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

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 BU 1951-010 EQ2 BU 1951-011 EQ2 BU 1951-012 EQ2 BU 1951-013 EQ2 BU 1951-015 EQ2 BU 1591-014 EQ2 BU 1591-007 EQ2	**Garages**	Public Rental #9-12 #13-19 #20-31 #32-40 #41-43 #44-46 #47-52	~100%

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.

Contents

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.

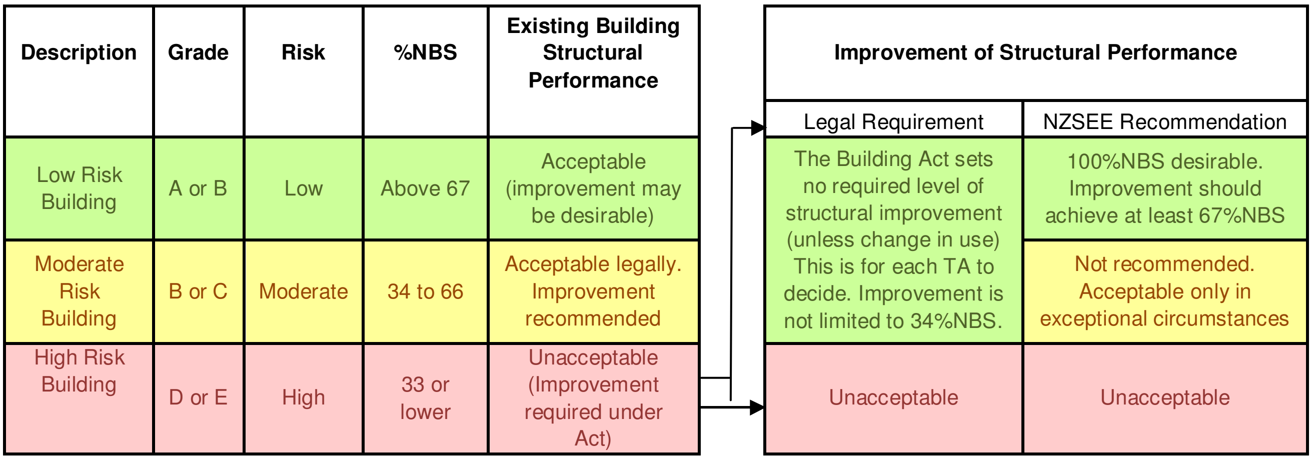
1.2 Ensuring that responsible steps are taken to minimise the risk of loss of life, injury or suffering which may result from your engineering activities, either directly or indirectly.

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 (unless change in use) This is for each TA to decide. Improvement is not limited to 34%NBS.	100%NBS desirable. Improvement should achieve at least 67%NBS
Moderate Risk Building	B or C	Moderate	34 to 66	Acceptable legally. Improvement recommended		Not recommended. Acceptable only in exceptional circumstances
High Risk Building	D or E	High	33 or lower	Unacceptable (Improvement 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 Order[1] 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

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[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.

Table 2: Building Names:

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

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.

Table 3: Building Geometry

Block	Approximate Date of Construction	No. of Storeys	Basement	No. of Units	Approx. overall dim.		Plan Area	Notes
					Trans.	Long.		
A	1966	3	No	18	9.8m	48.0m	1411 m^2	
B	1963	3	No	24	9.1m	53.8m	1468 m^2	
C	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	

Block	Approximate Date of Construction	No. of Storeys	Basement	No. of Units	Approx. overall dim.		Plan Area	Notes
					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.

Table 4: Building Construction

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	
B	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	

Block	Exterior Walls	Interior Walls	Elevated Slabs	Foundation	Roof	Notes
C	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:

Table 5: Observed Damage

Block	**Observed Damage**					
	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 1st and 2nd floor lines.	Minor <43 mm down from south to north side	None	
B	None	Minor <22 mm	Minor stepped cracks at joints. Minor horizontal crack in precast concrete fins adjacent to entries, at all 1st and 2nd floor lines.	Minor <56 mm down from north to south side	None	
C	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	

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	

Notes

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 Components (those that are required parts of the lateral resisting 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, 1st, and 2nd Storey Interior 200mm solid grouted concrete block	Flexural hinging of block wall piers.	No	72%
Longitudinal – 1st 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 Components (those that are required parts of the lateral resisting 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, 1st, and 2nd 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 – 1st 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 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
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 8: Summary of Seismic Performance for Block C and F – 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	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)			
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 – $\mu = 1.25$ (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 - Ground Storey – Exterior 150mm partially grouted concrete block	Flexural hinging of block wall piers.	No	51%
Longitudinal – Ground, 1st, and 2nd 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 – 1st Storey Exterior 150mm partially grouted concrete block	Shear yielding of block wall piers.	No	66%
Longitudinal– 1st 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%

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 – $\mu = 1.25$ (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)			
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 Non-residential 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 Salisbury Street	
1.	Front elevation	
2.	Side elevation	

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

	Block B: 51-57 Salisbury Street	
5.	Front elevation	
6.	Side elevation	

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

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

11.	Side elevation	
12.	Typical stepped crack at openings	

Block D: 16-18 Airedale 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 Conference Street	

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

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

23.	Side elevation	
24.	Elevation showing cantilevered stairs	

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

27.	Typical stepped crack at window opening	
	Block G: 28-30 Conference Street	
28.	Front 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	

<table>
<tr><td>37.</td><td>Concrete spalling at the top corner of the basement wall</td><td></td></tr>
<tr><td>38.</td><td>Vertical cracks in veneer at the building corner just above the basement wall</td><td></td></tr>
<tr><td colspan="3">Garages</td></tr>
</table>

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 — Cl. 3.1.3, NZS1170.5
  D (deep or soft soil)

- Seismic hazard factor — Cl. $2.2.14_B$, B1/VM1
  $Z = 0.30$

- Return period factor — Table 3.5, NZS1170.5
  $R_u = 1.0$ (*Importance* Level 2 structure, 50 year design life)

- Ductility factor — Cl. 2.6.1.2, NZS3101:2006
  $\mu = 1.25$ (nominally ductile)

- Structural performance factor — Cl. 2.6.2.2, NZS3101:2006
  $S_p = 0.925$

- Material properties

Table A1: Analysis Material Properties for all buildings

Concrete block nominal compressive strength, f'_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)
2. Based on guidance from *NZSEE 2006,* probable reinforcement yield strength is based on a value of 1.08 times the nominal yield strength (Cl. 7.1.1)

- Effective section properties

Table A2: Effective section properties from NZS3101:2006

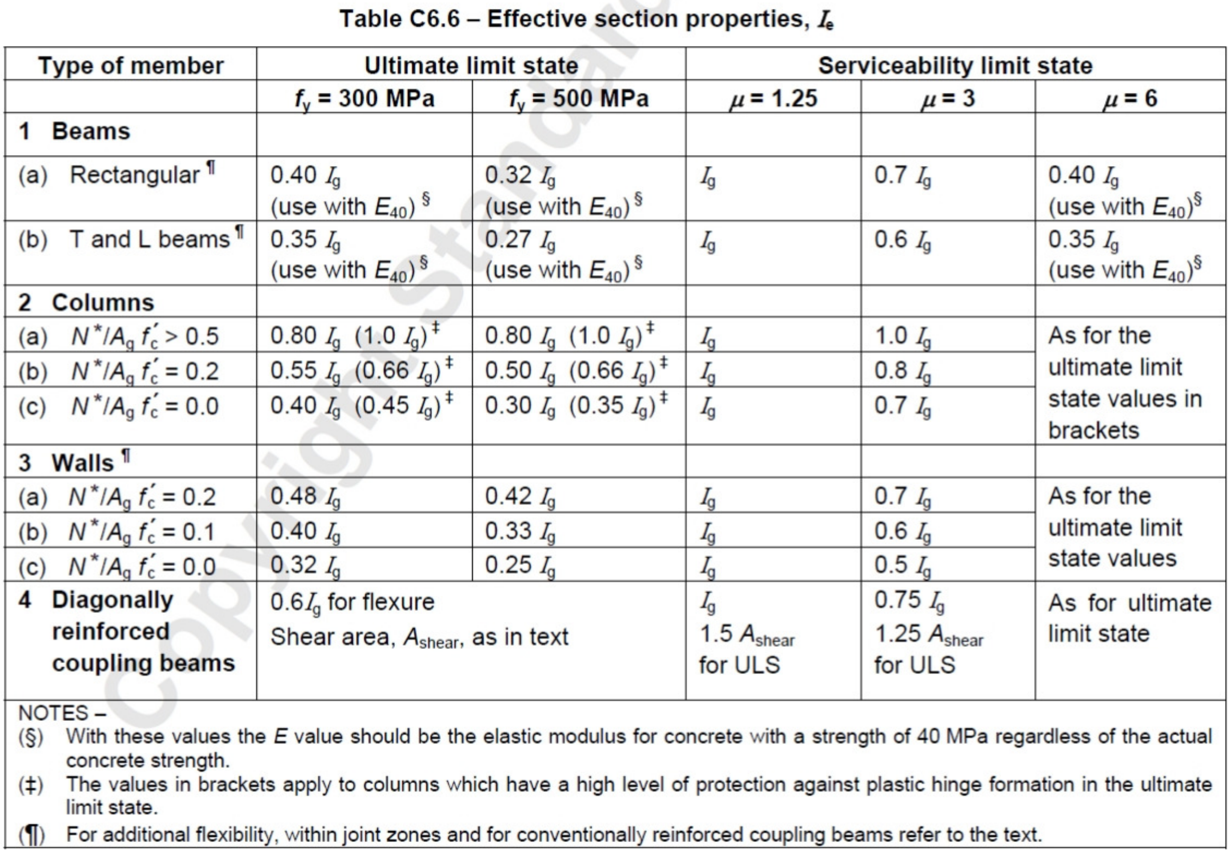


Table C6.6 – Effective section properties, I_e

Type of member	Ultimate limit state		Serviceability limit state		
	f_y = 300 MPa	f_y = 500 MPa	μ = 1.25	μ = 3	μ = 6
1 Beams					
(a) Rectangular ¶	0.40 I_g (use with E_{40}) §	0.32 I_g (use with E_{40}) §	I_g	0.7 I_g	0.40 I_g (use with E_{40})§
(b) T and L beams ¶	0.35 I_g (use with E_{40}) §	0.27 I_g (use with E_{40}) §	I_g	0.6 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) ‡	0.80 I_g (1.0 I_g) ‡	I_g	1.0 I_g	As for the ultimate limit state values in brackets
(b) $N^*/A_g f'_c = 0.2$	0.55 I_g (0.66 I_g) ‡	0.50 I_g (0.66 I_g) ‡	I_g	0.8 I_g	
(c) $N^*/A_g f'_c = 0.0$	0.40 I_g (0.45 I_g) ‡	0.30 I_g (0.35 I_g) ‡	I_g	0.7 I_g	
3 Walls ¶					
(a) $N^*/A_g f'_c = 0.2$	0.48 I_g	0.42 I_g	I_g	0.7 I_g	As for the ultimate limit state values
(b) $N^*/A_g f'_c = 0.1$	0.40 I_g	0.33 I_g	I_g	0.6 I_g	
(c) $N^*/A_g f'_c = 0.0$	0.32 I_g	0.25 I_g	I_g	0.5 I_g	
4 Diagonally reinforced coupling beams	0.6I_g for flexure Shear area, A_{shear}, as in text		I_g 1.5 A_{shear} for ULS	0.75 I_g 1.25 A_{shear} for ULS	As for ultimate limit state

NOTES –

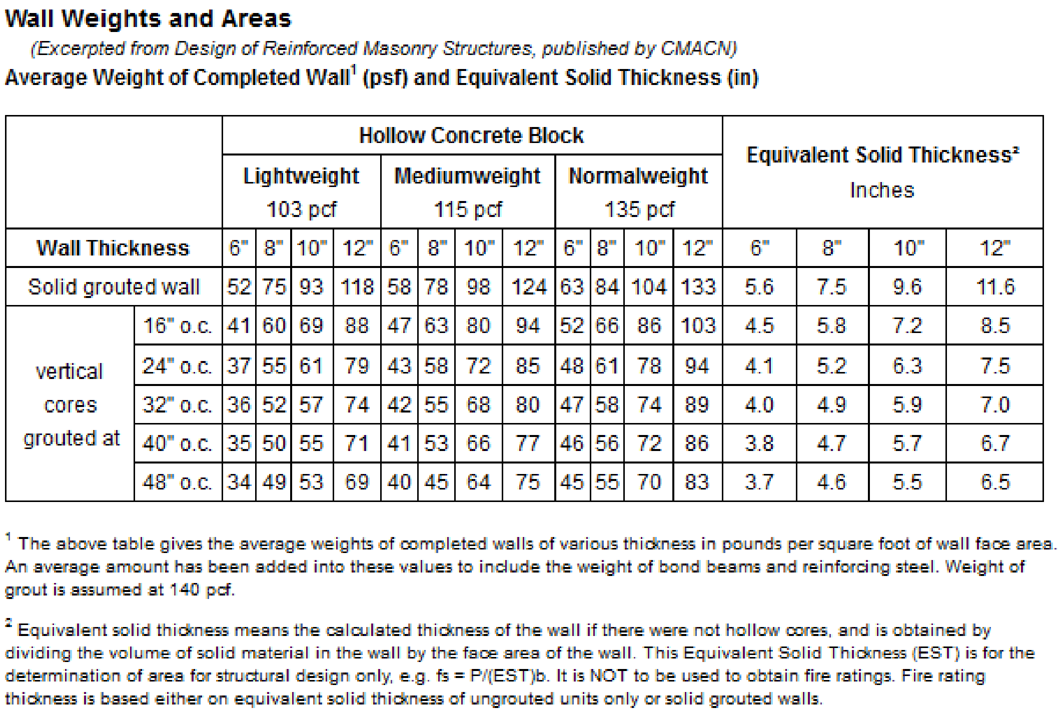
(§) With these values the *E* value should be the elastic modulus for concrete with a strength of 40 MPa regardless of the actual concrete strength.

(‡) 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 Wall[1] (psf) and Equivalent Solid Thickness (in)

		Hollow Concrete Block												Equivalent Solid Thickness[2] Inches			
		Lightweight 103 pcf				Mediumweight 115 pcf				Normalweight 135 pcf							
Wall Thickness		6"	8"	10"	12"	6"	8"	10"	12"	6"	8"	10"	12"	6"	8"	10"	12"
Solid grouted wall		52	75	93	118	58	78	98	124	63	84	104	133	5.6	7.5	9.6	11.6
vertical cores grouted at	16" o.c.	41	60	69	88	47	63	80	94	52	66	86	103	4.5	5.8	7.2	8.5
	24" o.c.	37	55	61	79	43	58	72	85	48	61	78	94	4.1	5.2	6.3	7.5
	32" o.c.	36	52	57	74	42	55	68	80	47	58	74	89	4.0	4.9	5.9	7.0
	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 — Cl. 4.2.2, AS/NZS1170.0

  $G + E_u + \Psi_E Q$

- Floor live loading — Table 3.1 Part G, AS/NZS1170.1

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

- Earthquake combination factor — Table 4.1, AS/NZS1170.0

  $\Psi_E = 0.3$

- Building seismic weight — Cl. 4.2, NZS1170.5

  $W_t = G + \Psi_E Q$

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

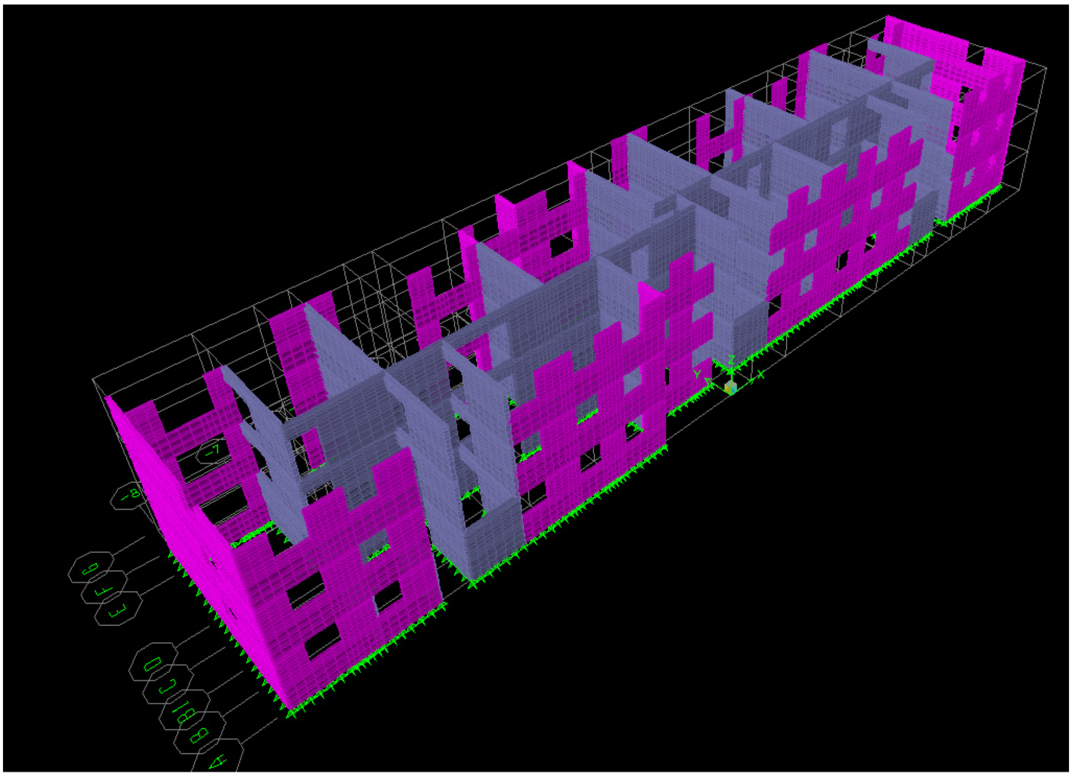


Figure A1: ETABS model of Block A

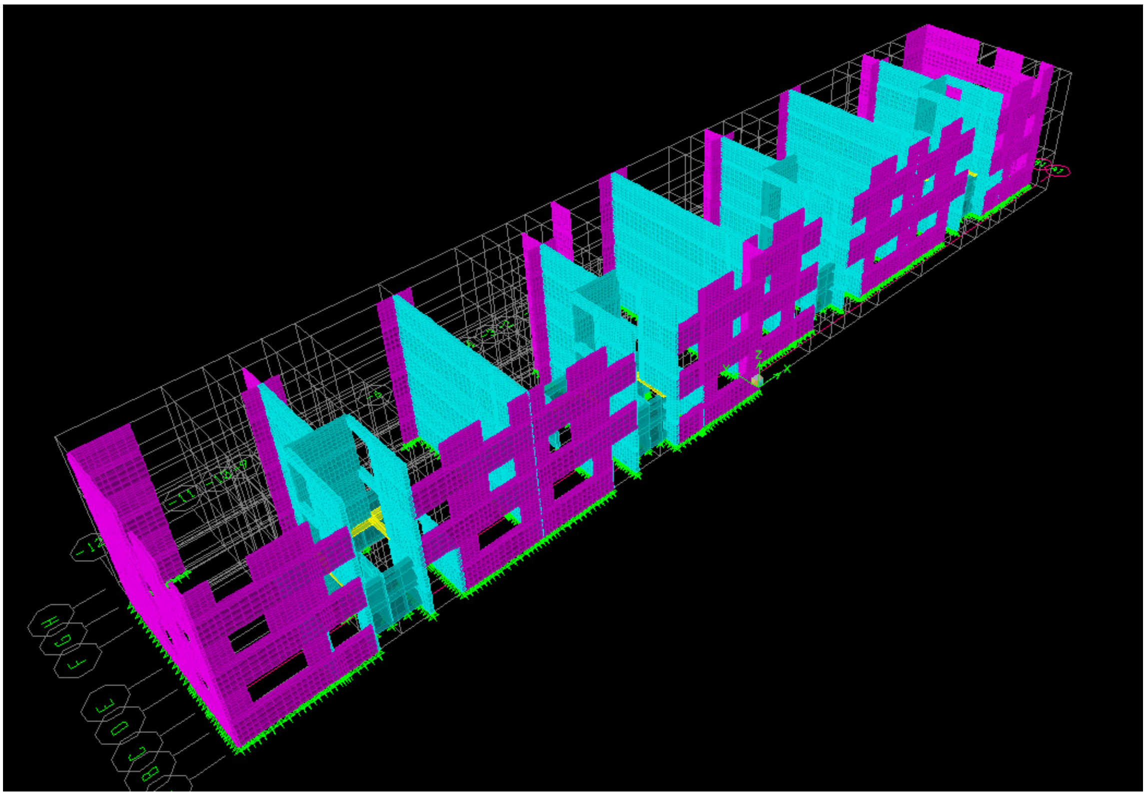


Figure A2: ETABS model of Block B

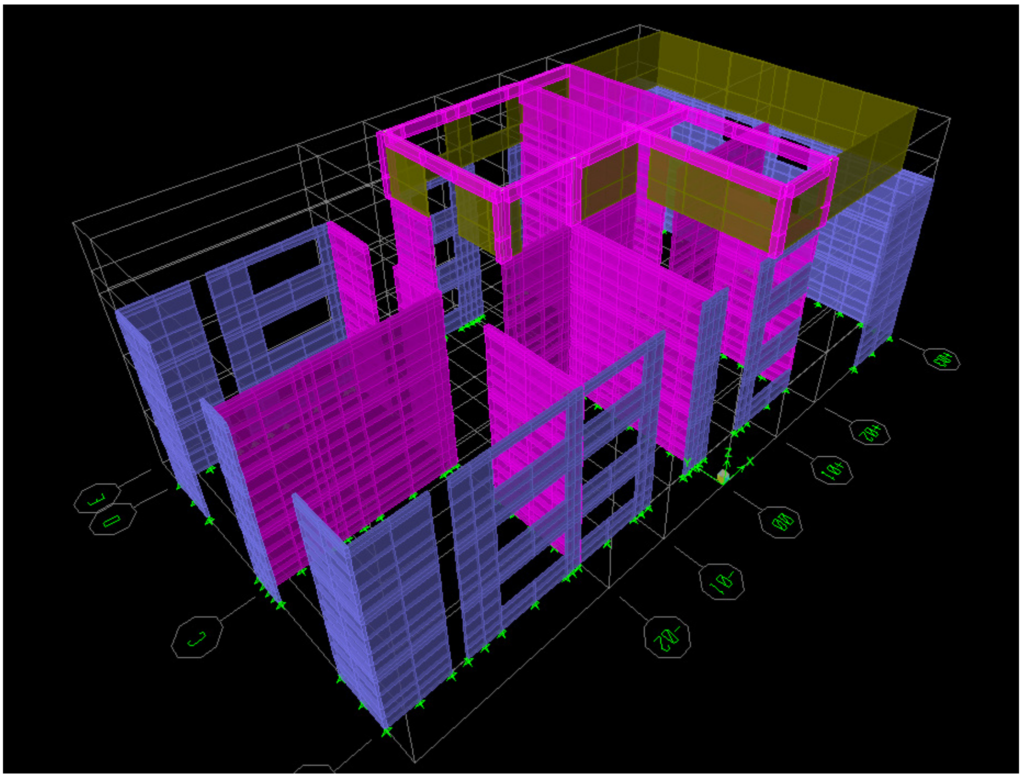


Figure A3: ETABS model of Block C and F

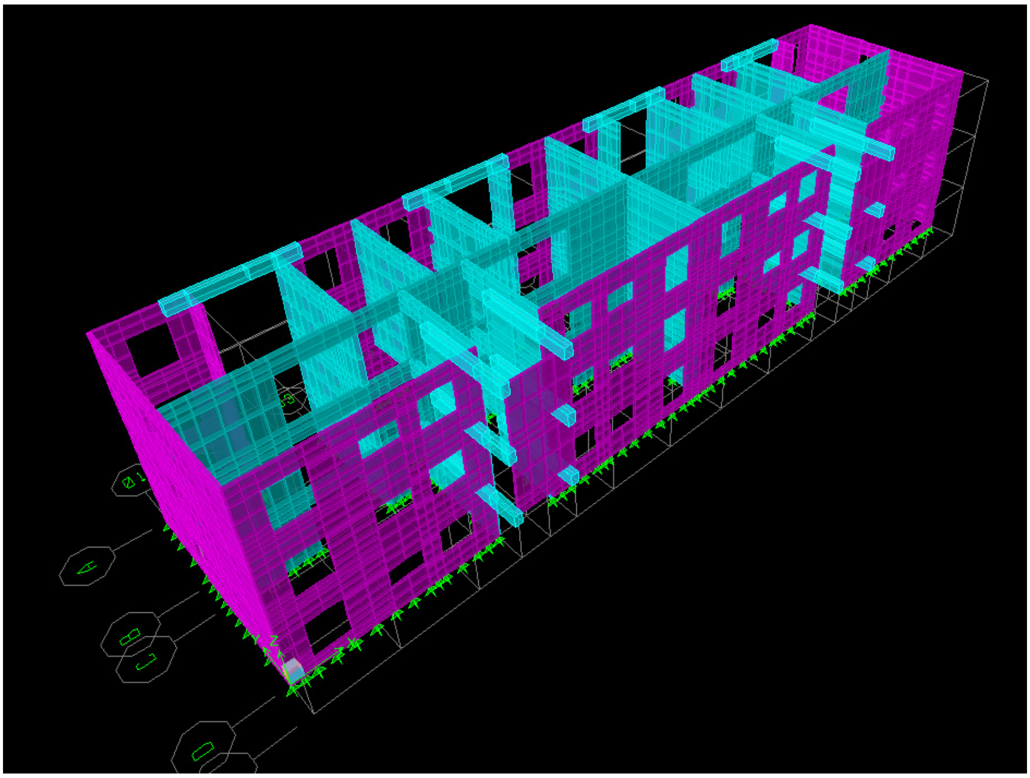


Figure A4: ETABS model of Block D and G

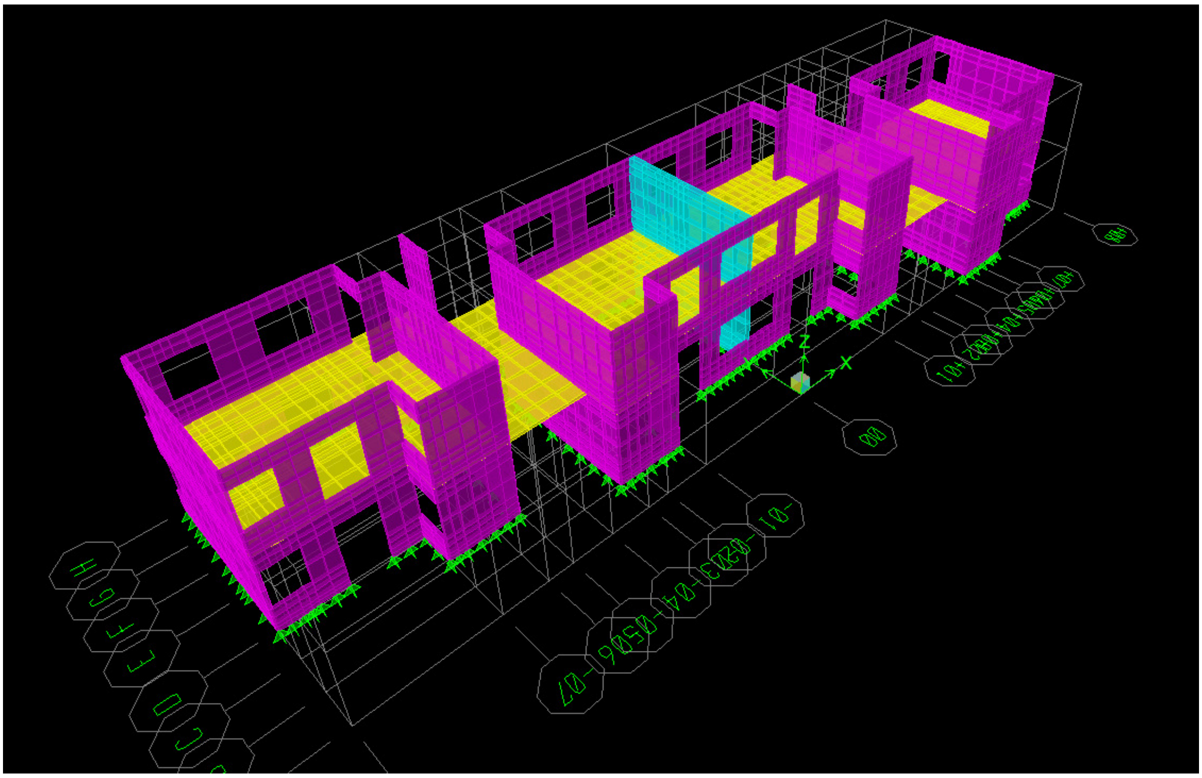


Figure A5: ETABS model of Block E

The fundamental building periods output from ETABS are:

Table A4: Fundamental time periods of buildings from ETABS output

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

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:

Table A5: Base shear from equivalent static method

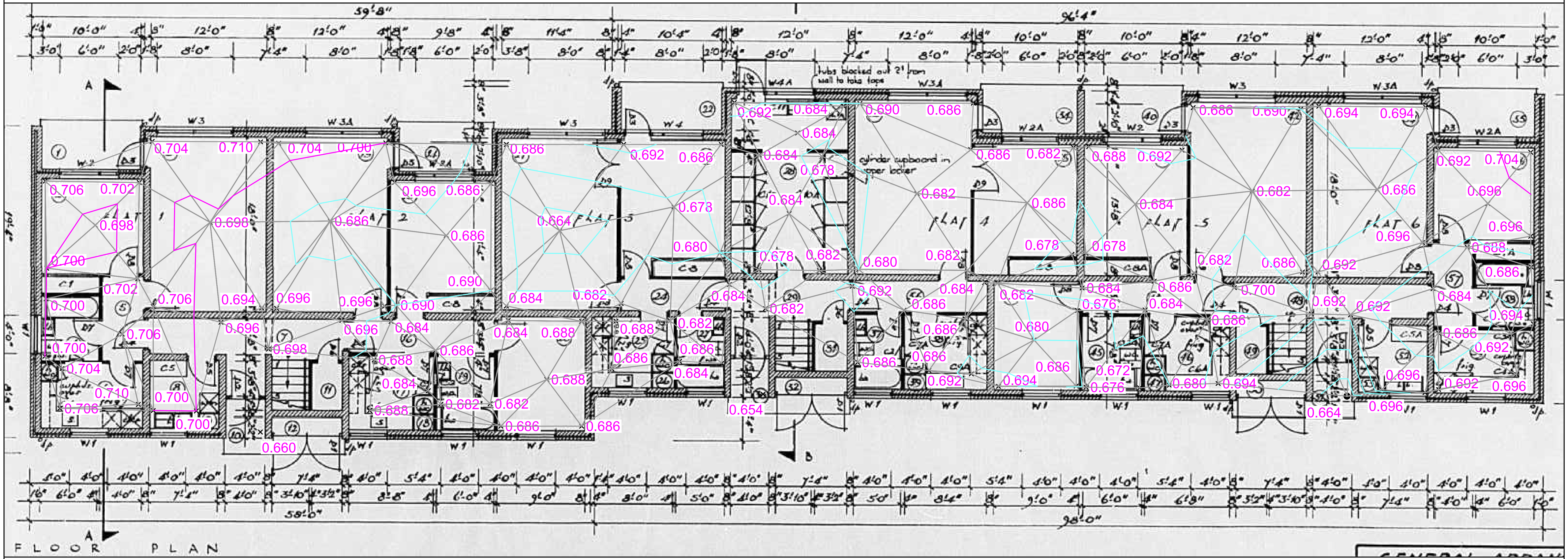
Building	Base shear -E/W direction (kN)	Base shear –N/S direction (kN)
Block A	6,888	6,888
Block B	6,310	6,310
Block C/F	4,168	4,168
Block D/G	4,330	4,330
Block E	1,556	1,556

The building was analysed as having limited ductility (μ = 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



Revision	Amendment	Approved	Revision Date

OPUS

Christchurch Office
P O Box 1482
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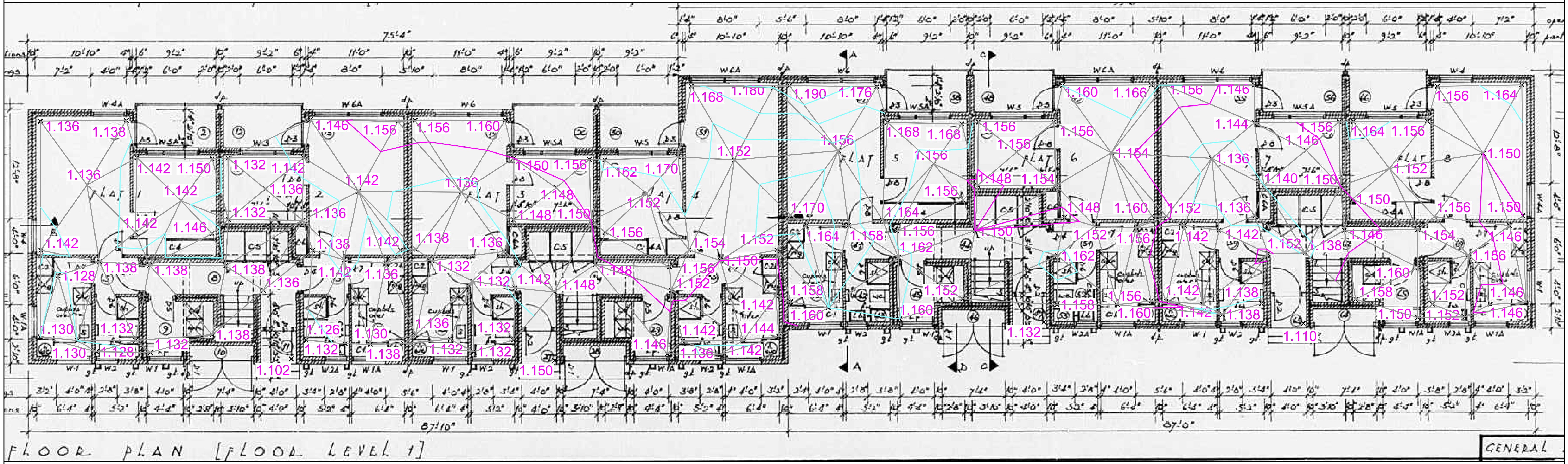
Project
Airedale Courts Levels Survey
Block A

Sheet

Drawn	Designed	Approved	Revision Date
S. Broughton		S.Becker	

Project No.	Scale	Drawing No.	Sheet. No.	Revision
6DQUCCC.85	Not to Scale	6/1366/251/2604	1/8	R0

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



300 mm
200
100
50
10 mm
0

Revision	Amendment	Approved	Revision Date

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Drawn	Designed	Approved	Revision Date
S. Broughton		S.Becker	

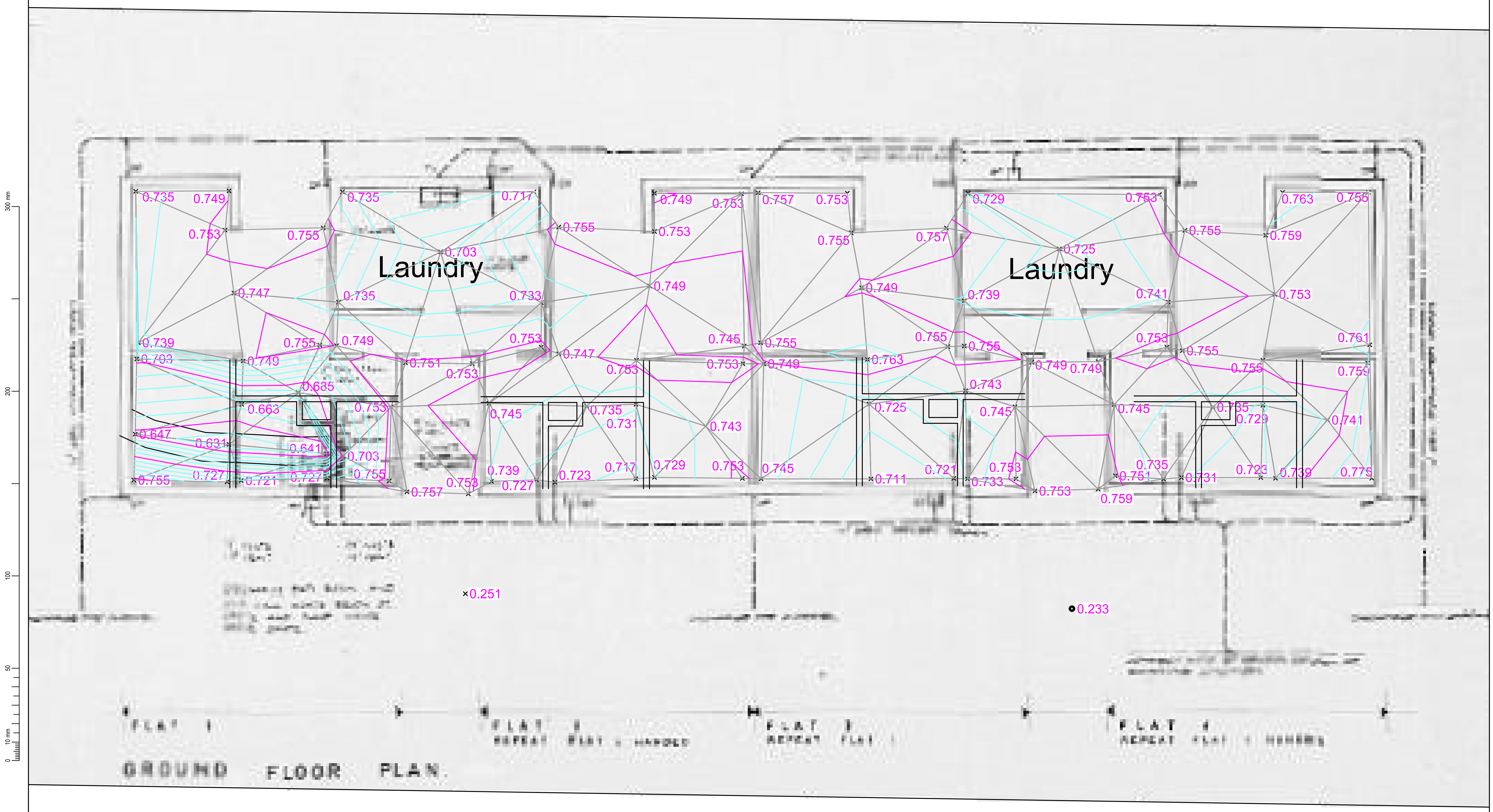
Project No.	Scale
6DQUCCC.85	Not to Scale

Project
Airedale Courts Levels Survey
Block B

Sheet

Drawing No.	Sheet No.	Revision
6/1366/251/2604	2/8	R0

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



Revision	Amendment	Approved	Revision Date

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Project
Airedale Courts Levels Survey
Block C

Sheet

Drawn	Designed	Approved	Revision Date
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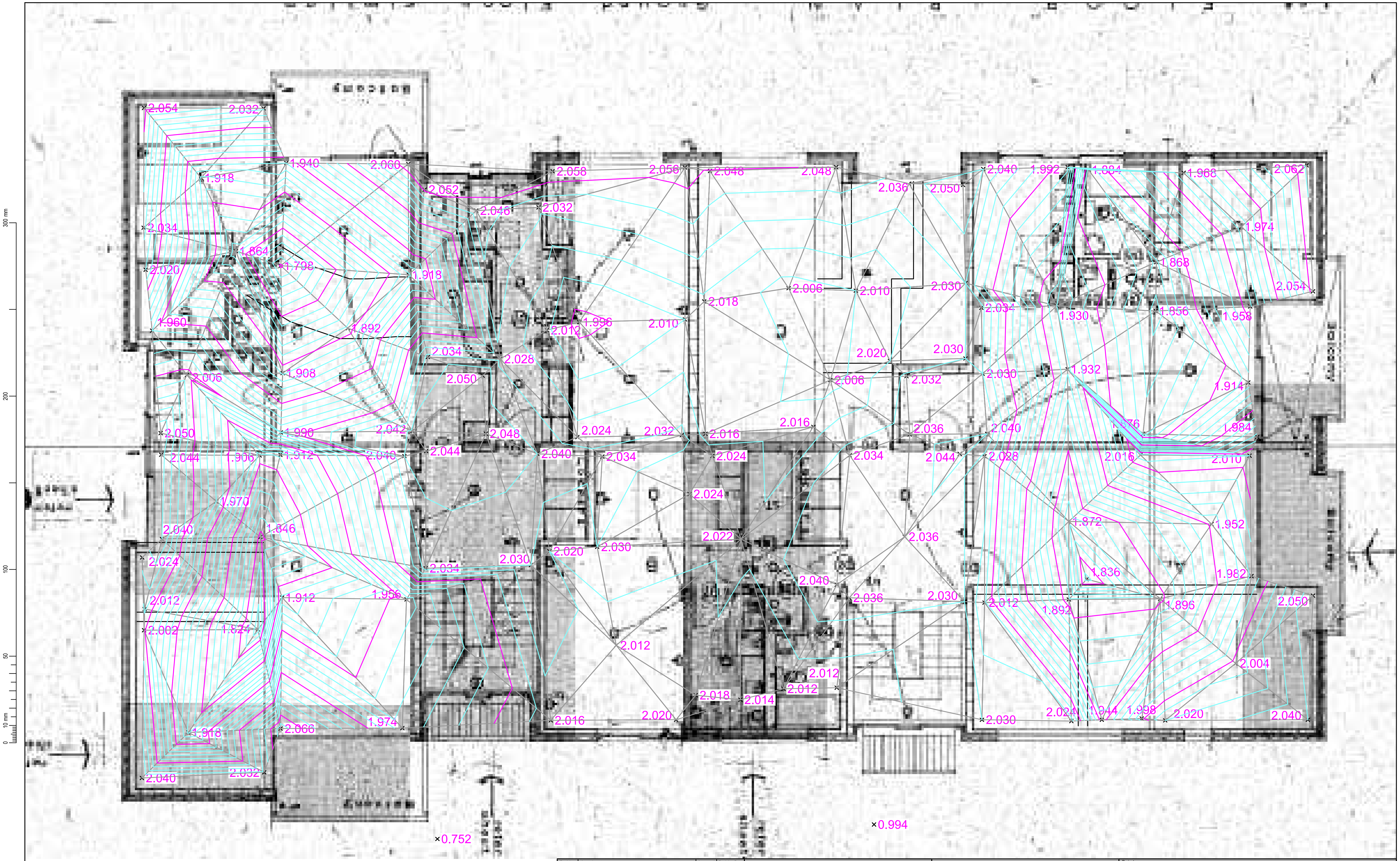
Project No.	Scale	Drawing No.	Sheet No.	Revision
6DQUCCC.85	Not To Scale	6/1366/251/2604	3/8	R0



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Project
Airedale Courts Levels Survey
Block D

Sheet

Drawn	Designed	Approved	Revision Date
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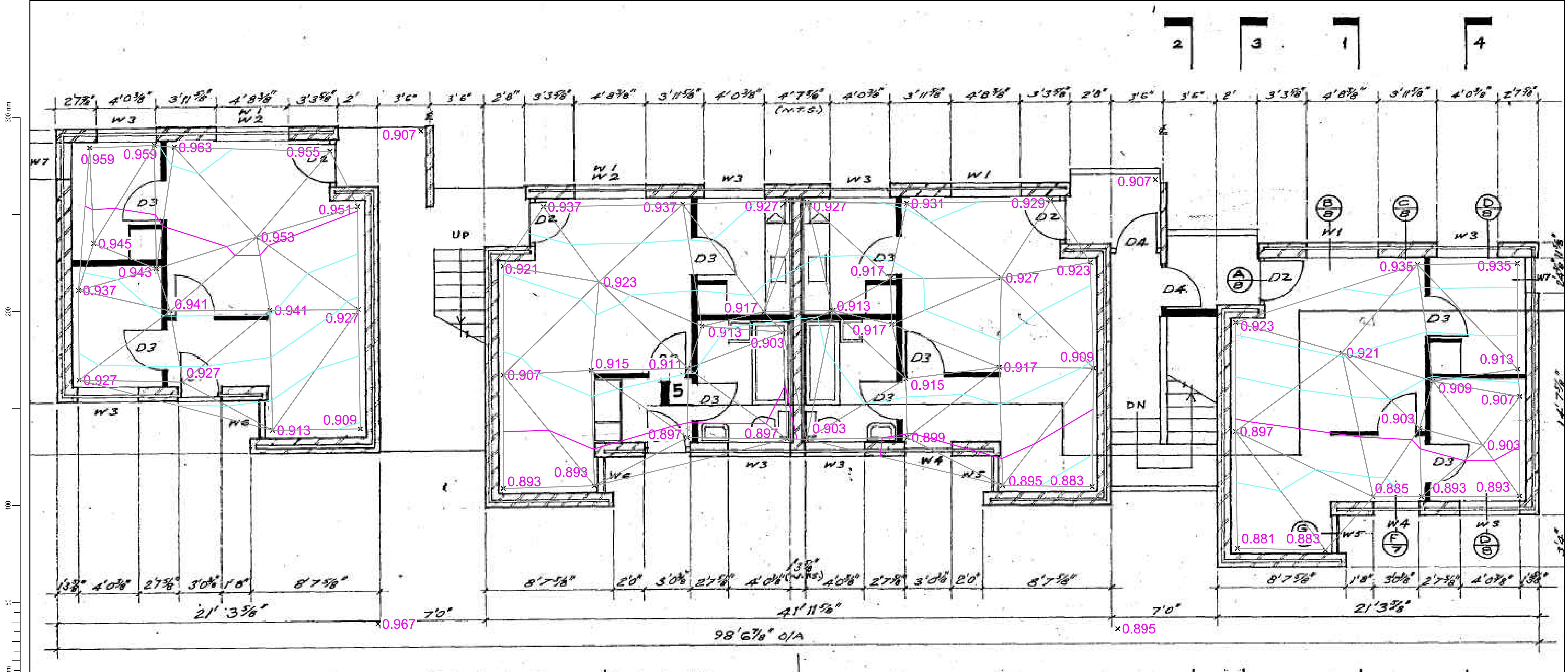
Project No.	Scale	Drawing No.	Sheet No.	Revision
6DQUCCC.85	Not To Scale	6/1366/251/2604	4/8	R0

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



HALF GROUND FLOOR PLAN

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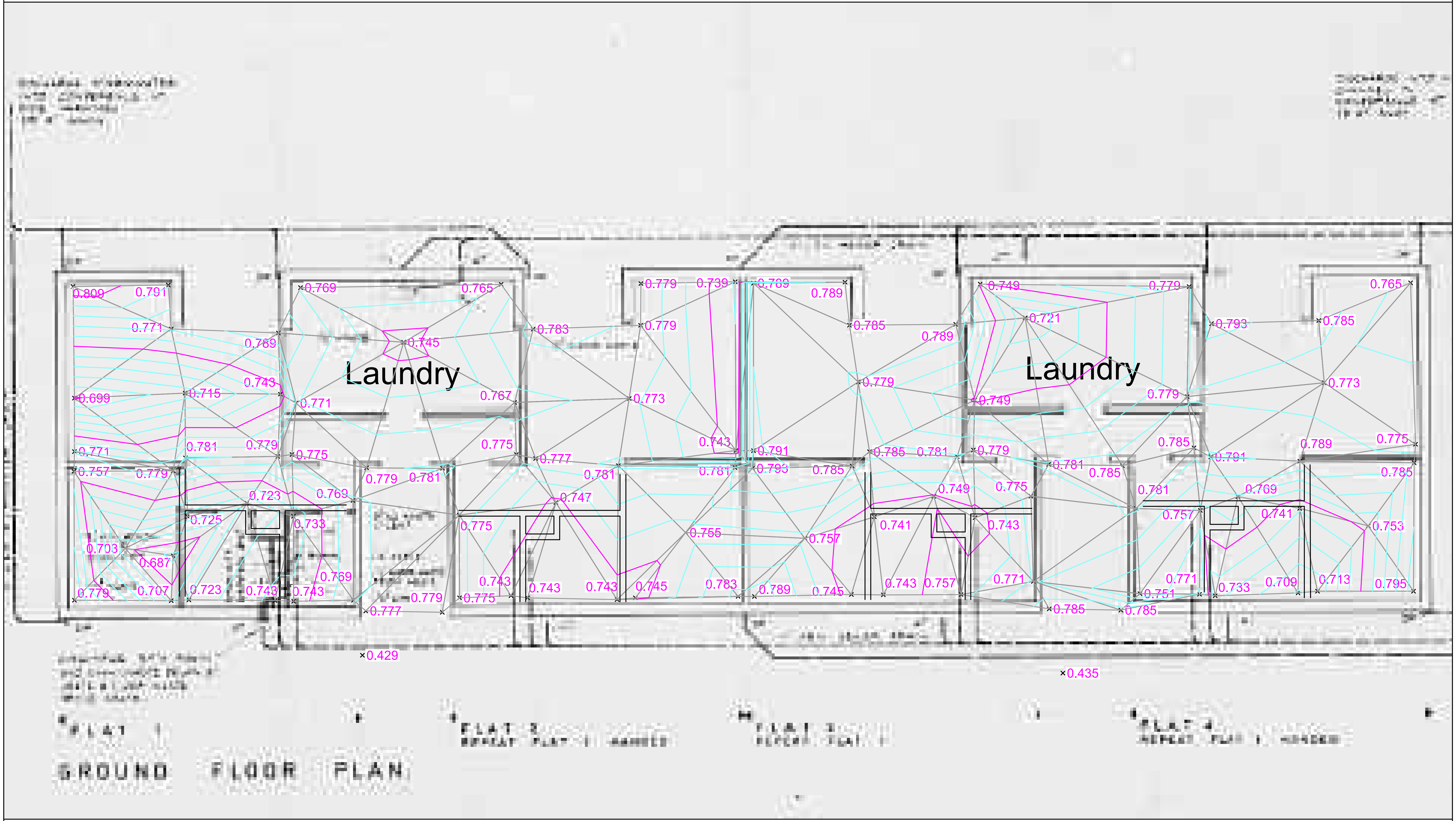
Project
Airedale Courts Levels Survey
Block E

Sheet

Drawn: S. Broughton
Designed:
Approved: S.Becker
Revision Date:

Project No.: 6DQUCCC.85
Scale: Not To Scale
Drawing No.: 6/1366/251/2604
Sheet No.: 5/8
Revision: R0



Revision	Amendment	Approved	Revision Date

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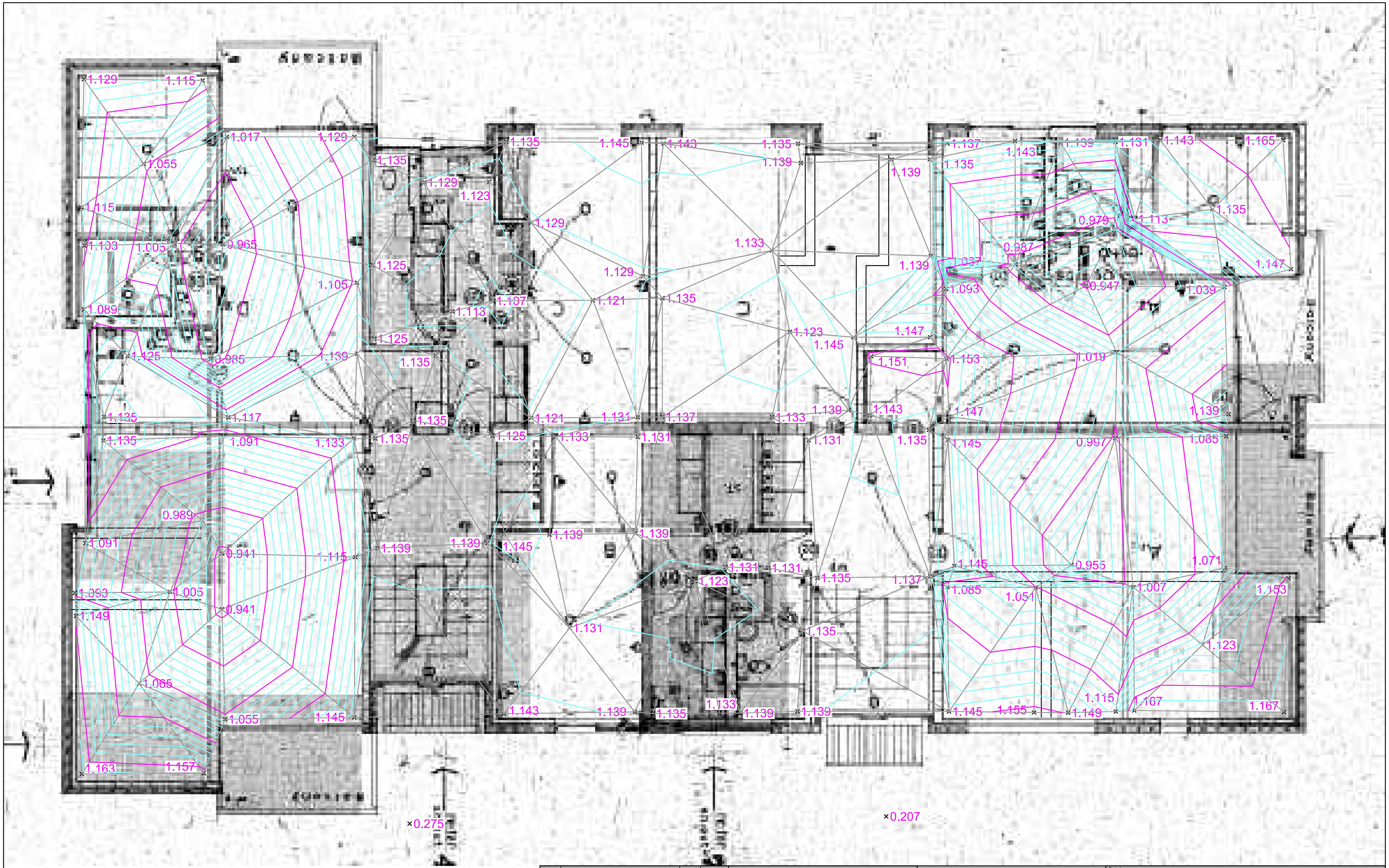
Project
Airedale Courts Levels Survey
Block F

Sheet

Drawn	Designed	Approved	Revision Date
S. Broughton		S.Becker	

Project No.	Scale	Drawing No.	Sheet No.	Revision
6DQUCCC.85	Not To Scale	6/1366/251/2604	6/8	R0

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



Revision	Amendment	Approved	Revision Date

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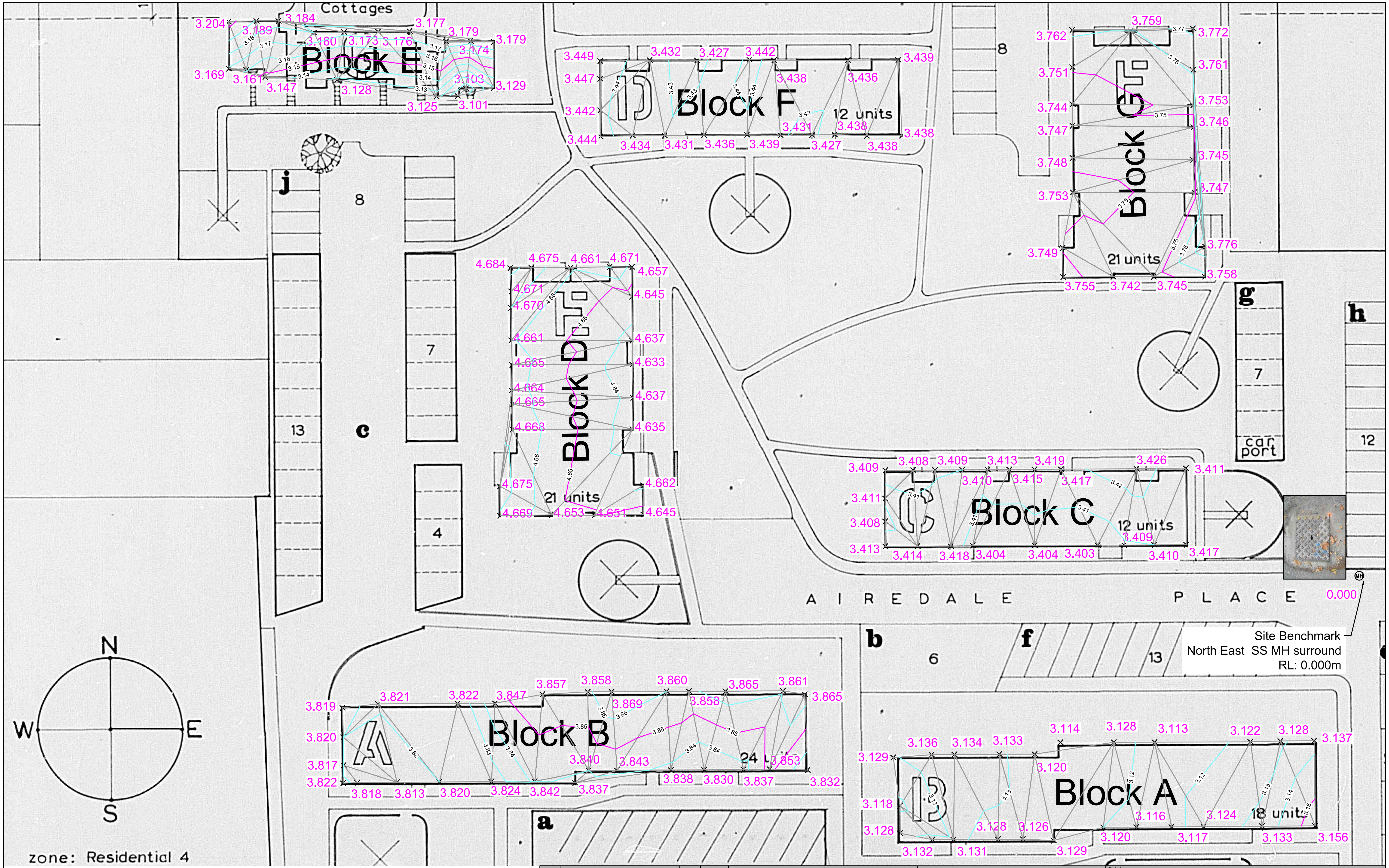
Project
Airedale Courts Levels Survey
Block G

Sheet

Drawn	Designed	Approved	Revision Date
S. Broughton		S.Becker	

Project No.	Scale	Drawing No.	Sheet No.	Revision
6DQUCCC.85	Not To Scale	6/1366/251/2604	7/8	R0

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



Vertical Datum: Assumed

Site Benchmark: North East SS MH surround

RL:0.000m

1:200 @ A1
1:400 @ A3
0 2 4 6 8 10 12 14 16 18 20 m

Revision	Amendment	Approved	Revision Date

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Drawn	Designed	Approved	Revision Date
S. Broughton		S.Becker	

Project No.	Scale
6DQUCCC.85	1:200 @ A1, 1:400 @ A3

Project
Airedale Courts First Floor Level Survey

Sheet

Drawing No.	Sheet. No.	Revision
6/1366/251/2604	8/8	R0

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

Appendix 5 – CERA DEE Data Sheets

Detailed Engineering Evaluation Summary Data

V1.11

Location

Building Name: Airedale - Block A
Building Address: Unit: No: 59-63 Street: Salisbury St
Legal Description:
GPS south: Degrees Min Sec
GPS east:
Building Unique Identifier (CCC): BU 1951-001 EQ2

Reviewer: Alistair Boyce
CPEng No: 209860
Company: Opus International
Company project number: 6-QUCCC.85
Company phone number: 03 363 5400
Date of submission: 25/09/2012
Inspection Date:
Revision: Final
Is there a full report with this summary? yes

Site

Site slope: flat
Soil type: silty sand
Site Class (to NZS1170.5): D
Proximity to waterway (m, if <100m):
Proximity to clifftop (m, if < 100m):
Proximity to cliff base (m,if <100m):

Max retaining height (m):
Soil Profile (if available):
If Ground improvement on site, describe:
Approx site elevation (m):

Building

No. of storeys above ground: 3 single storey = 1
Ground floor split? no
Storeys below ground 0
Foundation type: other (describe)
Building height (m): 7.80
Floor footprint area (approx): 480
Age of Building (years): 46

Ground floor elevation (Absolute) (m): 16.40
Ground floor elevation above ground (m): 0.30
if Foundation type is other, describe: piles
height from ground to level of uppermost seismic mass (for IEP only) (m):
Date of design: 1935-1965

Strengthening present? no
Use (ground floor): multi-unit residential
Use (upper floors): multi-unit residential
Use notes (if required):
Importance level (to NZS1170.5): IL2

If so, when (year)?
And what load level (%g)?
Brief strengthening description:

Gravity Structure

Gravity System: load bearing walls
Roof: timber framed
Floors: concrete flat slab
Beams:
Columns:
Walls: partially filled concrete masonry

rafter type, purlin type and cladding Timber purlins over jack stud trusses
slab thickness (mm) 140
Partially and fully grouted walls
thickness (mm)

Lateral load resisting structure

Lateral system along: partially filled CMU
Ductility assumed, μ: 1.25
Period along: 0.11 ##### enter height above at H31
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):

Note: Define along and across in detailed report!

Partially grouted ext./fully grouted int.
note total length of wall at ground (m): 107
estimate or calculation? calculated
estimate or calculation?
estimate or calculation?

Lateral system across: partially filled CMU
Ductility assumed, μ: 1.25
Period across: 0.10 ##### enter height above at H31
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):

Partially grouted ext./fully grouted int.
note total length of wall at ground (m): 104
estimate or calculation? calculated
estimate or calculation?
estimate or calculation?

Separations:

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

Non-structural elements

Stairs: cast insitu
Wall cladding: other heavy
Roof Cladding: Metal
Glazing: timber frames
Ceilings: strapped or direct fixed
Services(list):

notes
describe concrete block veneer, 140mm
describe

Available documentation

Architectural full
Structural none
Mechanical partial
Electrical full
Geotech report none

original designer name/date CCC
original designer name/date CCC
original designer name/date CCC
original designer name/date CCC
original designer name/date CCC

Damage

Site:
(refer DEE Table 4-2)

Site performance: Poor
Settlement: 25-100m
Differential settlement: 1:350-1:250
Liquefaction:
Lateral Spread:
Differential lateral spread:
Ground cracks:
Damage to area: moderate to substantial (1 in 5)

Describe damage: Moderate to severe liquefaction
notes (if applicable): site 40mm to 100mm
notes (if applicable): bldg. 43mm down from south to north side
notes (if applicable): yes
notes (if applicable): yes, some cracks
notes (if applicable):
notes (if applicable): yes
notes (if applicable):

Building:

Current Placard Status:

Along Damage ratio:
Describe (summary):
Describe how damage ratio arrived at:

Across Damage ratio: #DIV/0!
Describe (summary):

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

Diaphragms Damage?: no Describe:
CSWs: Damage?: no Describe: some discontinous walls
Pounding: Damage?: no Describe:
Non-structural: Damage?: yes Describe: veneer cracking, ground floor slab settlement

Recommendations

Level of repair/strengthening required: significant structural and strengthening
Building Consent required: yes
Interim occupancy recommendations: full occupancy

Describe: refer report for details, work req. for 67%
Describe:
Describe: repair ground floor before occupancy

Along Assessed %NBS before e'quakes: ##### %NBS from IEP below
Assessed %NBS after e'quakes: 34%

If IEP not used, please detail assessment methodology: quantitative

Across Assessed %NBS before e'quakes: ##### %NBS from IEP below
Assessed %NBS after e'quakes: 41%

IEP

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

Period of design of building (from above): 1935-1965
h_n from above: m

Seismic Zone, if designed between 1965 and 1992:
not required for this age of building
not required for this age of building

	along	across
Period (from above):	0.11	0.1
(%NBS)nom from Fig 3.3:		

Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0: 1.00
Note 2: for RC buildings designed between 1976-1984, use 1.2: 1.0
Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0): 1.0

	along	across
Final $(\%NBS)_{nom}$:	**0%**	**0%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, cl 3.1.6: 1.00

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

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3:
Z_{1992}, from NZS4203:1992
Hazard scaling factor, **Factor B:** #DIV/0!

2.4 Return Period Scaling Factor

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

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	1.00	1.00
Ductility scaling factor: =1 from 1976 onwards; or =kμ, if pre-1976, fromTable 3.3:		
Ductiity Scaling Factor, **Factor D**:	0.00	0.00

2.6 Structural Performance Scaling Factor:

Sp:	1.000	1.000
Structural Performance Scaling Factor **Factor E**:	1	1

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

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

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

3.1. Plan Irregularity, factor A: 1

3.2. Vertical irregularity, Factor B: 1

3.3. Short columns, Factor C: 1

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

3.5. Site Characteristics 1

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

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

3.6. Other factors, Factor F

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

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)
List any: Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

3.7. Overall Performance Achievement ratio (PAR)	**0.00**	**0.00**
4.3 PAR x (%NBS)b: PAR x Baselline %NBS:	**#DIV/0!**	**#DIV/0!**
4.4 Percentage New Building Standard (%NBS), (before)		**#DIV/0!**

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name: Airedale - Block B
Building Address: Unit: No: 51-57 Street: Salisbury Street
Legal Description:
GPS south: Degrees: Min: Sec:
GPS east: Degrees: Min: Sec:
Building Unique Identifier (CCC): BU 1951-004 EQ2

Reviewer: Alistair Boyce
CPEng No: 209860
Company: Opus International
Company project number: 6-QUCCC.85
Company phone number: 03 363 5400
Date of submission: 25/9//2012
Inspection Date:
Revision: Final
Is there a full report with this summary? yes

Site

Site slope: flat
Soil type: silty sand
Site Class (to NZS1170.5): D
Proximity to waterway (m, if <100m):
Proximity to clifftop (m, if < 100m):
Proximity to cliff base (m,if <100m):

Max retaining height (m):
Soil Profile (if available):
If Ground improvement on site, describe:
Approx site elevation (m):

Building

No. of storeys above ground: 3 single storey = 1
Ground floor split?
Storeys below ground 0
Foundation type: other (describe)
Building height (m): 7.80
Floor footprint area (approx): 430
Age of Building (years): 49

Ground floor elevation (Absolute) (m):
Ground floor elevation above ground (m):
if Foundation type is other, describe: Piles
height from ground to level of uppermost seismic mass (for IEP only) (m):
Date of design: 1935-1965

Strengthening present? no
Use (ground floor): multi-unit residential
Use (upper floors): multi-unit residential
Use notes (if required):
Importance level (to NZS1170.5): IL2

If so, when (year)?
And what load level (%g)?
Brief strengthening description:

Gravity Structure

Gravity System: load bearing walls
Roof: timber framed
Floors: concrete flat slab
Beams:
Columns:
Walls: partially filled concrete masonry

rafter type, purlin type and cladding Close butted sarking over timber purlins
slab thickness (mm) 140
Partially and fully grouted walls
thickness (mm)

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along: partially filled CMU
Ductility assumed, μ: 1.25
Period along: 0.15 ##### enter height above at H31
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):

Partially grouted ext./fully grouted int.
note total length of wall at ground (m): 88
estimate or calculation?
estimate or calculation?
estimate or calculation?

Lateral system across: partially filled CMU
Ductility assumed, μ: 1.25
Period across: 0.09 ##### enter height above at H31
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):

Partially grouted ext./fully grouted int.
note total length of wall at ground (m): 108
estimate or calculation? calculated
estimate or calculation?
estimate or calculation?

Separations:

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

Non-structural elements

Stairs: cast insitu
Wall cladding: other heavy
Roof Cladding: Metal
Glazing:
Ceilings: strapped or direct fixed
Services(list):

notes
describe concrete block veneer, 90mm
describe
gib ceiling

Available documentation

Architectural full
Structural none
Mechanical none
Electrical none
Geotech report none

original designer name/date CCC
original designer name/date CCC
original designer name/date CCC
original designer name/date CCC
original designer name/date CCC

Damage

Site:

(refer DEE Table 4-2)

Site performance: Poor
Describe damage: moderate to severe liquefaction

Settlement: 25-100m
Differential settlement: 1:350-1:250
Liquefaction:
Lateral Spread:
Differential lateral spread:
Ground cracks:
Damage to area: moderate to substantial (1 in 5)

notes (if applicable): site 40mm to 100mm
notes (if applicable): bldg. 56mm down from north to south side
notes (if applicable): yes
notes (if applicable): yes, some cracks
notes (if applicable):
notes (if applicable): yes
notes (if applicable):

Building:

Current Placard Status:

Along Damage ratio:
Describe (summary):
Describe how damage ratio arrived at:

Across Damage ratio: #DIV/0!
Describe (summary):

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

Diaphragms Damage?: no Describe:
CSWs: Damage?: no Describe: some discontinuous walls
Pounding: Damage?: no Describe:
Non-structural: Damage?: yes Describe: veneer cracking, ground floor slab settlement

Recommendations

Level of repair/strengthening required: significant structural and strengthening
Building Consent required: yes
Interim occupancy recommendations: do not occupy

Describe: refer report for details, strengthen to 34/67
Describe:
Describe: repair ground floor before occupancy

Along Assessed %NBS before e'quakes: ##### %NBS from IEP below
Assessed %NBS after e'quakes: 15%

If IEP not used, please detail assessment methodology: quantitative

Across Assessed %NBS before e'quakes: ##### %NBS from IEP below
Assessed %NBS after e'quakes: 15%

IEP

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

Period of design of building (from above): 1935-1965
h_n from above: m

Seismic Zone, if designed between 1965 and 1992:
not required for this age of building
not required for this age of building

	along	across
Period (from above):	0.15	0.09
(%NBS)nom from Fig 3.3:		

Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0 1.00
Note 2: for RC buildings designed between 1976-1984, use 1.2 1.0
Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0) 1.0

	along	across
Final (%NBS)$_{nom}$:	**0%**	**0%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, cl 3.1.6: 1.00

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

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3:
Z_{1992}, from NZS4203:1992
Hazard scaling factor, **Factor B:** #DIV/0!

2.4 Return Period Scaling Factor

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

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	1.00	1.00
Ductility scaling factor: =1 from 1976 onwards; or =kμ, if pre-1976, fromTable 3.3:		
Ductiity Scaling Factor, **Factor D**:	0.00	0.00

2.6 Structural Performance Scaling Factor:

	along	across
Sp:	1.000	1.000
Structural Performance Scaling Factor **Factor E**:	1	1

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

	along	across
%NBS$_b$:	**#DIV/0!**	**#DIV/0!**

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

3.1. Plan Irregularity, factor A: 1

3.2. Vertical irregularity, Factor B: 1

3.3. Short columns, Factor C: 1

3.4. Pounding potential Pounding effect D1, from Table to right 1.0
Height Difference effect D2, from Table to right 1.0

Therefore, Factor D: 1

3.5. Site Characteristics 1

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

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

3.6. Other factors, Factor F

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

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)
List any: Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

	along	across
3.7. Overall Performance Achievement ratio (PAR)	**0.00**	**0.00**
4.3 PAR x (%NBS)b: PAR x Baselline %NBS:	**#DIV/0!**	**#DIV/0!**
4.4 Percentage New Building Standard (%NBS), (before)		**#DIV/0!**

Detailed Engineering Evaluation Summary Data

V1.11

Location

Building Name: Airedale - Block C & F

Unit | No: | Street

Building Address: Airedale Place/Conference Street

Legal Description:

Degrees | Min | Sec

GPS south:

GPS east:

Building Unique Identifier (CCC): BU 1951-005 EQ2

Reviewer: Alistair Boyce

CPEng No: 209860

Company: Opus International

Company project number: 6-QUCCC.85

Company phone number: 03 363 5400

Date of submission: 25/09/2012

Inspection Date:

Revision: Final

Is there a full report with this summary? yes

Site

Site slope: flat

Soil type: silty sand

Site Class (to NZS1170.5): D

Proximity to waterway (m, if <100m):

Proximity to clifftop (m, if < 100m):

Proximity to cliff base (m,if <100m):

Max retaining height (m):

Soil Profile (if available):

If Ground improvement on site, describe:

Approx site elevation (m):

Building

No. of storeys above ground: 3 single storey = 1

Ground floor split?

Storeys below ground 0

Foundation type: other (describe)

Building height (m): 7.80

Floor footprint area (approx): 300

Age of Building (years): 45

Ground floor elevation (Absolute) (m):

Ground floor elevation above ground (m):

if Foundation type is other, describe: Unknown

height from ground to level of uppermost seismic mass (for IEP only) (m):

Date of design: 1965-1976

Strengthening present? no

Use (ground floor): multi-unit residential

Use (upper floors): multi-unit residential

Use notes (if required):

Importance level (to NZS1170.5): IL2

If so, when (year)?

And what load level (%g)?

Brief strengthening description:

Gravity Structure

Gravity System: load bearing walls

Roof: timber framed

Floors: concrete flat slab

Beams:

Columns:

Walls: partially filled concrete masonry

rafter type, purlin type and cladding Close butted sarking over timber purlins

slab thickness (mm) 140

Partially and fully grouted walls

thickness (mm)

Lateral load resisting structure

Lateral system along: partially filled CMU

Ductility assumed, μ: 1.25

Period along: 0.18 ##### enter height above at H31

Total deflection (ULS) (mm):

maximum interstorey deflection (ULS) (mm):

Note: Define along and across in detailed report!

Partially grouted int./fully grouted ext.

note total length of wall at ground (m): 95

estimate or calculation? calculated

estimate or calculation?

estimate or calculation?

Lateral system across: fully filled CMU

Ductility assumed, μ: 1.25

Period across: 0.16 ##### enter height above at H31

Total deflection (ULS) (mm):

maximum interstorey deflection (ULS) (mm):

Partially grouted int./fully grouted ext.

note total length of wall at ground (m): 35

estimate or calculation? calculated

estimate or calculation?

estimate or calculation?

Separations:

north (mm):

east (mm):

south (mm):

west (mm):

leave blank if not relevant

Non-structural elements

Stairs: precast, full flight

Wall cladding: other heavy

Roof Cladding: Metal

Glazing:

Ceilings: strapped or direct fixed

Services(list):

describe supports

describe concrete block veneer

describe

Available documentation

Architectural full

Structural full

Mechanical none

Electrical none

Geotech report none

original designer name/date

original designer name/date

original designer name/date

original designer name/date

original designer name/date

Damage

Site:
(refer DEE Table 4-2)

Site performance: Poor

Describe damage: Moderate to severe liquefaction

Settlement: 25-100m

Differential settlement:

Liquefaction:

Lateral Spread:

Differential lateral spread:

Ground cracks:

Damage to area: moderate to substantial (1 in 5)

notes (if applicable): site 40mm to 100mm

notes (if applicable):

notes (if applicable): yes

notes (if applicable): yes

notes (if applicable):

notes (if applicable): yes

notes (if applicable):

Building:

Current Placard Status:

Along Damage ratio:

Describe (summary):

Describe how damage ratio arrived at:

Across Damage ratio: #DIV/0!

Describe (summary):

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

Diaphragms Damage?: no Describe:

CSWs: Damage?: no Describe: discontinuous walls

Pounding: Damage?: no Describe:

Non-structural: Damage?: yes Describe: veneer cracking, ground floor slab settlement

Recommendations

Level of repair/strengthening required: minor non-structural

Building Consent required: no

Interim occupancy recommendations: full occupancy

Describe: refer report for details

Describe:

Describe: repair ground floor before occupancy

Along Assessed %NBS before e'quakes: ##### %NBS from IEP below

Assessed %NBS after e'quakes: 44%

If IEP not used, please detail assessment methodology: quantitative

Across Assessed %NBS before e'quakes: ##### %NBS from IEP below

Assessed %NBS after e'quakes: 44%

IEP

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

Period of design of building (from above): 1965-1976

h_n from above: m

Seismic Zone, if designed between 1965 and 1992:

not required for this age of building

not required for this age of building

	along	across
Period (from above):	0.18	0.16
(%NBS)nom from Fig 3.3:		

Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0 1.00

Note 2: for RC buildings designed between 1976-1984, use 1.2 1.0

Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0) 1.0

	along	across
Final $(\%NBS)_{nom}$:	**0%**	**0%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, cl 3.1.6: 1.00

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

2.3 Hazard Scaling Factor

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

Z_{1992}, from NZS4203:1992

Hazard scaling factor, **Factor B:** #DIV/0!

2.4 Return Period Scaling Factor

Building Importance level (from above): 2

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

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	1.00	1.00
Ductility scaling factor: =1 from 1976 onwards; or =kμ, if pre-1976, fromTable 3.3:		
Ductiity Scaling Factor, **Factor D**:	0.00	0.00

2.6 Structural Performance Scaling Factor:

Sp:	1.000	1.000
Structural Performance Scaling Factor **Factor E**:	1	1

2.7 Baseline %NBS, $(NBS\%)_b = (\%NBS)_{nom}$ x A x B x C x D x E **$\%NBS_b$:** **#DIV/0!** **#DIV/0!**

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

3.1. Plan Irregularity, factor A: 1

3.2. Vertical irregularity, Factor B: 1

3.3. Short columns, Factor C: 1

3.4. Pounding potential

Pounding effect D1, from Table to right 1.0

Height Difference effect D2, from Table to right 1.0

Therefore, Factor D: 1

3.5. Site Characteristics 1

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

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

3.6. Other factors, Factor F

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

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

List any: Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

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

4.3 PAR x (%NBS)b: PAR x Baselline %NBS: **#DIV/0!** **#DIV/0!**

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

Detailed Engineering Evaluation Summary Data

V1.11

Location

Building Name: Airedale - Block D & G
Building Address: Airedale Place/Conference Street
Unit No: Street:
Legal Description:
GPS south: Degrees: Min: Sec:
GPS east: Degrees: Min: Sec:
Building Unique Identifier (CCC): BU 1951-006 EQ2, BU 1951-009 EQ2

Reviewer: Alistair Boyce
CPEng No: 209860
Company: Opus International
Company project number: 6QUCCC.85
Company phone number: 03 363 5400
Date of submission: 25/09/2012
Inspection Date:
Revision: Final
Is there a full report with this summary? yes

Site

Site slope: flat
Soil type: silty sand
Site Class (to NZS1170.5): D
Proximity to waterway (m, if <100m):
Proximity to clifftop (m, if < 100m):
Proximity to cliff base (m,if <100m):

Max retaining height (m):
Soil Profile (if available):
If Ground improvement on site, describe:
Approx site elevation (m):

Building

No. of storeys above ground: 3 single storey = 1
Ground floor split?
Storeys below ground 0
Foundation type: driven precast piles
Building height (m): 10.40
Floor footprint area (approx): 400
Age of Building (years): 43

Ground floor elevation (Absolute) (m):
Ground floor elevation above ground (m):
if Foundation type is other, describe:
height from ground to level of uppermost seismic mass (for IEP only) (m):
Date of design: 1965-1976

Strengthening present? no
Use (ground floor): multi-unit residential
Use (upper floors): multi-unit residential
Use notes (if required):
Importance level (to NZS1170.5): IL2

If so, when (year)?
And what load level (%g)?
Brief strengthening description:

Gravity Structure

Gravity System: load bearing walls
Roof: timber framed
Floors: concrete flat slab
Beams:
Columns:
Walls: partially filled concrete masonry

rafter type, purlin type and cladding Close butted sarking over timber purlins
slab thickness (mm) 140
Partially and fully grouted walls
thickness (mm)

Lateral load resisting structure

Lateral system along: partially filled CMU
Ductility assumed, μ: 1.25
Period along: 0.15 ##### enter height above at H31
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):

Note: Define along and across in detailed report!

Partially grouted int./fully grouted ext.
note total length of wall at ground (m): 85
estimate or calculation? calculated
estimate or calculation?
estimate or calculation?

Lateral system across: partially filled CMU
Ductility assumed, μ: 1.25
Period across: 0.11 ##### enter height above at H31
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):

Partially grouted int./fully grouted ext.
note total length of wall at ground (m): 69
estimate or calculation? calculated
estimate or calculation?
estimate or calculation?

Separations:

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

Non-structural elements

Stairs: precast, full flight
Wall cladding: other heavy
Roof Cladding: Metal
Glazing:
Ceilings: strapped or direct fixed
Services(list):

describe supports
describe concrete block veneer
describe

Available documentation

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

Damage

Site:
(refer DEE Table 4-2)

Site performance: Poor
Describe damage: Moderate to severe liquefaction

Settlement:	25-100m	notes (if applicable):	site 40mm to 100mm
Differential settlement:	0-1:350	notes (if applicable):	bldg. 38mm down from NE corner to midpoint along east side
Liquefaction:		notes (if applicable):	yes
Lateral Spread:		notes (if applicable):	yes
Differential lateral spread:		notes (if applicable):	
Ground cracks:		notes (if applicable):	yes
Damage to area:	moderate to substantial (1 in 5)	notes (if applicable):	

Building:

Current Placard Status:

Along Damage ratio:
Describe (summary):
Describe how damage ratio arrived at:

Across Damage ratio: #DIV/0!
Describe (summary):

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

Diaphragms Damage?: no Describe:
CSWs: Damage?: no Describe:
Pounding: Damage?: no Describe:
Non-structural: Damage?: no Describe: ground floor slab settlement

Recommendations

Level of repair/strengthening required: minor non-structural Describe: refer to report for details
Building Consent required: no Describe:
Interim occupancy recommendations: full occupancy Describe: repair ground floor before occupancy

Along Assessed %NBS before e'quakes: ##### %NBS from IEP below
Assessed %NBS after e'quakes: 50%
If IEP not used, please detail assessment methodology: quantitative

Across Assessed %NBS before e'quakes: ##### %NBS from IEP below
Assessed %NBS after e'quakes: 50%

IEP

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

Period of design of building (from above): 1965-1976
h_n from above: m

Seismic Zone, if designed between 1965 and 1992:
not required for this age of building
not required for this age of building

	along	across
Period (from above):	0.15	0.11
(%NBS)nom from Fig 3.3:		

Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0: 1.00
Note 2: for RC buildings designed between 1976-1984, use 1.2: 1.0
Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0): 1.0

	along	across
Final $(\%NBS)_{nom}$:	**0%**	**0%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, cl 3.1.6: 1.00

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

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3:
Z_{1992}, from NZS4203:1992
Hazard scaling factor, **Factor B:** #DIV/0!

2.4 Return Period Scaling Factor

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

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	1.00	1.00
Ductility scaling factor: =1 from 1976 onwards; or =kμ, if pre-1976, fromTable 3.3:		
Ductiity Scaling Factor, **Factor D**:	0.00	0.00

2.6 Structural Performance Scaling Factor:

Sp:	1.000	1.000
Structural Performance Scaling Factor **Factor E**:	1	1

2.7 Baseline %NBS, $(NBS\%)_b = (\%NBS)_{nom} \times A \times B \times C \times D \times E$ **$\%NBS_b$:** **#DIV/0!** **#DIV/0!**

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

3.1. Plan Irregularity, factor A: 1
3.2. Vertical irregularity, Factor B: 1
3.3. Short columns, Factor C: 1
3.4. Pounding potential Pounding effect D1, from Table to right 1.0
Height Difference effect D2, from Table to right 1.0
Therefore, Factor D: 1
3.5. Site Characteristics 1

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

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

3.6. Other factors, Factor F

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

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)
List any: Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

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

4.3 PAR x (%NBS)b: PAR x Baselline %NBS: **#DIV/0!** **#DIV/0!**

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

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name: Airedale - Block E
Unit No: Street
Building Address: Conference Street
Legal Description:
Degrees Min Sec
GPS south:
GPS east:
Building Unique Identifier (CCC): BU 1951-003 EQ2

Reviewer: Alistair Boyce
CPEng No: 209860
Company: Opus International
Company project number: 6QUCCC.85
Company phone number: 03 363 5400
Date of submission: 25/09/2012
Inspection Date:
Revision: Final
Is there a full report with this summary? yes

Site

Site slope: flat
Soil type: silty sand
Site Class (to NZS1170.5): D
Proximity to waterway (m, if <100m):
Proximity to clifftop (m, if < 100m):
Proximity to cliff base (m,if <100m):

Max retaining height (m):
Soil Profile (if available):
If Ground improvement on site, describe:
Approx site elevation (m):

Building

No. of storeys above ground: 2 single storey = 1
Ground floor split?
Storeys below ground 0
Foundation type: other (describe)
Building height (m): 5.20
Floor footprint area (approx): 290
Age of Building (years): 46

Ground floor elevation (Absolute) (m):
Ground floor elevation above ground (m):
if Foundation type is other, describe: foundation beams with slab on grade
height from ground to level of uppermost seismic mass (for IEP only) (m):
Date of design: 1965-1976

Strengthening present? no
Use (ground floor): multi-unit residential
Use (upper floors): multi-unit residential
Use notes (if required):
Importance level (to NZS1170.5): IL2

If so, when (year)?
And what load level (%g)?
Brief strengthening description:

Gravity Structure

Gravity System: load bearing walls
Roof: timber framed
Floors: non-composite concrete in steel deck
Beams:
Columns:
Walls: fully filled concrete masonry

rafter type, purlin type and cladding Timber purlins over timber rafters
tray type, overall thickness and 125
#N/A

Lateral load resisting structure

Lateral system along: partially filled CMU
Ductility assumed, μ: 1.25
Period along: 0.10 ##### enter height above at H31
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):

Note: Define along and across in detailed report!

note total length of wall at ground (m): 60
estimate or calculation? calculated
estimate or calculation?
estimate or calculation?

Lateral system across: fully filled CMU
Ductility assumed, μ: 1.25
Period across: 0.07 ##### enter height above at H31
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):

note total length of wall at ground (m): 32
estimate or calculation? calculated
estimate or calculation?
estimate or calculation?

Separations:

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

Non-structural elements

Stairs:
Wall cladding: other heavy describe concrete block veneer
Roof Cladding: Metal describe
Glazing:
Ceilings:
Services(list):

Available documentation

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

Damage

Site:
(refer DEE Table 4-2)

Site performance: Poor
Describe damage: Moderate to severe liquefaction

Settlement: 25-100m notes (if applicable): site 40mm to 100mm
Differential settlement: 1:250-1:150 notes (if applicable): bldg. 103mm down from west to east end
Liquefaction: notes (if applicable): yes
Lateral Spread: notes (if applicable): yes
Differential lateral spread: notes (if applicable):
Ground cracks: notes (if applicable): yes
Damage to area: moderate to substantial (1 in 5) notes (if applicable):

Building:

Current Placard Status:

Along Damage ratio:
Describe (summary):
Describe how damage ratio arrived at:

Across Damage ratio: #DIV/0!
Describe (summary):

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

Diaphragms Damage?: Describe:
CSWs: Damage?: Describe:
Pounding: Damage?: Describe:
Non-structural: Damage?: Describe:

Recommendations

Level of repair/strengthening required: minor structural Describe:
Building Consent required: yes Describe:
Interim occupancy recommendations: full occupancy Describe:

Along Assessed %NBS before e'quakes: ##### %NBS from IEP below
Assessed %NBS after e'quakes: 52%

If IEP not used, please detail assessment methodology: quantitative

Across Assessed %NBS before e'quakes: ##### %NBS from IEP below
Assessed %NBS after e'quakes: 52%

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

Period of design of building (from above): 1965-1976
h_n from above: m

Seismic Zone, if designed between 1965 and 1992:
not required for this age of building
not required for this age of building

	along	across
Period (from above):	0.1	0.07
(%NBS)nom from Fig 3.3:		

Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0 1.00
Note 2: for RC buildings designed between 1976-1984, use 1.2 1.0
Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0) 1.0

	along	across
Final $(\%NBS)_{nom}$:	**0%**	**0%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, cl 3.1.6: 1.00

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

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3:
Z_{1992}, from NZS4203:1992
Hazard scaling factor, **Factor B:** #DIV/0!

2.4 Return Period Scaling Factor

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

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	1.00	1.00
Ductility scaling factor: =1 from 1976 onwards; or =kμ, if pre-1976, fromTable 3.3:		
Ductiity Scaling Factor, **Factor D**:	0.00	0.00

2.6 Structural Performance Scaling Factor:

	along	across
Sp:	1.000	1.000
Structural Performance Scaling Factor **Factor E**:	1	1

2.7 Baseline %NBS, $(NBS\%)_b = (\%NBS)_{nom}$ x A x B x C x D x E **$\%NBS_b$:** **#DIV/0!** **#DIV/0!**

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

3.1. Plan Irregularity, factor A: 1

3.2. Vertical irregularity, Factor B: 1

3.3. Short columns, Factor C: 1

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

3.5. Site Characteristics 1

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

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

3.6. Other factors, Factor F

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

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)
List any: Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

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

4.3 PAR x (%NBS)b: PAR x Baselline %NBS: **#DIV/0!** **#DIV/0!**

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

Detailed Engineering Evaluation Summary Data

V1.11

Location

Building Name: Airedale - Garages 9-12, 13-19, & 20-31
Building Address: Conference Street (Unit / No: / Street)
Legal Description:
GPS south: (Degrees / Min / Sec)
GPS east:
Building Unique Identifier (CCC):

Reviewer: Alistair Boyce
CPEng No: 209860
Company: Opus International
Company project number: 6-QUCCC.85
Company phone number: 03 363 5400
Date of submission: 25/09/2012
Inspection Date:
Revision: Final
Is there a full report with this summary? yes

Site

Site slope: flat
Soil type: silty sand
Site Class (to NZS1170.5): D
Proximity to waterway (m, if <100m):
Proximity to clifftop (m, if < 100m):
Proximity to cliff base (m,if <100m):

Max retaining height (m):
Soil Profile (if available):
If Ground improvement on site, describe:
Approx site elevation (m):

Building

No. of storeys above ground: 1 single storey = 1
Ground floor split? no
Storeys below ground 0
Foundation type: other (describe)
Building height (m): 2.55
Floor footprint area (approx):
Age of Building (years): 46

Ground floor elevation (Absolute) (m):
Ground floor elevation above ground (m):
if Foundation type is other, describe: foundation beams with slab on grade
height from ground to level of uppermost seismic mass (for IEP only) (m):
Date of design: 1965-1976

Strengthening present? no
Use (ground floor): parking
Use (upper floors):
Use notes (if required):
Importance level (to NZS1170.5): IL2

If so, when (year)?
And what load level (%g)?
Brief strengthening description:

Gravity Structure

Gravity System: load bearing walls
Roof: timber framed
Floors:
Beams:
Columns:
Walls: load bearing concrete

rafter type, purlin type and cladding Timber roof joists
precast concrete wall/partially filled int. transverse wall
#N/A

Lateral load resisting structure

Lateral system along: concrete shear wall
Ductility assumed, μ: 1.25
Period along: 0.20 ##### enter height above at H31
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):

Note: Define along and across in detailed report!

enter wall data in "IEP period calcs" worksheet for period calculation
estimate or calculation? calculated
estimate or calculation?
estimate or calculation?

Lateral system across: fully filled CMU
Ductility assumed, μ: 1.25
Period across: 0.20 ##### enter height above at H31
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):

note total length of wall at ground (m):
estimate or calculation? calculated
estimate or calculation?
estimate or calculation?

Separations:

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

Non-structural elements

Stairs:
Wall cladding:
Roof Cladding: Metal describe
Glazing:
Ceilings:
Services(list):

Available documentation

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

Damage

Site:
(refer DEE Table 4-2)

Site performance: Poor
Describe damage: Moderate to severe liquefaction

Settlement: notes (if applicable): site 40-100mm
Differential settlement: notes (if applicable): bldg. not surveyed
Liquefaction: notes (if applicable): yes
Lateral Spread: notes (if applicable): yes
Differential lateral spread: notes (if applicable):
Ground cracks: notes (if applicable): yes
Damage to area: moderate to substantial (1 in 5) notes (if applicable):

Building:

Current Placard Status:

Along Damage ratio:
Describe (summary):
Describe how damage ratio arrived at:

Across Damage ratio: #DIV/0!
Describe (summary):

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

Diaphragms Damage?: no Describe:
CSWs: Damage?: no Describe:
Pounding: Damage?: no Describe:
Non-structural: Damage?: no Describe:

Recommendations

Level of repair/strengthening required: none Describe:
Building Consent required: Describe:
Interim occupancy recommendations: full occupancy Describe:

Along Assessed %NBS before e'quakes: ##### %NBS from IEP below
Assessed %NBS after e'quakes: 100%
If IEP not used, please detail assessment methodology: quantitative, based on limited drawings

Across Assessed %NBS before e'quakes: ##### %NBS from IEP below
Assessed %NBS after e'quakes: 100%

IEP

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

Period of design of building (from above): 1965-1976
h_n from above: m

Seismic Zone, if designed between 1965 and 1992:
not required for this age of building
not required for this age of building

	along	across
Period (from above):	0.2	0.2
(%NBS)nom from Fig 3.3:		

Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0 1.00
Note 2: for RC buildings designed between 1976-1984, use 1.2 1.0
Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0) 1.0

	along	across
Final $(\%NBS)_{nom}$:	**0%**	**0%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, cl 3.1.6: 1.00

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

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3:
Z_{1992}, from NZS4203:1992
Hazard scaling factor, **Factor B:** #DIV/0!

2.4 Return Period Scaling Factor

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

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	1.00	1.00
Ductility scaling factor: =1 from 1976 onwards; or =kμ, if pre-1976, fromTable 3.3:		
Ductiity Scaling Factor, **Factor D**:	0.00	0.00

2.6 Structural Performance Scaling Factor:

Sp:	1.000	1.000
Structural Performance Scaling Factor **Factor E**:	1	1

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

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

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

3.1. Plan Irregularity, factor A: 1
3.2. Vertical irregularity, Factor B: 1
3.3. Short columns, Factor C: 1
3.4. Pounding potential Pounding effect D1, from Table to right 1.0
Height Difference effect D2, from Table to right 1.0
Therefore, Factor D: 1
3.5. Site Characteristics 1

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

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

3.6. Other factors, Factor F

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

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)
List any: Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

3.7. Overall Performance Achievement ratio (PAR)	**0.00**	**0.00**
4.3 PAR x (%NBS)b: PAR x Baselline %NBS:	**#DIV/0!**	**#DIV/0!**
4.4 Percentage New Building Standard (%NBS), (before)		**#DIV/0!**

OPUS