. Summary of Geotechnical Appraisal

7.1 General

Christchurch City Council commissioned Opus International Consultants to undertake a desktop study of the ground conditions beneath the Airedale Courts. The result of this study was detailed in a memo dated 3 July 2012 (an update to a previous memo dated 31 May 2011), which is included in Appendix 2 of this report. The key points of the study are summarised herein.

7.2 Liquefaction Potential

The 2004 ECan Solid Facts Liquefaction Study indicates the site as having moderate liquefaction potential under low groundwater conditions. Ground damage is expected to be moderate with subsidence between 100 to 300mm.

The area has been identified to have undergone moderate to severe liquefaction as a result

of the 22 February 2011 and 13 June 2011 events. This was evident throughout the site with observations from aerial photos of ejected liquefied soils, ground floor damage and settlement.

A detailed floor survey was completed for each building and is included in Appendix 4 of this report. Ground floor slabs in Blocks C, D, F and G have suffered significant damage. Differential settlement up to 260mm has been recorded.

7.3 Summary

Blocks A to G are founded on shallow and deep foundations, refer to Table 4 in Section 4.1 of this report for a description of the known foundation details. The length of pile under Blocks A and B is unknown. Test pits are recommended to confirm the foundation type for Blocks C and F.

The ground surrounding Blocks C, D, F, and G has settled by approximately 100mm. Fill subsidence below the floor slabs have caused cracks and differential settlements.

Liquefaction is the likely cause of subsidence, but some contribution may also be from settlement of poorly compacted, low quality fill placed during construction.

Further level survey of the pile caps or at the base of the cladding is required to assess the performance of the foundations of Blocks C, D, F and G. Further liquefaction and subsequent damage is possible in a future magnitude 6 or greater earthquake close to Christchurch or large earthquakes from more distant faults.

7.4 Further Work

Further site investigations including test pits, borehole and CPT testing followed by geotechnical assessment is recommended to determine the potential for further liquefaction and to identify conceptual foundation repair and strengthening works.

8. Conclusions

a) The %NBS for each building is summarised below:

BU Number	CCC Building Name	Address	%NBS
BU 1951-001 EQ2	Block A	59-63 Salisbury	34%
BU 1951-004 EQ2	Block B	51-57 Salisbury	15%
BU 1951-005 EQ2	Block C	12-14 Airedale	44%
BU 1951-006 EQ2	Block D	16-18 Airedale	50%
BU 1951-003 EQ2	Block E	16 Conference	52%
BU 1951-008 EQ2	Block F	24-26 Conference	44%
BU 1951-009 EQ2	Block G	28-30 Conference	50%
BU 1951-002 EQ2 BU 1951-010 EQ2 BU 1951-011 EQ2	Garages	Public Rental #9-12 #13-19	~100%



BU Number	CCC Building Name	Address	%NBS
BU 1951-012 EQ2		#20-31	
BU 1951-013 EQ2		#32-40	
BU 1951-015 EQ2		#41-43	
BU 1591-014 EQ2		#44-46	
BU 1591-007 EQ2		#47-52	

- b) Block B has been assessed to have a seismic capacity of 15% NBS. This is governed by flexure yielding in the partially grouted exterior walls. The first floor exterior walls on the southern elevation govern the building's minimum capacity. The building is therefore defined as earthquake prone in accordance with the Building Act 2004.
- c) Blocks A, C, D, E, F and G have been assessed to have a seismic capacity of 34% to 52% NBS, and are generally governed by flexural hinging of partially or fully grouted block walls. This capacity level implies the buildings are considered a moderate risk as defined by NZSEE guidelines.
- d) We have identified the following critical structural weaknesses:
 - Several walls in Blocks A, B, C, and F are discontinuous or have large openings at the ground floor that impose high overturning loads on supporting piers or beams. These have been evaluated in our assessment and govern the response in Blocks B and C. We have found these cases result in tension yielding of pier reinforcement and therefore a ductility factor of 1.25 is appropriate.
- e) Ground damage has been moderate to significant at the site. The ground surrounding Blocks C, D, F, and G has settled between 40 to 100mm, which has caused cracks and differential settlements in the ground floor slabs. Some differential settlement has occurred in the superstructure as well, most significantly at Block E. Liquefaction is the likely cause of subsidence, but some contribution may also be from settlement of poorly compacted, low quality fill placed during construction.
- f) Superstructure damage has been limited to minor stepped cracks in the veneer, minor cracks in architectural precast concrete fins, and horizontal cracks along the construction joint between the block and concrete basement walls.
- g) No structural drawings of Blocks A and B were available for the assessment. The structural assessment for these blocks was undertaken using the results of intrusive investigation work.

9. **Recommendations**

- a) Develop a strengthening works scheme to increase the seismic capacity of the buildings to at least 67%NBS; this will need to consider compliance with accessibility and fire requirements.
- b) Engage a quantity surveyor to determine the costs for strengthening the buildings.



c) Perform a full geotechnical assessment of the site to determine the liquefaction potential and to identify conceptual foundation repair and strengthening works.

10. Limitations

- 1. This report is based on an inspection of the structure of the buildings and focuses on the structural damage resulting from the 4 September 2010 Darfield Earthquake and the 22 February 2011 Canterbury Earthquake and aftershocks. Some non-structural damage is described but this is not intended to be a complete list of damage to non-structural items.
- 2. Our professional services are performed using a degree of care and skill normally exercised, under similar circumstances, by reputable consultants practicing in this field at this time.
- 3. We were not able to locate structural drawings for Block A and B thus we have based the quantitative assessment on the results of a limited field investigation to confirm typical interior and exterior wall construction.
- 4. We have limited drawings for Garages 9-12, 13-19, and 20-31 and performed an appropriate level of evaluation for the information given. Other than our visual inspections, we could not assess the remaining garages.
- 5. This report is prepared for CCC to assist with assessing the remedial works required for council buildings and facilities. It is not intended for any other party or purpose.

11. References

- [1] NZS 1170.5: 2004, *Structural design actions, Part 5 Earthquake actions,* Standards New Zealand.
- [2] NZSEE: 2006, Assessment and improvement of the structural performance of buildings in *earthquakes*, New Zealand Society for Earthquake Engineering.
- [3] Engineering Advisory Group, *Guidance on Detailed Engineering Evaluation of Earthquake* Affected *Non-residential Buildings in Canterbury, Part 2 Evaluation Procedure*, Draft Prepared by the Engineering Advisory Group, Revision 5, 19 July 2011.
- [4] Engineering Advisory Group, *Guidance on Detailed Engineering Evaluation of Nonresidential buildings, Part 3 Technical Guidance*, Draft Prepared by the Engineering Advisory Group, 13 December 2011.
- [5] SESOC, *Practice Note Design of Conventional Structural Systems Following Canterbury Earthquakes*, Structural Engineering Society of New Zealand, 21 December 2011.





Appendix 1 – Photographs



Airedale Courts, Christchurch		
No.	Item description	Photo
	Block A: 59-63 Salis	sbury Street
1.	Front elevation	
2.	Side elevation	



3.	Typical stepped crack at window opening	
4.	Horizontal crack in precast concrete fin adjacent to entry	







7.	Typical stepped crack at window opening	
8.	Horizontal cracks in precast concrete fins	


	Block C: 12-14 Air	redale Place
9.	Front elevation	
10.	Elevation showing cantilevered stairs	



11.	Side elevation	
12.	Typical stepped crack at openings	



	Block D: 16-18 Aire	dale Place
13.	Front elevation	
14.	Building corner	



15.	Side elevation	
16.	Doorway with visible settlement at entry stairs	



17.	Settlement and cracking of ground floor slab. Note the separation between the slab and the base of the walls	
18.	Separation at ground floor slab	
	Block E: 16 Confere	ence Street



19.	Front elevation	
20.	Close up elevation of typical unit	



21.	Rear elevation	
	Block F: 24-26 Cor	nference Street
22.	Front elevation	



23.	Side elevation	
24.	Elevation showing cantilevered stairs	



25.	Close up view of cantilevered stairs	
26.	Side elevation	







29.	Building corner	
30.	Side elevation	



31.	Ground floor settlement at entry	
32.	Horizontal crack at block and basement wall interface	



33.	Ground floor slab cracks	
34.	Ground floor slab cracks and settlement	



35.	Vertical crack in basement wall	
36.	Visible gaps between interior partition walls and ground floor slab due to settlement	



37.	Concrete spalling at the top corner of the basement wall	
38.	Vertical cracks in veneer at the building corner just above the basement wall	
	Garages	



39.	Garages 32-40	
40.	Garages 32-40	



41.	Garages 32-40	
42.	Garages 20-31	



43.	Front view of stall 30	
44.	Garages 20-31	



45.	Garage 13-19	

Appendix 2 – Geotechnical Appraisal



Appendix 3 – Quantitative Assessment Methodology and Assumptions



A3.1. Referenced Documents

- AS/NZS 1170.0:2002, *Structural design actions, Part 0: General principles,* Standards New Zealand.
- AS/NZS 1170.1:2002, *Structural design actions, Part 1: Permanent, imposed and other actions,* Standards New Zealand.
- NZS 1170.5:2004, *Structural design actions, Part 5: Earthquake actions New Zealand,* Standards New Zealand.
- NZS 3101: Part 1: 2006, *Concrete Structures Standard, The Design of Concrete Structures,* Standards New Zealand.
- NZS 3101: Part 2: 2006, *Concrete Structures Standard, Commentary on the Design of Concrete Structures,* Standards New Zealand.
- NZBC, *Clause B1 Structure, Verification Method B1/VM1*, Department of Building and Housing.
- NZSEE: 2006, Assessment and Improvement of the Structural Performance of Buildings in Earthquakes, New Zealand Society for Earthquake Engineering.
- Engineering Advisory Group, *Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury, Part 2 Evaluation Procedure*, Draft Prepared by the Engineering Advisory Group, Revision 5, 19 July 2011.
- ASCE/SEI 41-06, *Seismic Rehabilitation of Existing Buildings,* Structural Engineering Institute of the American Society of Civil Engineers, 2007.

A3.2. Analysis Parameters

The following parameters are used for the seismic analysis:

-	Site soil category D (deep or soft soil)	Cl. 3.1.3, NZS1170.5
-	Seismic hazard factor $Z = 0.30$	Cl. 2.2.14 _B , B1/VM1
-	Return period factor $R_u = 1.0$ (<i>Importance</i> Level 2 structure, 50	Table 3.5, NZS1170.5 year design life)
-	Ductility factor $\mu = 1.25$ (nominally ductile)	Cl. 2.6.1.2, NZS3101:2006
-	Structural performance factor $S_p = 0.925$	Cl. 2.6.2.2, NZS3101:2006



Material properties

Table A1: Analysis Material Properties for all buildings

Concrete block nominal compressive strength, <i>f</i> ' _m (MPa)	10
Concrete nominal compressive strength, f_c (MPa) ⁽¹⁾	25
Mild reinforcing nominal yield strength, f_y (MPa) ⁽²⁾	275

Notes: 1. Based on guidance from *NZSEE 2006*, probable concrete compressive strength is based on a value of 1.5 times the nominal compressive strength (Cl. 7.1.1) Based on guidance from *NZSEE 2006*, probable reinforcement yield strength is based on a value of 1.08 times the

2. nominal yield strength (Cl. 7.1.1)

Effective section properties

Table A2: Effective section properties from NZS3101:2006

Type of member	Ultimate	limit state	Serviceability limit state				
	<i>f</i> _y = 300 MPa	<i>f</i> _y = 500 MPa	μ = 1.25	μ=3	μ = 6		
1 Beams		0					
(a) Rectangular [¶]	0.40 <i>I</i> _g (use with <i>E</i> ₄₀) [§]	0.32 I_{g} (use with E_{40}) [§]	Ig	0.7 <i>I</i> g	0.40 I_{g} (use with E_{40}) [§]		
(b) T and L beams [¶]	0.35 <i>I</i> _g (use with <i>E</i> ₄₀) [§]	0.27 I_{g} (use with E_{40}) [§]	Ig	0.6 <i>I</i> g	0.35 I_{g} (use with E_{40}) [§]		
2 Columns							
(a) $N^*/A_g f_c > 0.5$	$0.80 I_{g} (1.0 I_{g})^{\ddagger}$	$0.80 I_g (1.0 I_g)^{\ddagger}$	I_{g}	1.0 Ig	As for the		
(b) $N^*/A_q f'_c = 0.2$	$0.55 I_{g} (0.66 I_{g})^{\ddagger}$	$0.50 I_{g} (0.66 I_{g})^{\ddagger}$	Ig	0.8 Ig	ultimate limit		
(c) $N^*/A_g f'_c = 0.0$	0.40 I_{g} (0.45 I_{g}) [‡]	0.30 Ig (0.35 Ig) [‡]	Ig	0.7 <i>I</i> g	state values in brackets		
3 Walls [¶]							
(a) $N^*/A_g f'_c = 0.2$	0.48 Ig	0.42 Ig	Ig	0.7 Ig	As for the		
(b) $N^*/A_g f'_c = 0.1$	0.40 Ig	0.33 Ig	Ig	0.6 Ig	ultimate limit		
(c) $N^*/A_g f'_c = 0.0$	0.32 Ig	0.25 Ig	Ig	0.5 Ig	state values		
4 Diagonally	$0.6I_{g}$ for flexure	aa in tavt	Ig 15A	0.75 Ig	As for ultimate		
coupling beams	Snear area, A _{shear} ,	as in text	for ULS	for ULS	infill State		
NOTES -							

Table C6.6 - Effective section properties, Ie

(\$) With these values the E value should be the elastic modulus for concrete with a strength of 40 MPa regardless of the actual concrete strength.

(‡) The values in brackets apply to columns which have a high level of protection against plastic hinge formation in the ultimate limit state.

(¶) For additional flexibility, within joint zones and for conventionally reinforced coupling beams refer to the text.

Section properties of Concrete Masonry Walls



Table A3: Average weight and equivalent solid thickness of Concrete Masonry Walls

Wall Weights and Areas

(Excerpted from Design of Reinforced Masonry Structures, published by CMACN) Average Weight of Completed Wall¹ (psf) and Equivalent Solid Thickness (in)

Hollo						ollov	llow Concrete Block								Equivalant Solid Thicknose		
			Lightweight Mediumweight Normalweight 103 pcf 115 pcf 135 pcf					Inches									
Wall Thickness		6"	8"	10"	12"	6"	8"	10"	12"	6"	8"	10"	12"	6"	8"	10"	12"
Solid grout	ed wall	52	75	93	118	58	78	98	124	63	84	104	133	5.6	7.5	9.6	11.6
	16" o.c.	41	60	69	88	47	63	80	94	52	66	86	103	4.5	5.8	7.2	8.5
vertical	24" o.c.	37	55	61	79	43	58	72	85	48	61	78	94	4.1	5.2	6.3	7.5
cores	32" o.c.	36	52	57	74	42	55	68	80	47	58	74	89	4.0	4.9	5.9	7.0
grouted at	40" o.c.	35	50	55	71	41	53	66	77	46	56	72	86	3.8	4.7	5.7	6.7
	48" o.c.	34	49	53	69	40	45	64	75	45	55	70	83	3.7	4.6	5.5	6.5

¹ The above table gives the average weights of completed walls of various thickness in pounds per square foot of wall face area. An average amount has been added into these values to include the weight of bond beams and reinforcing steel. Weight of grout is assumed at 140 pcf.

² Equivalent solid thickness means the calculated thickness of the wall if there were not hollow cores, and is obtained by dividing the volume of solid material in the wall by the face area of the wall. This Equivalent Solid Thickness (EST) is for the determination of area for structural design only, e.g. fs = P/(EST)b. It is NOT to be used to obtain fire ratings. Fire rating thickness is based either on equivalent solid thickness of ungrouted units only or solid grouted walls.

(http://www.angelusblock.com/products/technical_articles_wall_weights.cfm)

- Earthquake load combination $G + E_u + \Psi_E Q$

Cl. 4.2.2, AS/NZS1170.0

Table 3.1 Part G, AS/NZS1170.1

- Floor live loading

Q = 1.5 kPa – General Areas Q = 0.5 kPa – Non-habitable roof spaces

- Earthquake combination factor $\Psi_E = 0.3$

Table 4.1, AS/NZS1170.0

- Building seismic weight $W_t = G + \Psi_E Q$ Cl. 4.2, NZS1170.5

Building seismic weights of different buildings are as follows: Block A = 9456 kNBlock B = 8663 kNBlock C and F = 5722 kNBlock D and G = 5944 kNBlock E = 2136 kN



A3.3. Assessment Methodology

Static Analysis

The seismic assessment was undertaken by completing static analysis for the building in accordance with NZS 1170.5:2004.

A 3D model was set up using the structural analysis program ETABS, and effective section properties for structural members were taken from Table A2 above. The floor diaphragms were modelled with shell elements and treated as non-rigid diaphragms.



Figure A1: ETABS model of Block A





Figure A2: ETABS model of Block B



Figure A3: ETABS model of Block C and F





Figure A4: ETABS model of Block D and G



Figure A5: ETABS model of Block E



The fundamental building periods output from ETABS are:

Building	Time period -E/W direction (s)	Time period –N/S direction (s)
Block A	0.11	0.10
Block B	0.15	0.09
Block C/F	0.18	0.16
Block D/G	0.15	0.11
Block E	0.10	0.07

Table A4: Fundamental time periods of buildings from ETABS output

An equivalent static analysis was carried out to perform the seismic assessment of the building. The base shears resulting from the equivalent static method are:

Building	Base shear -E/W direction (kN)	Base shear –N/S direction (kN)
Block A	6,888	6,888
Block B	6,310	6,310
Block C/F	4,168	4,168
Block D/G	4,330	4,330
Block E	1,556	1,556

Table A5: Base shear from equivalent static method

The building was analysed as having limited ductility ($\mu = 1.25$) and the design actions were applied separately in each perpendicular direction, with 100% for the first axis plus 30% on the second axis, and then 30% on the first axis and 100% on the second axis, as required by NZS1170.5, Clause 5.3.1.2.

Element Demand to Capacity

Element force demands were extracted from the equivalent static analysis and compared to calculated capacities based on the material properties assumed in Table A1. The results of these demand to capacity checks are summarized in further detail in the report and reported as %NBS.



Appendix 4 – Floor Level Survey



p:\projects\6-quake.01\ccc_residential units\airedale\survey\cilvil 3d\6quccc.85 airedale courts level survey 08.05.12.dwg - Block A nal Sheet Size A1 [841x594] 10/05/12 @ 17:28 Plot Date



Revision	Amendment	Approved	Revision Date							Project	
							Christchurch Office		Airedale Courts Levels Survey Block B		
						OPUS		Christchurch 8140, N), New Zealand	Sheet	
					<i></i>			+ 64 3 363 5400			
				Drawn	D	Designed	Approved Revision		Revision Date		
				S. Brough	ghton		S.Becker				
				Project No.	Project No.		S	Scale		Drawing No.	Sheet. No.
				6DQUC	6DQUCCC.85		N	Not to Scale		6/1366/251/2604	2/8



Original Sheet Size A1 [841x594] Plot Date 10/05/12 @ 17:28 p:/projects/6-quake.01/locc/_residential units/airedale/survey/clivil 3d/6quccc.85 airedale courts level survey 08.05.12.dwg - Block C





riginal Sheet Size A1 (841	1x5941	Plot Date	10/05/12 @ 17:28	p:\projects\6-quake.01\ccc\	residential units/airedale/survey	//cilvil 3d\6ouccc.85 airedale c	ourts level survey 08.05.12.dw	a - Block F

Not To Scale






Original Sheet Size A1 [841x594] Plot Date 10/05/12 @ 17:28 p:\projects\6-quake.01\ccc_residential units\airedale\survey/clivil 3d6quccc.85 airedale courts level survey 08.05.12.dwg - First Floor Lev

Appendix 5 – CERA DEE Data Sheets



Location				V1.11
	Building Name:	Airedale - Block A	Reviewer	Alistair Boyce
	Building Address:	Unit 59-63	No: Street CPEng No Salisbury St Company	209860 Opus International
	Legal Description:	Dearmon	Company project number Company phone number	03 363 5400
	GPS south:	Degrees	Date of submission	25/09/2012
	Building Unique Identifier (CCC):	BU 1951-001 EQ2	Revision Is there a full report with this summary	r Final ? yes
L				,
Site				
	Site slope: Soil type:	flat silty sand	Max retaining height (m) Soil Profile (if available)	
	Proximity to waterway (m, if <100m): Provimity to clifftop (m, if <100m):	D	If Ground improvement on site, describe	
	Proximity to cliff base (m,if <100m):		Approx site elevation (m)	E
Building				
	No. of storeys above ground: Ground floor split?	3 no	single storey = 1 Ground floor elevation (Absolute) (m) Ground floor elevation above ground (m)	16.40 0.30
	Storeys below ground Foundation type:	0 other (describe)	if Foundation type is other, describe	piles
	Floor footprint area (approx): Age of Building (years):	480	neight from ground to level of uppermost seismic mass (for IEP only) (m)	1935-1965
	J			
	Strengthening present?	no	If so, when (year)' And what load level (%g)'	?
	Use (ground floor): Use (upper floors):	multi-unit residential multi-unit residential	Brief strengthening description	d
	Importance level (to NZS1170.5):	IL2		
Gravity Structure	Gravity System:	load bearing walls	1	
	Roof: Floors:	timber framed concrete flat slab	rafter type, purlin type and cladding slab thickness (mm	g Timber purlins over jack stud trusses) 140
	Beams: Columns:			Partially and fully grouted walls
Lateral load resisting s	wais:	partially filled concrete masonry	unoxness (mm	y
Eutora load robbing b	Lateral system along: Ductility assumed, µ:	partially filled CMU 1.25	Note: Define along and across in detailed report! note total length of wall at ground (m)	Partially grouted ext./fully grouted int. 107
	Period along: Total deflection (ULS) (mm):	0.11	##### enter height above at H31 estimate or calculation' estimate or calculation'	? calculated ?
ma	aximum interstorey deflection (ULS) (mm):		estimate or calculation?	?
	Lateral system across: Ductility assumed, µ:	1.25	note total length of wall at ground (m)	r aruany grouted ext./fully grouted int. 104 2 calculated
m	Total deflection (ULS) (mm): aximum interstorey deflection (LILS) (mm):	0.10	estimate or calculation estimate or calculation	?
Separations:	(, ()			
	north (mm): east (mm):		leave blank if not relevant	
	south (mm): west (mm):			
Non-structural element	nts Stairs:	cast insitu	note:	s
	Wall cladding: Roof Cladding:	other heavy Metal	describ describ	e concrete block veneer, 140mm
	Glazing: Ceilings:	strapped or direct fixed		
	Services(iIST)			
Available documenta	ation Architectural	full	original designer name/date	
	Structural Mechanical	none partial	original designer name/date original designer name/date	9000 9000
	Electrical Geotech report	none	original designer name/date original designer name/date	e CCC
Damage				
Site: (refer DEE Table 4-2)	Site performance:	Poor	Describe damage	Moderate to severe liquefaction
	Differential settlement:	25-100m 1:350-1:250	notes (if applicable) notes (if applicable)	bldg. 43mm down from south to north side
	Lateral Spread: Differential lateral spread:		notes (if applicable) notes (if applicable)	yes, some cracks
	Ground cracks: Damage to area:	moderate to substantial (1 in 5)	notes (if applicable) notes (if applicable)	: yes
Building:	0			
Along	Damage ratio		Describe how damage ratio arrived at	t
, long	Describe (summary):		(% NBS (before) - % NBS (after))	M
Across	Damage ratio: Describe (summary):	#DIV/0!	$Damage _Ratio = \frac{(8.1435 (edgere))^{-1}(1125 (edgere))^{-1}}{\% NBS (before)}$	
Diaphragms	Damage?:	no	Describe	d
CSWs:	Damage?:	no	Describe	some discontinous walls
Pounding:	Damage?:	no	Describe	
Non-structural:				
Non-andetara.	Damage?:	ves	Describe	veneer cracking, ground floor slab settlement
Recommendations	Damage?:	pionificant structural and strengthening	j Describe	veneer cracking, ground floor slab settlement
Recommendations	Damage ?: Level of repair/strengthening required: Building Consent required: Interim occupancy recommendations;	significant structural and strengthening yes	I Lescribe	reveneer cracking, ground floor slab settlement
Recommendations	Level of repair/strengthening required: Building Consent required: Interim occupancy recommendations: Assessed %NBS before e'quakes:	significant structural and strengthening yes full occupancy	Lescribe Describe Lescribe Les	Eveneer cracking, ground floor slab settlement
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Recommendations Along Across IEP Seismic Z	Level of repair/strengthening required: Building Consent required: Interim occupancy recommendations: Assessed %ABS before equakes: Assessed %ABS after equakes: Assessed %ABS after equakes: Consection of the second form above): Use of this Period of design of building (from above): Cone, if designed between 1965 and 1992: Note:1 for speci Note:1 for speci 2.2 Near Fault Scaling Factor 2.3 Hazard Scaling Factor 2.4 Return Period Scaling Factor 2.5 Ductility Scaling Factor 2.5 Ductility Scaling Factor 2.6 Structural Performance Scaling F Global Critical Structural Weaknesses: 3.1. Plan Irregularity, Factor B: 3.2. Vertical irregularity, Factor C: 3.4. Pounding potential 4.5 Site Characteristics 3.6. Other factors, Factor F Detail Critical Structural Weaknesses: List any: 3.7. Overall Performance Achievement 4.3 PAR x (%NBS)b:	Significant structural and strengthening Yes Y	Justicity Justicity ##### %/NBS from IEP below If IEP not used, please detail assessment methodology ##### %/NBS from IEP below If IEP not used, please detail assessment methodology ##### %/NBS from IEP below If IEP not used, please detail assessment methodology ##### %/NBS from IEP below If IEP not used, please detail assessment methodology ##### %/NBS from IEP below If IEP not used, please detail assessment methodology #### %/NBS from IEP below If IEP not used, please detail assessment methodology #### %/NBS from IEP below If IEP not used, please detail assessment methodology #analysis may give a different answer, which would take precedence. Do not fill in flow in the gradient of this age of building not required for this age of building not required for this age of building for the gradient of this age of building for the gradient of the gradient form Table 3.1 (% NBS)new Near Fault scaling factor (1/N(T,D), Factor A 1 Hazard factor Z for site from AS1170.5, Table 3.3 (100 Return Period Scaling factor from Table 3.1, factor C 0.00 Sp: 1.00 In the for selection of D1 0.28 (100) Sp: 1.00 In the for selection of D1 0.28 (100)	evener cracking, ground floor slab settlement infer report for details, work req. for 67%. ingering report floor before occupancy it affer report for details, work req. for 67%. ingering report floor before occupancy it auron table settlement it auron table

Detailed Engineeri	ing Evaluation Summary Data							V1.1
ocation	Building Name:	Airedale - Block B	No:	Street		Reviewer:	Alistair Boyce	20086
	Building Address: Legal Description:	51-57	INU.	Salisbury Street	נ	Company project number:	Opus International 6-QUCCC.85	20986
	GPS south:	Degrees	Min	Sec]	Company phone number: Date of submission:	25/9//2012	
	GPS east:]	Inspection Date: Revision:	Final	
	Building Unique Identifier (CCC):	BU 1951-004 EQ2			Is there a	full report with this summary?	yes	
te		n -	1					
	Site slope: Soil type: Site Class (to NZS1170.5):	flat silty sand D				Max retaining height (m): Soil Profile (if available):		
	Proximity to waterway (m, if <100m): Proximity to clifftop (m, if < 100m):				If Ground in	nprovement on site, describe:		
	Proximity to cliff base (m,if <100m):					Approx site elevation (m):		_
uilding	No. of storeys above ground:	3	1	single storey = 1	Ground	floor elevation (Absolute) (m):		
	Ground floor split? Storeys below ground	0			Ground floo	r elevation above ground (m):		
	Foundation type: Building height (m): Floor footprint area (approx):	0ther (describe) 7.80 430		height from ground to level o	f uppermost sei	smic mass (for IEP only) (m):	Piles	
	Age of Building (years):	49				Date of design:	1935-1965	
	Strengthening present?	no	l			If so, when (year)? And what load level (%q)?		
	Use (ground floor): Use (upper floors):	multi-unit residential multi-unit residential			B	rief strengthening description:		
	Use notes (if required): Importance level (to NZS1170.5):	IL2						
ravity Structure	Gravity System:	load bearing walls						
	Roof: Eloors	timber framed			rafter	type, purlin type and cladding	Close butted sarking over timber pu	urlins 14
	Beams: Columns:					alab (Incitieaa (Initi)	Partially and fully grouted walls	14
toral load registing	Walls:	partially filled concrete masonry				thickness (mm)		
tterai load resisting	Lateral system along: Ductility assumed, µ:	partially filled CMU 1.25		Note: Define along and across in detailed report!	note tota	al length of wall at ground (m):	Partially grouted ext./fully grouted in	nt. 8
	Period along: Total deflection (ULS) (mm):	0.15	#####	# enter height above at H31		estimate or calculation? estimate or calculation?		
	maximum interstorey deflection (ULS) (mm):	partially filled CMU				estimate or calculation?	Partially grouted ext /fully grouted in	nt.
	Ductility assumed, μ: Period across:	1.25	#####	# enter height above at H31	note tota	al length of wall at ground (m): estimate or calculation?	calculated	10
	Total deflection (ULS) (mm): maximum interstorey deflection (ULS) (mm):					estimate or calculation? estimate or calculation?		
eparations:	north (mm):			leave blank if not relevant				
	east (mm): south (mm):							
on-structural elem	ents							
	Stairs: Wall cladding:	cast insitu other heavy				notes describe	concrete block veneer, 90mm	
	Hoot Cladding: Glazing: Ceilings:	strapped or direct fixed				describe	gib ceiling	
	Services(list):							_
vailable docume	ntation Architectural	full				original designer name/date	lece	
	Structural Mechanical	none				original designer name/date original designer name/date	CCC CCC	
	Electrical Geotech report	none				original designer name/date original designer name/date	CCC	
amage								
<u>te:</u> efer DEE Table 4-	2) Sattlement	Poor				Describe damage:	moderate to severe liquefaction	
	Differential settlement: Liquefaction:	1:350-1:250				notes (if applicable): notes (if applicable): notes (if applicable):	bldg. 56mm down from north to sou yes	uth side
	Lateral Spread Differential lateral spread					notes (if applicable): notes (if applicable):	yes, some cracks	
	Damage to area:	moderate to substantial (1 in 5)				notes (if applicable): notes (if applicable):	yes	
uilding:	Current Placard Status:							
ong	Damage ratio: Describe (summary):				Describe	e how damage ratio arrived at:		
cross	Damage ratio:	#DIV/0!	Da	$mage _Ratio = \frac{(\% NBS (b))}{c}$	efore) – %	NBS (after))		
iaphraoms	Describe (summary): Damage?:	no		7	0 INDS (Dejo	Describe:		
SWs:	Damage?:	no				Describe:	some discontinuous walls	
ounding:	Damage?:	no				Describe:		
on-structural:	Damage?:	yes				Describe:	veneer cracking, ground floor slab	settlem
ecommendation	s Level of repair/strengthening required:	significant structural and strengthening	1			Describe:	refer report for details, strengthen to	o 34/67
	Building Consent required: Interim occupancy recommendations:	yes do not occupy				Describe: Describe:	repair ground floor before occupant	cy
long	Assessed %NBS before e'quakes: Assessed %NBS after e'quakes:	15%	#####	# %NBS from IEP below	If IEP not us	ed, please detail assessment methodology:	quantitative	
ross	Assessed %NBS before e'quakes:	159/	#####	# %NBS from IEP below				
	Assessed Janua and equales.	1578						
Ρ	Use of this	method is not mandatory - more detailed a	analys	sis may give a different answer, whic	h would take p	recedence. Do not fill in fi	elds if not using IEP.	
Seismir	 Period or design of building (from above): Zone, if designed between 1965 and 1992. 	1999-1900			pot re	hn from above:		
Colonill					not re	equired for this age of building		
				Period (from above): (%NBS)nom from Fig.2.2		along 0.15	across 0.09	
	Note:1 for speci	ically design public buildings, to the code of th	e day:	: pre-1965 = 1.25; 1965-1976, Zone A =	=1.33; 1965-19	76, Zone B = 1.2; all else 1.0	1.00	
				Note 2: for RC build Note 3: for buildings designed prio	lings designed r to 1935 use 0	between 1976-1984, use 1.2 .8, except in Wellington (1.0)	1.0	
				Final (%NBS)nom		along 0%	across 0%	
	2.2 Near Foult Cooling Fo					or from N791470 5 10 1	4.00	
	2.2 Near Fault Scaling Factor		Near F	Near Fa	ault scaling fact	or, from NZS1170.5, cl 3.1.6: along	1.00 across	
	2.3 Hazard Scaling Factor			Hazar	rd factor Z for si	te from AS1170.5, Table 3.3:	· · ·	
					Ha	Z1992, from NZS4203:1992 zard scaling factor, Factor B:	#DIV/0!	
	2.4 Return Period Scaling Factor				Building	nportance level (from above)	2	
				Return Pe	riod Scaling fac	tor from Table 3.1, Factor C:	-	
	2.5 Ductility Scaling Factor	Ductility costing factory of from the	Assess 6 cm	sed ductility (less than max in Table 3.2)	-	along 1.00	across 1.00	
		Ductility scaling factor: =1 from 197	o onwa	Ductify Scaling Factor Factor D		0.00	0.00	_
	2.6 Structural Performance Scaling F	actor:		Sp:		1.000	1.000	
		Str	uctura	al Performance Scaling Factor Factor E:		1	1	
	2.7 Baseline %NBS. (NBS%)b = (%NR4	S)nom x A x B x C x D x E		%NRS+		#DIV/0!	#DIV/01	
	Global Critical Structural Weaknesses:	(refer to NZSEE IEP Table 3.4)		/011335.				
	3.1. Plan Irregularity, factor A:		1					
	3.2. Vertical irregularity, Factor B:		1			0	Simplifie	
	3.3. Short columns, Factor C:		1	Table for selection of D1	Separation	Severe 0 <sep<.005h .0<="" td=""><td>Significant Insignificant/r 105<sep<.01h sep="">.01H</sep<.01h></td><td>none 1</td></sep<.005h>	Significant Insignificant/r 105 <sep<.01h sep="">.01H</sep<.01h>	none 1
	3.4. Pounding potential	Pounding effect D1, from Table to right sight Difference effect D2, from Table to right	1.0 1.0	Alignment of floors with Alignment of floors not with	nin 20% of H nin 20% of H	0.7 0.4	0.8 1 0.7 0.8	
		Therefore, Factor D:	1	Table for Selection of D2		Severe	Significant Insignificant/r	none
	3.5. Site Characteristics		1	Height difference	Separation e > 4 storeys	0 <sep<.005h .0<br="">0.4</sep<.005h>	05 <sep<.01h sep="">.01H 0.7 1</sep<.01h>	1
				Height difference 2 Height difference	to 4 storeys	0.7	0.9 1	
	3.6 Other feature Factor	For 2 0 store	-25	othenuice may value - 1.5		Along	Across	
	3.b. Other factors, Factor F	For ≤ 3 storeys, max value	=2.5,	Rationale for choice of F factor, if not 1	L			-
	Detail Critical Structural Weaknesses:	(refer to DEE Procedure section 6)						
	List any:		Refer	also section 6.3.1 of DEE for discussion	n of F factor mo	dification for other critical stru	ctural weaknesses	
	3.7. Overall Performance Achievemen	t ratio (PAR)				0.00	0.00	
	4.3 PAR x (%NBS)b:			PAR x Baselline %NBS:		#DIV/0!	#DIV/0!	
	4.4 Percentage New Building Standar	1 (%NBS), (before)					#DIV/0!	

Detailed Engineerin	g Evaluation Summary Data				V1.11
Location	Building Name:	Airedale - Block C & F		Reviewer:	Alistair Boyce
	Building Address: Legal Description:	Unit Airedale Place/Conference Street	No: Street	CPEng No: Company: Company project number:	209860 Opus International 6-QUCCC.85
	GPS couth	Degrees	Min Sec	Company phone number:	03 363 5400
	GPS east:			Inspection Date: Revision:	Final
	Building Unique Identifier (CCC):	BU 1951-005 EQ2	1	is there a full report with this summary?	yes
Site					
	Site slope: Soil type:	flat silty sand		Max retaining height (m): Soil Profile (if available):	
	Site Class (to NZS1170.5): Proximity to waterway (m, if <100m): Proximity to clifftop (m, if <100m):	D	lf	Ground improvement on site, describe:	
	Proximity to cliff base (m,if <100m):			Approx site elevation (m):	
Building	No. of storeys above ground:	3	single storey – 1	Ground floor elevation (Absolute) (m):	
	Ground floor split? Storeys below ground	0	Gr	round floor elevation above ground (m):	
	Foundation type: Building height (m): Eloor footprint area (approx)	other (describe) 7.80 300	height from ground to level of uppe	if Foundation type is other, describe: ermost seismic mass (for IEP only) (m):	Unknown
	Age of Building (years):	45		Date of design:	1965-1976
	Strengthening present?	no		If so, when (year)?	
	Use (ground floor): Use (upper floors):	multi-unit residential multi-unit residential		Brief strengthening description:	
	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	Close butted sarking over timber purlins
	Beams: Columns:			siab (nickness (mm)	Partially and fully grouted walls
	Walls:	partially filled concrete masonry		thickness (mm)	
Lateral load resisting	Lateral system along: Ductility assumed, µ:	partially filled CMU 1.25	Note: Define along and across in detailed report!	note total length of wall at ground (m):	Partially grouted int./fully grouted ext. 95
	Period along: Total deflection (ULS) (mm):	0.18	##### enter height above at H31	estimate or calculation? estimate or calculation?	calculated
m	aximum interstorey detlection (ULS) (mm): Lateral system across:	fully filled CMU		estimate or calculation?	Partially grouted int./fully grouted ext.
	Ductility assumed, µ: Period across:	1.25	##### enter height above at H31	note total length of wall at ground (m): estimate or calculation?	calculated 35
m	aximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Separations:	north (mm):	[]	leave blank if not relevant		
	east (mm): south (mm):				
Non-structural element	nts				
	Stairs: Wall cladding: Reof Cladding	precast, tull tlight other heavy Metal		describe supports describe	concrete block veneer
	Glazing: Ceilings:	strapped or direct fixed		Gescribe	
	Services(list):				
Available document	tation Architectural	full		original designer name/date	
	Structural Mechanical	full		original designer name/date original designer name/date	
	Electrical Geotech report	none		original designer name/date	
Damage	Cite and an			Describe democra	Madanata ta annan linuafactina
(refer DEE Table 4-2)) Settlement:	25-100m		Describe damage: notes (if applicable);	site 40mm to 100mm
	Differential settlement: Liquefaction:			notes (if applicable): notes (if applicable):	yes
	Lateral Spread: Differential lateral spread: Ground cracks			notes (if applicable): notes (if applicable): notes (if applicable):	yes
	Damage to area:	moderate to substantial (1 in 5)		notes (if applicable):	<u>yos</u>
Building:	Current Placard Status:				
Along	Damage ratio: Describe (summary):			Describe how damage ratio arrived at:	
Across	Damage ratio:	#DIV/0!	Damage _ Ratio = $\frac{(\% NBS (before))}{(\% NBS (before))}$	e) - % NBS (after))	
Diaphragms	Describe (summary):	Ino	% IND	Describe:	
CSWs:	Damage?:	no		Describe:	discontinuous walls
Pounding:	Damage?:	no		Describe:	
Non-structural:	Damage?:	yes		Describe:	veneer cracking, ground floor slab settlement
Recommendations	Lougl of repair/strengthening required	miner pep structural		Describe:	rafor report for dataila
	Building Consent required: Interim occupancy recommendations:	no full occupancy		Describe: Describe: Describe:	repair ground floor before occupancy
Along	Assessed %NBS before e'quakes:	44%	##### %NBS from IEP below If I	EP not used, please detail assessment	quantitative
Across	Assessed %NBS before e'quakes:		##### %NBS from IEP below	menodology.	
	Assessed %NBS after e'quakes:	44%			
IEP	Use of this	method is not mandatory - more detailed a	analysis may give a different answer, which wou	Id take precedence. Do not fill in fie	elds if not using IEP.
Coloria	Period of design of building (from above):	1965-1976		hn from above:	m
Seismic .	zone, il designed between 1965 and 1992:			not required for this age of building not required for this age of building	
			Period (from above):	along 0.18	across 0.16
	Note:1 for speci	fically design public buildings, to the code of th	(%NBS)nom from Fig 3.3: e day: pre-1965 = 1.25; 1965-1976. Zone A =1.33.	1965-1976, Zone B = 1.2; all else 1.0	1.00
			Note 2: for RC buildings of Note 3: for buildings designed prior to 19	designed between 1976-1984, use 1.2 335 use 0.8, except in Wellington (1.0)	1.0
			Final (%NRShort	along 0%	across 0%
	2.2 Near Fault Scaling Factor		Near Fault scaling factor (1/b)(T.D). For the A	along factor, from NZS1170.5, cl 3.1.6:	1.00 across
	2.3 Hazard Scaling Factor		Hazard fact	or Z for site from AS1170.5. Table 3.3:	
				Z1992, from NZS4203:1992 Hazard scaling factor, Factor B:	#DIV/0!
	2.4 Return Period Scaling Factor			Building Importance level (from above)	2
	Trong ocanny Factor		Return Period S	caling factor from Table 3.1, Factor C:	
	2.5 Ductility Scaling Factor	Ductility cooling factory of from the	Assessed ductility (less than max in Table 3.2)	along 1.00	across 1.00
		Documy scaling ractor: =1 from 197	Ductility Scaling Factor. Factor D	0.00	0.00
	2.6 Structural Performance Scaling F	actor:	Sp.	1.000	1.000
		Str	uctural Performance Scaling Factor Factor E:	1	1
	2.7 Baseline %NBS, (NBS%)₀ = (%NBS	S)nom x A x B x C x D x E	%NBS6:	#DIV/0!	#DIV/0!
	Global Critical Structural Weaknesses:	(refer to NZSEE IEP Table 3.4)			
	3.1. Plan Irregularity, factor A:		1		
	3.2. Vertical irregularity, Factor B:		Table for selection of D1	Severe	Significant Insignificant/pope
	3.3. Short columns, Factor C:	Pounding offest D.f. from T. H	1 Table for selection of D1 Sep	aration 0 <sep<.005h .0<="" td=""><td>05<sep<.01h sep="">.01H</sep<.01h></td></sep<.005h>	05 <sep<.01h sep="">.01H</sep<.01h>
	3.4. Pounding potential	Pounding effect D1, from Table to right eight Difference effect D2, from Table to right	1.0 Alignment of floors within 20 1.0 Alignment of floors not within 20	0% of H 0.7 0% of H 0.4	0.8 1 0.7 0.8
		Therefore, Factor D:	1 Table for Selection of D2	Severe	Significant Insignificant/none
	3.5. Site Characteristics		1 Sep Height difference > 4	storeys 0.4	0.7 1
			Height difference 2 to 4 Height difference < 2	storeys 0.7 storeys 1	0.9 1 1 1
	3.6. Other factors, Factor F	For ≤ 3 storeys, max value	=2.5, otherwise max valule =1.5, no minimum	Along	Across
		,	Rationale for choice of F factor, if not 1		
	Detail Critical Structural Weaknesses:	(refer to DEE Procedure section 6)	Refer also section 6.3.1 of DEE for discussion of E	factor modification for other critical etrus	ctural weaknesses
	3.7. Overall Performance Achievemen	it ratio (PAR)		0.00	0.00
	4.3 PAR x (%NBS)b:	d (%NRS) (before)	PAR x Baselline %NBS:	#DIV/0!	#DIV/0!
	Fercentage New Building Standar	((Jone Day, (Delore)			#017/0!

Detailed Engineeri	ring Evaluation Summary Data						V1.11
Location	Building Name:	Airedale - Block D & G	No: St	reat	Reviewer CREng No.	Alistair Boyce	200966
	Building Address: Legal Description:	Airedale Place/Conference Street	110. 30	eet	Company Company project number	Opus International 6QUCCC.85	209000
	GPS south	Degrees	Min Se	c	Company phone number	03 363 5400	25/09/2012
	GPS east				Inspection Date Revision	Final	23/03/2012
	Building Unique Identifier (CCC):	BU 1951-006 EQ2, BU 1951-009 EQ2		Is there a	ull report with this summary?	yes	
ite							
	Site slope: Soil type:	flat silty sand			Max retaining height (m) Soil Profile (if available)		
	Site Class (to NZS1170.5): Proximity to waterway (m, if <100m): Provinity to eliffton (m, if <100m):			If Ground in	nprovement on site, describe	:[
	Proximity to cliff base (m,if <100m): Proximity to cliff base (m,if <100m):				Approx site elevation (m)	:[
uilding							
-	No. of storeys above ground: Ground floor split?	3	sin	igle storey = 1 Ground 1 Ground floo	loor elevation (Absolute) (m) r elevation above ground (m)		
	Storeys below ground Foundation type:	0 driven precast piles		if Foun	dation type is other, describe		
	Floor footprint area (approx): Age of Building (years):	400		neight from ground to level of uppermost sei	smic mass (for IEP only) (m) Date of design	1965-1976	
	Age of Building (years).				Date of design	1303-1370	
	Strengthening present?	no			If so, when (year) And what load level (%g)		
	Use (ground floor): Use (upper floors):	multi-unit residential multi-unit residential		Br	ief strengthening description	-1	
	Importance level (to NZS1170.5):	.IL2					
iravity Structure	Gravity System:	load bearing walls					
	Roof	timber framed		rafter	type, purlin type and cladding	Close butted sarking over	r timber purlins
	Floors: Beams: Columno	concrete flat slab			slab thickness (mm	Portially and fully gravited	140
	Walls:	partially filled concrete masonry			thickness (mm))	walls
ateral load resisting	i <u>g structure</u> Lateral system along:	partially filled CMU	Nc	te: Define along and across in		Partially grouted int./fully	grouted ext.
	Ductility assumed, μ Period along:	1.25	de ##### en	tailed report! note tota ter height above at H31	l length of wall at ground (m) estimate or calculation?	calculated	85
	Total deflection (ULS) (mm): maximum interstorey deflection (ULS) (mm):				estimate or calculation? estimate or calculation?	, 	
	Lateral system across: Ductility assumed up	partially filled CMU		note tota	l length of wall at ground (m)	Partially grouted int./fully	grouted ext.
	Period across Total deflection (ULS) (mm)	0.11	##### en	ter height above at H31	estimate or calculation	calculated	
	maximum interstorey deflection (ULS) (mm):				estimate or calculation?		
eparations:	north (mm):		lea	we blank if not relevant			
	east (mm): south (mm): west (mm):						
Non-structural elem	nents						
	- Stairs: Wall cladding:	precast, full flight other heavy			describe supports describe	concrete block veneer	
	Roof Cladding Glazing:	Metal			describe		
	Ceilings: Services(list):						
vailable docume	entation						
	Architectural Structural	full full			original designer name/date original designer name/date	2000 2000	
	Mechanical Electrical	none			original designer name/date original designer name/date		
	Geotech report	none			original designer name/date	1000	
Damage Site:	Site performance:	Poor			Describe damage	Moderate to severe liquet	action
refer DEE Table 4-	-2) Settlement:	25-100m			notes (if applicable)	site 40mm to 100mm	
	Differential settlement: Liquefaction	0-1:350			notes (if applicable) notes (if applicable)	bldg. 38mm down from Ni yes	E corner to midpoi
	Lateral Spread Differential lateral spread				notes (if applicable) notes (if applicable)	yes	
	Damage to area	moderate to substantial (1 in 5)			notes (if applicable) notes (if applicable)	i ves	
Building:	Current Placard Status:						
Nong	Damage ratio:			Describe	how damage ratio arrived at	4	
	Describe (summary):		Deres	Batia (% NBS (before) - %	NBS (after))		
Across	Damage ratio: Describe (summary):	#DIV/0!	Dama	$ge _Ratio = \frac{\%}{\%} NBS (before)$	ore)		
Diaphragms	Damage?	no			Describe	:	
CSWs:	Damage?	no			Describe	۶ ـ ــــــــ	
ounding:	Damage?	no			Describe	-	
Ion-structural:	Damage?	no			Describe	ground floor slab settleme	int
Recommendation	IS	minor non-structural			Describe	refer to report for details	
	Building Consent required: Interim occupancy recommendations:	no full occupancy			Describe	repair ground floor before	occupancy
Along	Assessed %NBS before e'quakes:		##### %1	NBS from IEP below If IEP not us	ed, please detail assessmen	Iquantitative	
lorooo	Assessed %NBS after e'quakes:	50%	##### 9/1	VPC from IEB bolow	methodology	1	
ACTOSS	Assessed %NBS after e'quakes:	. 50%	##### 761	NBS ITOM IEP Delow			
EP	Use of this	method is not mandatory - more detailed a	analysis m	nay give a different answer, which would take p	recedence. Do not fill in fi	elds if not using IEP.	
	Period of design of building (from above):	1965-1976			h₀ from above	. m	
Seismic	c Zone, if designed between 1965 and 1992			not re	quired for this age of building	a	
				not re	quired for this age of building		
				Period (from above): (%NBS)nom from Fig 3.3:	0.15	across 0.11	
	Note:1 for speci	fically design public buildings, to the code of the	e day: pre	-1965 = 1.25; 1965-1976, Zone A =1.33: 1965-19	76, Zone B = 1.2; all else 1.0	1.00	
				Note 2: for RC buildings designed I Note 3: for buildings designed prior to 1935 use 0	between 1976-1984, use 1.2 8, except in Wellington (1.0)	1.0	
				-	along	across	
				Final (%NBS)nom:	0%	0%	
	2.2 Near Fault Scaling Factor			Near Fault scaling fact	or, from NZS1170.5, cl 3.1.6	1.00	
			Near Fault	scaling factor (1/N(T,D), Factor A:	1	1	
	2.3 Hazard Scaling Factor			Hazard factor Z for si	te from AS1170.5, Table 3.3 Z1992, from NZS4203:1992		
				Haz	ard scaling factor, Factor B	#DIV/0	!
	2.4 Return Period Scaling Factor			Building Ir	nportance level (from above)	2	
				Return Period Scaling fac	along	۱ <u>ــــــــــــــــــــــــــــــــــــ</u>	
	2.5 Ductility Scaling Factor	A Ductility scaling factor: =1 from 1971	Assessed of 6 onwards	ductility (less than max in Table 3.2)	1.00	1.00	
		Ducinity scaling factor 1 from 1570	o onwarda,	Ductility Scaling Factor, Factor D:	0.00	0.00	
	2.6 Structural Performance Scaling F	actor:		Sp:	1.000	1.000	
		Str	uctural Per	formance Scaling Factor Factor E:	1	1	
	0.7 Per-line at the				#DI3/(0)		
	2.7 Baseline %NBS, (NBS%) _b = (%NB			%NBSb:	#UIV/0!	#DIV/0	1
	Giobal Critical Structural Weaknesses	(rener to NZSEE IEP Table 3.4)	1				
	3.2. Vertical irregularity. Factor R:		1				
	3.3. Short columns, Factor C:		1	Table for selection of D1	Severe	Significant Insig	nificant/none
	3.4. Pounding potential	Pounding effect D1, from Table to right	1.0	Alignment of floors within 20% of H	0 <sep<.005h .0<="" td=""><td>05<sep<.01h s<="" td=""><td>ep>.01H</td></sep<.01h></td></sep<.005h>	05 <sep<.01h s<="" td=""><td>ep>.01H</td></sep<.01h>	ep>.01H
	н	eight Difference effect D2, from Table to right	1.0	Alignment of floors not within 20% of H	0.4	0.7	0.8
		Therefore, Factor D:	1	Table for Selection of D2	Severe	Significant Insig	nificant/none
	3.5. Site Characteristics		1	Separation Height difference > 4 storeys	0.4 0.4	0.7	1
				Height difference 2 to 4 storeys Height difference < 2 storeys	0.7	0.9	1
					Along	Across	
			0.7			7107000	
	3.6. Other factors, Factor F	For ≤ 3 storeys, max value	=2.5, othe Rat	erwise max valule =1.5, no minimum tionale for choice of F factor, if not 1			
	3.6. Other factors, Factor F	For ≤ 3 storeys, max value	=2.5, othe Rat	erwise max valule =1.5, no minimum tionale for choice of F factor, if not 1			
	3.6. Other factors, Factor F Detail Critical Structural Weaknesses List any	For ≤ 3 storeys, max value (refer to DEE Procedure section 6)	=2.5, othe Rat Refer also	arwise max valule = 1.5, no minimum ionale for choice of F factor, if not 1 section 6.3.1 of DEE for discussion of F factor mo	dification for other critical stru	ctural weaknesses	
	3.6. Other factors, Factor F Detail Critical Structural Weaknesses List any 3.7. Overall Performance Achievemen	For ≤ 3 storeys, max value (refer to DEE Procedure section 6) t ratio (PAR)	=2.5, othe Rat Refer also	rwise max valule =1.5, no minimum ionale for choice of F factor, if not 1 section 6.3.1 of DEE for discussion of F factor mo	dification for other critical stru	ictural weaknesses	
	3.6. Other factors, Factor F Detail Critical Structural Weaknesses List any. 3.7. Overall Performance Achievemen	For ≤ 3 storeys, max value (refer to DEE Procedure section 6) tt ratio (PAR)	=2.5, othe Rat	Invise max value = 1.5, no minimum ionale for choice of F factor, if not 1	dification for other critical stru 0.00	ictural weaknesses	
	 3.6. Other factors, Factor F Detail Critical Structural Weaknesses List any. 3.7. Overall Performance Achievement 4.3 PAR x (%NBS)b: 	For ≤ 3 storeys, max value (refer to DEE Procedure section 6) It ratio (PAR)	=2.5, othe Rat	Invise max valule = 1.5, no minimum ionale for choice of F factor, if not 1 section 6.3.1 of DEE for discussion of F factor mo	dification for other critical stru 0.00 #DIV/0!	ictural weaknesses	

Detailed Engineerin	g Evaluation Summary Data							V1.11
Location	Building Name:	Airedale - Block E Unit	No:	Street		Reviewer CPEng No	Alistair Boyce	209860
	Building Address: Legal Description:	Conference Street] Company	Company project number	Opus International 6QUCCC.85	
	GPS south:	Degrees	Min	Sec	Da	te of submission	103 363 5400	25/09/2012
	GPS east: Building Unique Identifier (CCC):	BU 1951-003 EQ2			Is there a full report wit	Inspection Date Revision h this summary?	Final	
							194 m	
Site	Site slope:	flat			Max reta	aining height (m)		
	Soil type: Site Class (to NZS1170.5):	silty sand D			Soil Pro	ofile (if available)		
	Proximity to valerway (m, if < 100m): Proximity to clifftop (m, if < 100m): Proximity to cliff base (m,if <100m):				Approx s	ite elevation (m)		
Building								
Bulluling	No. of storeys above ground: Ground floor split?	2		single storey = 1	Ground floor elevatio Ground floor elevation a	n (Absolute) (m) pove ground (m)	8 8 9	
	Storeys below ground Foundation type: Building beight (m)	0 other (describe)		height from ground to level o	if Foundation type is	s other, describe	foundation beams with sl	ab on grade
	Floor footprint area (approx): Age of Building (years):	290 46		neight noin ground to iever o	opportioat aciantic mass (Date of design	1965-1976	
	Strengthening present?	no			lf	so, when (vear)?	, 	
	Use (ground floor):	multi-unit residential			And what Brief strengthe	load level (%g)		
	Use (upper floors): Use notes (if required): Importance level (to NZS1170.5):	IL2						
Gravity Structure		lead be arise wells						
	Roof: Floors:	timber framed non-composite concrete in steel deck			rafter type, purlin t tray type, over	ype and cladding all thickness and	Timber purlins over timb	er rafters 125
	Beams: Columns: Walls:	fully filled concrete masonry				#N/A		
Lateral load resisting	structure	runy mied concrete masonry				#19/7		
	Lateral system along: Ductility assumed, µ: Periori along:	partially filled CMU 1.25 0.10	*****	Note: Define along and across in detailed report!	note total length of w	all at ground (m)	calculated	60
m	Total deflection (ULS) (mm): naximum interstorey deflection (ULS) (mm):	0.10		enter neight above at nor	estima estima	te or calculation?		
	Lateral system across: Ductility assumed up	fully filled CMU			note total length of w	all at ground (m)		32
	Period across: Total deflection (ULS) (mm):	0.07	#####	enter height above at H31	estima	te or calculation	calculated	02
m Separations:	aximum interstorey deflection (ULS) (mm):				estima	e or calculation?		
	north (mm): east (mm):			leave blank if not relevant				
	west (mm):							
Non-structural elemer	nts Stairs: Wall daddisor	other heavy				describe	concrete block veneer	
	Roof Cladding: Glazing:	Metal				describe		
	Ceilings: Services(list):							
Available document	tation						000	
	Architectural Structural Mechanical	tull full none			original de original de	signer name/date signer name/date]
	Electrical Geotech report	none			original de original de	signer name/date		
Damage								
<u>Site:</u> (refer DEE Table 4-2)) Site performance:	Poor			C	escribe damage	Moderate to severe lique	faction
	Settlement: Differential settlement: Liquefaction:	1:250-1:150			not not not	es (if applicable) es (if applicable) es (if applicable)	bldg. 103mm to 100mm	west to east end
	Lateral Spread: Differential lateral spread:				not	es (if applicable) es (if applicable)	yes	
	Ground cracks: Damage to area:	moderate to substantial (1 in 5)			not	es (if applicable) es (if applicable)	yes	
Building:	Current Placard Status:	[
Along	Damage ratio: Describe (summary):				Describe how damag	e ratio arrived at		
Across	Damage ratio:	#DIV/0!	Dan	$nage _Ratio = \frac{(\% NBS (b))}{\alpha}$	efore) – % NBS (af	ter))		
Diaphragms	Describe (summary): Damage?:			7	u ividis (Dejore)	Describe		
CSWs:	Damage?:					Describe		
Pounding:	Damage?:					Describe		
Non-structural:	Damage?:					Describe		
Recommendations	Level of repair/strengthening required:	minor structural				Describe		
	Building Consent required: Interim occupancy recommendations:	yes full occupancy				Describe		
Along	Assessed %NBS before e'quakes: Assessed %NBS after e'quakes:	52%	#####	%NBS from IEP below	If IEP not used, please d	etail assessmen methodology	quantitative	
Across	Assessed %NBS before e'quakes: Assessed %NBS after e'quakes:	52%	######	%NBS from IEP below				
	11 644-1					De net fill in fi	alda Maaturiaa IED	
IC.F	Period of design of building (from above):	1965-1976	marysi	s may give a unierent answer, which	n would take precedence.	h₀ from above	: m	
Seismic 2	Zone, if designed between 1965 and 1992:				not required for th	is age of building	2	
					along	is age of building	across	J
				Period (from above): (%NBS)nom from Fig 3.3:	0.1		0.07	
	Note:1 for specif	ically design public buildings, to the code of th	e day:	pre-1965 = 1.25; 1965-1976, Zone A = Note 2: for RC build	=1.33; 1965-1976, Zone B = lings designed between 197	1.2; all else 1.0 6-1984, use 1.2	1.00	
				Note 3: for buildings designed prio	r to 1935 use 0.8, except in	weilington (1.0)	1.0 across	
				Final (%NBS)nom:	0%		0%	
	2.2 Near Fault Scaling Factor			Near Fa	ault scaling factor, from NZS along	1170.5, cl 3.1.6	1.00 across	
	2.3 Hazard Scaling Easter		Near Fa	ault scaling factor (1/N(T,D), Factor A:	d factor Z for site from ACC	170.5 Table 0.0	1	
	Lo nazaro Scanny Pactor			Hazar	Z actor Z for site from AS1 Z1992, fron Hazard scaling	NZS4203:1992 actor, Factor B	#DIV/0	!
	2.4 Beturp Period Scaling Factor				Building Importance In	vel (from above)		
				Return Pe	riod Scaling factor from Tab	le 3.1, Factor C	2	
	2.5 Ductility Scaling Factor	Ductility coaling faster of from	Assess	ed ductility (less than max in Table 3.2)	along 1.00		across 1.00	
		County according ractor: =1 front 197	o onWa	Ductiity Scaling Factor, Factor D:	0.00		0.00	
	2.6 Structural Performance Scaling F	actor:		Sp:	1.000		1.000	
		Str	uctural	Performance Scaling Factor Factor E:	1		1	
	2.7 Baseline %NBS, (NBS%) _b = (%NBS	s)nom x A x B x C x D x E		%NBSb:	#DIV/0!		#DIV/0	!
	Global Critical Structural Weaknesses:	(refer to NZSEE IEP Table 3.4)						
	3.1. Plan irregularity, factor A: 3.2. Vertical irregularity. Factor B:		1					
	3.3. Short columns, Factor C:		1	Table for selection of D1	Separation	ere	Significant Insig	nificant/none
	3.4. Pounding potential	Pounding effect D1, from Table to right hight Difference effect D2, from Table to right	1.0	Alignment of floors with	in 20% of H 0.		0.8	1 0.0
	He	Therefore, Factor D:	1	Alignment of floors not with	11n 20% of H 0.	4 ere	0.7 Significant Ineir	0.8 nificant/none
	3.5. Site Characteristics		1	Height differen	Separation 0 <sep< td=""><td>005H</td><td>005<sep<.01h 5<="" td=""><td>Sep>.01H</td></sep<.01h></td></sep<>	005H	005 <sep<.01h 5<="" td=""><td>Sep>.01H</td></sep<.01h>	Sep>.01H
				Height difference 2	to 4 storeys 0.	7	0.9	1
					Along		Across	
	3.6. Other factors, Factor F	For ≤ 3 storeys, max value	=2.5, c	therwise 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)						
	3.7. Overall Performance Achieverse	t ratio (PAR)	Refer a	Iso section 6.3.1 of DEE for discussion	of F factor modification for	other critical stru	ictural weaknesses	
					0.00		0.00	
	4.3 PAR x (%NBS)b:			PAR x Baselline %NBS:	#DIV/0!		#DIV/0	!

Detailed Engineeri	ring Evaluation Summary Data							V1.1
ocation	Building Name:	Airedale - Garages 9-12, 13-19, & 20-31 Unit	No: Str	reet	-	Review CPEng N	o: Alistair Boyce	20986
	Building Address: Legal Description:	Conterence Street			Com	npany project numbi npany phone numbi	y: Opus Internation er: 6-QUCCC.85 er: 03 363 5400	18/
	GPS south: GPS east:	Degrees	Min Se	C]	Date of submission Inspection Date	n: e:	25/09/201
	Building Unique Identifier (CCC):				Is there a full repo	Revision Revision Revision Revision	n: Final /? yes	
ha								
ne	Site slope: Soil type:	flat silty sand			Ma	x retaining height (n iil Profile (if available):):	
	Site Class (to NZS1170.5): Proximity to waterway (m, if <100m): Provinity to cliffton (m if < 100m):	D			If Ground improven	nent on site, describ	e:	
	Proximity to cliff base (m,if <100m):				Арр	rox site elevation (n):	
uilding	No. of storeys above ground:	1	sir	igle storey = 1	Ground floor ele	vation (Absolute) (n):	
	Ground floor split? Storeys below ground	no othor (describe)		- ·	Ground floor elevati	ion above ground (n	i):	na with alah an grada
	Building height (m): Floor footprint area (approx):	2.55		height from ground to level o	of uppermost seismic ma	ass (for IEP only) (n):	is with side on grade
	Age of Building (years):	46				Date of desig	n: 1965-1976	
	Strengthening present?	no			And	If so, when (year what load level (%g)? ?	
	Use (upper floors): Use notes (if required):	parking			Brief Strei	iginening descriptic		
ravity Structure	Importance level (to NZS1170.5):	IL2						
<u>any ordere</u>	Gravity System: Roof:	load bearing walls timber framed			rafter type, pu	Irlin type and claddi	ng Timber roof jois	ıts
	Beams:						precast concrete	e wall/partially filled int.
	Columns: Walls:	load bearing concrete				#N	transverse wall	
ateral load resisting	<u>ig structure</u> Lateral system along:	concrete shear wall	No	te: Define along and across in	enter wall data	a in "IEP period calc	s"	
	Ductility assumed, µ: Period along: Total deflection (ULS) (mm):	1.25	de ##### en	tailed report! ter height above at H31	worksheel es	t for period calculation stimate or calculation stimate or calculation	on calculated	-
1	maximum interstorey deflection (ULS) (mm):				es	stimate or calculation	1?	
	Lateral system across: Ductility assumed, µ: Period across:	fully filled CMU 1.25 0.20	##### en	ter height above at H31	note total length	of wall at ground (n	i):	
	Total deflection (ULS) (mm): maximum interstorey deflection (ULS) (mm):				65 65	stimate or calculation	1?	
aparations:	north (mm):		lea	we blank if not relevant				
	east (mm): south (mm):							
Ion-structural elem	nents							
	Stairs: Wall cladding: Boot Cladding:	Metal				descri	xe	
	Glazing: Ceilings:					30001		
	Services(list):							
vailable docume	Architectural	partial			origina	al designer name/da	te	
	Structural Mechanical Electrical	none			origina origina origina	a designer name/da al designer name/da al designer name/da	te	
	Geotech report	none			origina	al designer name/da	te	
amage ite:	Site performance:	Poor				Describe damag	e: Moderate to sev	vere liquefaction
efer DEE Table 4-	-2) Settlement:					notes (if applicable): site 40-100mm	ind
	Liquefaction: Lateral Spread:					notes (if applicable notes (if applicable	a): bidg. not survey a): yes a): yes	ed
	Differential lateral spread: Ground cracks:	moderate to substantial (1 in 5)				notes (if applicable notes (if applicable	a):): yes	
uilding:	Danage to area.	moderate to substantial (1 in 5)				notes (ii applicabli	9-	
long	Current Placard Status:				Describe how d	mage ratio arrived	at-	
liong	Describe (summary):			". (% NBS (b	pefore) – % NBS	(after))	***	
cross	Damage ratio: Describe (summary):	#DIV/0!	Dama	$ge Ratio = \frac{1}{9}$	% NBS (before)			
liaphragms	Damage?:	no				Describ	e:	
ounding:	Damage?: Damage?:	no				Describ	e:	
lon-structural:	Damage?:	no	l			Describ	e:	
Recommendation	IS							
	Level of repair/strengthening required: Building Consent required: Interim occupancy, recommendations:	none full occupancy				Describ Describ Describ	e:	
Nong	Assessed %NBS before e'quakes:	·······	##### %1	NBS from IEP below	If IEP not used, plea	ase detail assessme	nt quantitative, bas	ed on limited drawings
cross	Assessed %NBS before e'quakes:	100%	##### %I	NBS from IEP below		metriodolog	y:	
	Assessed %NBS after e'quakes:	100%						
P	Use of this	method is not mandatory - more detailed a	analysis n	nay give a different answer, which	ch would take precede	nce. Do not fill in	fields if not using	IEP.
Seismic	Period of design of building (from above):	1965-1976	I		not required t	h≞ from abov ior this age of buildi	e: m	
					not required t	or this age of building		00005-
				Period (from above): (%NBS)nom from Fig 3.3:	: 0.	2		0.2
	Note:1 for specif	ically design public buildings, to the code of th	ie day: pre	-1965 = 1.25; 1965-1976, Zone A =	=1.33; 1965-1976, Zon	e B = 1.2; all else 1.	0	1.00
				Note 2: for HC build Note 3: for buildings designed prio	or to 1935 use 0.8, exce	pt in Wellington (1.0))	1.0
				Final (%NBS)nom:	alo : 09	ng %		across 0%
	2.2 Near Fault Scaling Factor			Near Fa	ault scaling factor, from	NZS1170.5, cl 3.1	6:	1.00
			Near Fault	scaling factor (1/N(T,D), Factor A:	alo	ng		across 1
	2.3 Hazard Scaling Factor			Hazar	rd factor Z for site from Z1992.	AS1170.5, Table 3 from NZS4203:19	3:	
					Hazard sca	ling factor, Factor	3:	#DIV/0!
	2.4 Return Period Scaling Factor			Return Pe	Building Importan eriod Scaling factor from	ce level (from above Table 3.1, Factor)): D:	2
	2.5 Ductility Section France		Asee	ductility (less than movie T + + 0	alo	ng		across
	2.5 Ductility Scaling Factor	Ductility scaling factor: =1 from 197	6 onwards	; or =kµ, if pre-1976, fromTable 3.3:	1.0			1.00
	2.6 Structural Barlar	actor		Ductiity Scaling Factor, Factor D:	. 0.(00		0.00
	2.0 Graduar Performance Scaling F	Str	uctural Pe	Sp: formance Scaling Factor Factor E:	×1.0			1
	2.7 Repairs 9/ NDC / NDC					//01		#DIV/01
	Global Critical Structural Weaknesses	(refer to NZSEE IEP Table 3.4)		%NBS _b :	*L#DI			#DI4/01
	3.1. Plan Irregularity, factor A:		1					
	3.2. Vertical irregularity, Factor B:		1	Table for sale time		Soucer	Similia	Incignifier
	3.3. Short columns, Factor C:	Pourseing offert D.t. (1	Table for selection of D1	Separation 0<	severe sep<.005H	Significant 005 <sep<.01h< td=""><td>Insignificant/none Sep>.01H</td></sep<.01h<>	Insignificant/none Sep>.01H
	3.4. Pounding potential	eight Difference effect D2, from Table to right	1.0	Alignment of floors with Alignment of floors not with	hin 20% of H hin 20% of H	0.7 0.4	0.8 0.7	1 0.8
		Therefore, Factor D:	1	Table for Selection of D2	Separation	Severe	Significant	Insignificant/none
	3.5. Site Characteristics		1	Height difference	e > 4 storeys	0.4 0.7	0.7	Sep>.01H 1
				Height difference 2 Height difference	e < 2 storeys	1	1	1
	3.6. Other factors, Factor F	For ≤ 3 storeys, max value	=2.5, othe	erwise max valule =1.5, no minimum	Ald	ing		Across
			Rat	uonale tor choice of F factor, if not 1				
	Detail Critical Structural Weaknesses: List any:	(refer to DEE Procedure section 6)	Refer also	section 6.3.1 of DEE for discussion	n of F factor modificatio	n for other critical st	ructural weakness	35
	3.7. Overall Performance Achievemen	t ratio (PAR)			0.0	00		0.00
	4.3 PAR - 1% NBC%.					//01		#DIV/01
	4.4 Percentage New Building Standard	d (%NBS), (before)		Proceeding of the second of th				#DIV/0!

