Torrens Road Housing Complex Detailed Engineering Evaluation BU 0480 - 001EQ2 - Block A BU 0480 - 002 EQ2 - Block B Quantitative Report

Prepared for Christchurch City Council (Client)

By Beca Carter Hollings & Ferner Ltd (Beca)

17 April 2013

Revision History

Revision Nº	Prepared By	Description	Date
A	Andrew Franklin	Draft for CCC review	26 March 2013
B	Andrew Franklin	Final	17 April 2013

Document Acceptance

Action	Name	Signed	Date
Prepared by	Andrew Franklin		17 April 2013
Reviewed by	Jonathan Barnett		17 April 2013
Approved by	David Whittaker		17 April 2013
on behalf of	Beca Carter Hollings & Ferner Ltd		

Torrens Road Housing Complex
BU 0480 - 001 EQ2 - Block A
BU 0480 - 002 EQ2 - Block B

Detailed Engineering Evaluation
Quantitative Report – SUMMARY
Version 1

Address
53 Torrens Road
Middleton
Christchurch

Background

This is a summary of the Quantitative Assessment report for the building structures, and is based on the document 'Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury – Part 2 Evaluation Procedure' (draft) issued by the Engineering Advisory Group (EAG) on 19 July 2011.

The format and content of this report follows a template provided by CCC, which is based on the EAG document.

Block A

Block A is a two storey building built in 1980, with an approximate internal floor area of 420m^2. There are five ground floor units and four first floor units. The primary structural system is filled and partially reinforced concrete masonry block walls. The roof consists of tiles on timber battens and timber trusses. A set of structural and architectural drawings by Waimairi County Council, dated 1978, was made available. Calculations have been undertaken as part of the Quantitative Assessment.

Block B

Block B is a two storey building built in 1980, with an approximate internal floor area of 900m^2.There are ten ground floor units and nine first floor units. The primary structural system is filled and partially reinforced concrete masonry block walls. The roof consists of tiles on timber battens and timber trusses. A set of structural and architectural drawings by Waimairi County Council, dated 1978, was made available. Calculations have been undertaken as part of the Quantitative Assessment.

Key Damage Observed

Visual inspections on 11 December 2012 indicate the building has suffered minor earthquake damage. The key damage observed includes:

- Cracking and separation of internal linings.
- Cracking of concrete masonry block wall mortar.

- Cracking of first floor concrete balconies.
- Cracking to ground bearing concrete slab in the transverse direction to ground floor unit 18 in Block B.

Critical Structural Weaknesses (CSW)

The following Critical Structural Weaknesses have been identified:

- No reinforcement ties between ground slab and perimeter foundations.
- No horizontal reinforcement in external concrete masonry block walls.

Indicative Building Strength (from Detailed Assessment)

The Block A and Block B buildings have been assessed to have an indicative seismic capacity of 34% and 38%NBS respectively, using the New Zealand Society for Earthquake Engineering (NZSEE) Detailed Assessment guideline ‘Assessment and Improvement of the Structural Performance of Buildings in Earthquakes’ (AISPBE), 2006, and Standards New Zealand ‘Design of Reinforced Concrete Masonry Structures’ (NZS 4230:2004), 2004, and is therefore Earthquake Prone and classified as Seismic Grade C.

The structural damage observed is predominantly minor and the seismic capacity is not considered to have significantly diminished from its pre-earthquake level.

Our assessment has identified the structural components that have governed/limited the building’s seismic performance, and their potential failure mechanisms, are as follows:

Block A

- First floor masonry walls in the longitudinal loading direction, 34%NBS, governed by out-of-plane flexure

Block B

- First floor masonry walls in the longitudinal loading direction, 38%NBS, governed by out-of-plane flexure.

Recommendations

In order for the owner to make an informed decision about the on-going use and occupancy of their building the following information is presented in line with the Department of Building and Housing document ‘Guidance for engineers assessing the seismic performance of non-residential and multi-unit residential buildings in greater Christchurch’, June 2012.

Block A and Block B

The buildings are considered to be earthquake risk, having an assessed capacity between than 34% and 67%NBS, and is classified as Seismic Grade C. The risk of collapse of an earthquake prone building of this grade is considered to be 5 to 10 times greater than that of an equivalent new building.

No significant damage or hazards were identified to the seismic or gravity load resisting system that would further reduce its ability to resist further loads and therefore no restrictions on use or occupancy are recommended.

It is recommended that:

- A full damage assessment is carried out for insurance purposes.
- A verticality and level survey could be carried out to determine the extent of any settlement of the building for insurance purposes.
- According to the recent CCC Instructions to Engineers document (16 October 2012), Council's insurance provides for repairing damaged elements to a condition substantially as new. We suggest you consult further with your insurance advisor.

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Appendices

1 Background

Beca Carter Hollings & Ferner Ltd (Beca) has been engaged by Christchurch City Council (CCC) to undertake a Quantitative Detailed Engineering Evaluation (DEE) of Block A and Block B located at 53 Torrens Road, Middleton, Christchurch.

This report is a Quantitative Assessment of the building structures, and is based on the document 'Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury – Part 2 Evaluation Procedure' (draft) issued by the Engineering Advisory Group (EAG) on 19 July 2011.

A quantitative assessment involves analytical calculations of the buildings' strengths and may involve material testing, geotechnical testing and intrusive investigation.

The purpose of this assessment is to determine the likely building performance and damage patterns, to identify any potential Critical Structural Weaknesses (CSW) or collapse hazards, and to make an assessment of the likely building strength in terms of percentage of New Building Standard (%NBS).

A set of structural and architectural drawings was made available and has been used in our assessment of these buildings. The building descriptions below are based on a review of the drawings and our visual inspections.

The format and content of this report follows a template provided by CCC, which is based on the EAG document.

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 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 understood that CERA is adopting the Detailed Engineering Evaluation Procedure document (draft) issued by the Engineering Advisory Group on 19 July 2011, which sets out a methodology for both qualitative and quantitative assessments. We understand this report will be used in response to CERA Section 51.

The qualitative assessment includes a thorough visual inspection of the building coupled with a desktop review of available documentation such as drawings, specifications and IEP's. The quantitative assessment involves analytical calculation of the building's strength and may require non-destructive or destructive material testing, geotechnical testing and intrusive investigation.

It is anticipated that factors determining the extent of evaluation and strengthening level required will include:

- The importance level and occupancy of the building
- The placard status that was assigned during the state of emergency following the 22 February 2011 earthquake
- The age and structural type of the building
- Consideration of any Critical Structural Weaknesses
- The extent of any earthquake damage

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 any alteration. This effectively means that a building cannot be weakened as a result of an alteration (including partial demolition).

Section 115 – Change of Use

This section requires that the territorial authority (in this case Christchurch City Council (CCC)) be satisfied that the building with a new use complies with the relevant sections of the Building Code 'as near as is reasonably practicable'. Regarding seismic capacity 'as near as reasonably practicable' has previously been interpreted by CCC as achieving a minimum of 67%NBS however where practical achieving 100%NBS is desirable. The New Zealand Society for Earthquake Engineering (NZSEE) recommend a minimum of 67%NBS.

Section 121 – Dangerous Buildings

The definition of dangerous building in the Act was extended by the Canterbury Earthquake (Building Act) Order 2010, and it now defines a building as dangerous if:

- In the ordinary course of events (excluding the occurrence of an earthquake), the building is likely to cause injury or death or damage to other property; or
- In the event of fire, injury or death to any persons in the building or on other property is likely because of fire hazard or the occupancy of the building; or
- There is a risk that the building could collapse or otherwise cause injury or death as a result of earthquake shaking that is less than a 'moderate earthquake' (refer to Section 122 below); or
- There is a risk that that other property could collapse or otherwise cause injury or death; or
- A territorial authority has not been able to undertake an inspection to determine whether the building is dangerous.

Section 122 – Earthquake Prone Buildings

This section defines a building as earthquake prone if its ultimate capacity would be exceeded in a ‘moderate earthquake’ and it would be likely to collapse causing injury or death, or damage to other property. A moderate earthquake is defined by the building regulations as one that would generate ground shaking 33% of the shaking used to design an equivalent new building.

Section 124 – Powers of Territorial Authorities

This section gives the territorial authority the power to require strengthening work within specified timeframes or to close and prevent occupancy to any building defined as dangerous or earthquake prone.

Section 131 – Earthquake Prone Building Policy

This section requires the territorial authority to adopt a specific policy for earthquake prone, dangerous and insanitary buildings.

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 of the 4th September 2010.

The 2010 amendment includes the following:

- A process for identifying, categorising and prioritising Earthquake Prone Buildings, commencing on 1 July 2012;
- A strengthening target level of 67% of a new building for buildings that are Earthquake Prone;
- A timeframe of 15-30 years for Earthquake Prone Buildings to be strengthened; and,
- Repair works for buildings damaged by earthquakes will be required to comply with the above.

The council has stated their willingness to consider retrofit proposals on a case by case basis, considering the economic impact of such a retrofit.

It is understood that any building with a capacity of less than 33%NBS (including consideration of Critical Structural Weaknesses) will need to be strengthened to a target of 67%NBS of new building standard as recommended by the Policy.

If strengthening works are undertaken, a building consent will be required. A requirement of the consent will require upgrade of the building to comply ‘as near as is reasonably practicable’ with:

- The accessibility requirements of the Building Code.
- The fire requirements of the Building Code. This is likely to require a fire report to be submitted with the building consent application.

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:

a. Hazard Factor increased from 0.22 to 0.3 (36% increase in the basic seismic design load)

b. Serviceability Return Period Factor increased from 0.25 to 0.33 (80% increase in the serviceability design loads when combined with the Hazard Factor increase)

The increase in the above factors has resulted in a reduction in the level of compliance of an existing building relative to a new building despite the capacity of the existing building not changing.

3 Earthquake Resistance Standards

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

No consideration has been given at this stage to checking the level of compliance against the increased Serviceability Limit State requirements.

The likely ultimate capacity of this building has been derived in accordance with the New Zealand Society for Earthquake Engineering (NZSEE) guidelines 'Assessment and Improvement of the Structural Performance of Buildings in Earthquakes' (AISPBE), 2006. These guidelines provide an Initial Evaluation Procedure that assesses a building's capacity based on a comparison of loading codes from when the building was designed and currently. It is a quick high-level procedure that can be used when undertaking a Qualitative analysis of a building. The guidelines also provide guidance on calculating a modified Ultimate Limit State capacity of the building which is much more accurate and can be used when undertaking a Quantitative analysis.

The New Zealand Society for Earthquake Engineering has proposed a way for classifying earthquake risk for existing buildings in terms of %NBS and this is shown in Figure 3.1 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	Unacceptable	Unacceptable

Figure 3.1: NZSEE Risk Classifications Extracted from Table 2.2 of the NZSEE 2006 AISPBE Guidelines

Table 3.1 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. on average 0.2% in any year). It is noted that the current seismic risk in Christchurch results in a 6% risk of exceedance in the next year.

Table 3.1: %NBS Compared to Relative Risk of Failure

Building Grade	Percentage of New Building Standard (%NBS)	Approx. Risk Relative to a New Building
A+	>100	<1
A	80-100	1-2 times
B	67-80	2-5 times
C	33-67	5-10 times
D	20-33	10-25 times
E	<20	>25 times

4 Building Description

4.1 General

Block A

Summary information about the building is given in the following table.

Table 4.1: Building Summary Information – Block A

Item	Details	Comment
Building name	Torrens Road Housing Complex - Block A.	
Street Address	53 Torrens Road, Middleton.	
Age	33 years. 1980 construction, 1978 design.	From information received from CCC.
Description	Two-storey, stand-alone residential unit block.	9 units (5 ground floor, 4 first floor)
Building Footprint / Floor Area	Internal floor area ≈ 420m^2 Building footprint ≈ 230m^2 Overall dimensions ≈ 27.6m x 9.4m in plan.	
No. of storeys / basements	2 storeys / No basement.	
Occupancy / use	Residential.	Importance Level 2.

Item	Details	Comment
Construction	Concrete masonry block walls and timber framed walls. Timber truss roof with tiles. First floor slab is 140mm thick reinforced concrete cast in situ.	From the drawings: 190mm concrete masonry blocks are fully filled (4hr fire wall). Typical reinforcement is D12@600 vertical for the ground floor walls and D16@600 vertical for the first floor walls. Ground floor longitudinal walls also have D16@800 horizontal reinforcement. The first floor slab has typically D12@250 bottom reinforcement in one direction and D12@350 the other direction. The top reinforcement is D12@175 locally over walls.
Gravity load resisting system	Gravity loads from the roof structure are supported by the timber framed longitudinal walls while gravity loads from the first floor slab are supported by the concrete masonry block walls. The loads are then transferred into the concrete slab on grade foundation. Gravity loads from the ground floor slab are transferred directly into the foundations.	
Seismic load resisting system	Lateral loads acting across the building are resisted by the reinforced concrete masonry block walls. Lateral loads acting along the building are resisted at first floor level by the timber framed walls and their associated linings as well as concrete block masonry walls cantilevering out of plane. And at ground floor by the reinforced concrete block masonry walls located central to each unit. Lateral loads in the roof structure at the north-eastern end are transferred to the concrete masonry block walls through diagonal metal rod bracing.	
Foundation system	Slab on grade.	
Stair system	Timber treads and timber stringers. Concrete landing.	

Item	Details	Comment
Other notable features	North-eastern end of the building is on single storey only. Cantilevered reinforced concrete balconies on north-eastern side of first floor apartments.	.
External works	Asphalt pavement surrounding building.	
Construction information	Full architectural and structural drawings (Waimairi County Council, 1978).	
Likely design standard	NZS 4203:1976	Inferred from age of building
Heritage status	No heritage status.	
Other		

Block B

Summary information about the building is given in the following table.

Table 4.2: Building Summary Information – Block B

Item	Details	Comment
Building name	Torrens Road Housing Complex - Block B.	
Street Address	53 Torrens Road, Middleton.	
Age	33 years. 1980 construction, 1978 design.	From information received from CCC.
Description	Two-storey, stand-alone residential unit block.	19 units (10 ground floor, 9 first floor)
Building Footprint / Floor Area	Internal floor area ≈ 900m^2 Building footprint ≈ 470m^2 Overall dimensions ≈ 56.2m x 9.4m in plan.	
No. of storeys / basements	2 storeys / No basement.	
Occupancy / use	Residential.	Importance Level 2.
Construction	Concrete masonry block walls and timber framed walls. Timber truss roof with tiles. First floor slab is 140mm thick reinforced concrete cast in situ.	From the drawings: 190mm concrete masonry blocks are fully filled (4hr fire wall). Typical reinforcement is D12@600 vertical for the ground floor walls and D16@600 vertical for the first floor walls. Ground floor longitudinal walls also have D16@800 horizontal reinforcement. The first floor slab typically has D12@250 bottom

Item	Details	Comment
		reinforcement in one direction and D12@350 the other direction. The top reinforcement is D12@140 locally over walls.
Gravity load resisting system	Gravity loads from the roof structure are supported by the timber framed longitudinal walls while gravity loads from the first floor slab are supported by the concrete masonry block walls. The loads are then transferred into the concrete slab on grade foundation. Gravity loads from the ground floor slab are transferred directly into the foundations.	
Seismic load resisting system	Lateral loads acting across the building are resisted by the concrete masonry block walls. Lateral loads acting along the building are resisted by the timber framed walls and their associated linings, and at the first floor reinforced concrete masonry walls cantilevering out of plane, and the ground floor reinforced concrete masonry walls in plane centrally to each unit. Lateral loads in the roof structure at the north-eastern end are transferred to the concrete masonry block walls through diagonal metal rod bracing.	
Foundation system	Slab on grade.	
Stair system	Timber treads and timber stringers. Concrete landing.	
Other notable features	North-eastern end of the building is on single storey only. Cantilevered reinforced concrete balconies on north-eastern side of first floor apartments.	
External works	Asphalt pavement surrounding building.	
Construction information	Full architectural and structural drawings (Waimairi County Council, 1978).	
Likely design standard	NZS 4203:1976	Inferred from age of building
Heritage status	No heritage status.	
Other		

4.2 Structural 'Hot-spots'

Areas in which damage may be expected to occur from earthquake shaking are outlined below:

- First floor stair landings, diaphragm discontinuity.
- Connections between walls, floor and roof typically.

5 Site Investigations

5.1 Previous Assessments

Block A

It is assumed that the Block A building had a Level 1 rapid assessment undertaken following the February 2011 earthquake event, however a documented form was only made available for the Block B building.

Block B

The building had a Level 1 rapid assessment undertaken following the February 2011 earthquake event (refer to Appendix D).

5.2 Level 5 Investigations

Visual inspections as part of the Level 5 damage assessment were undertaken on 11 December 2012. No intrusive investigations were carried out as part of the Level 5 quantitative assessment.

6 Damage Assessment

6.1 Damage Summary

The table below provides a summary of damage observed during our inspection. Refer to Appendix A for photographs.

Table 6.1: Damage Summary – Block A

Damage type	Unknown	Minor	Moderate	Major	Comment
settlement of foundations	✓				None observed during visual inspection. Level survey may be required to confirm.
tilt of building	✓				None observed during visual inspection. Verticality survey may be required to confirm.
Liquefaction					None observed during visual inspection. The aerial reconnaissance on 24 February 2011 indicates liquefaction did not occur at the site.
settlement of external ground		✓			Differential settlement of external pavement observed.

Damage type	Unknown	Minor	Moderate	Major	Comment
lateral spread / ground cracks	✓				Some cracking to external pavement was observed however is not believed to be earthquake damage.
Frame					NA
concrete / masonry walls		✓			Cracking to concrete masonry block mortar was observed on the walls that weren't concealed by linings.
cracking to concrete floors	✓				None observed as the concrete floors were concealed.
bracing		✓			Cracking and separation of internal linings observed. Inspection of metal roof bracing in the roof of the north-eastern apartment was not possible as it was concealed.
cladding / envelope		✓			Cracking and separation of external linings observed.
building services	✓				No inspection of services was carried out.
other					

Table 6.2: Damage Summary – Block B

Damage type	Unknown	Minor	Moderate	Major	Comment
settlement of foundations	✓				None observed during visual inspection. Level survey may be required to confirm.
tilt of building	✓				None observed during visual inspection. Verticality survey may be required to confirm.
Liquefaction					None observed during visual inspection. The aerial reconnaissance on 24 February 2011 indicates liquefaction did not occur at the site.
settlement of external ground		✓			Differential settlement of external pavement observed.
lateral spread / ground cracks	✓				Some cracking to external pavement was observed however is not believed to be earthquake damage.
Frame					NA
concrete / masonry walls		✓			Cracking to concrete masonry block mortar.

Damage type	Unknown	Minor	Moderate	Major	Comment
cracking to concrete floors		✓			Cracking of ground bearing concrete floor of unit 18, the extent was concealed by floor coverings.
bracing		✓			Cracking and separation of internal linings observed. Inspection of metal roof bracing in the roof of the north-eastern apartment was not possible as it was concealed.
cladding / envelope		✓			Cracking and separation of external linings observed.
building services	✓				No inspection of services was carried out.
other					

6.2 Surrounding Buildings

Block A and B are sufficiently spaced so as not to affect each other during an earthquake. There are no additional adjacent structures that are close enough that may affect Block A or Block B during an earthquake.

6.3 Residual Displacements and General Observations

No evidence of permanent settlement or displacements was observed during our visual inspection, however a global settlement survey may reveal movement that could be not be identified by brief visual inspection.

6.4 Implication of Damage

Based on our visual inspection, the structures appear to have suffered minor damage and therefore we believe the structural capacities have not been significantly diminished.

7 Generic Issues

The following generic issues referred to in Appendix A of the EAG guideline document have been identified as applicable to the Block A and Block B buildings:

- Mesh reinforcement in ground floor slab making it prone to non-ductile failure.

Fully Filled Concrete Masonry

- Inadequate shear strength
- Inadequate connections of floor and roof diaphragms to the walls.

However, only minor earthquake damage has been observed.

8 Geotechnical Consideration

No specific geotechnical information is currently available for this site; however the CERA residential red zone and Department of Building & Housing (DBH) technical categories maps zone this site as foundation Technical Category 2 (TC2).

The definition of TC2 is minor to moderate land damage from liquefaction is possible in future large earthquakes. Lightweight construction or enhanced foundations are likely to be required such as enhanced concrete raft foundations (ie, stiffer floor slabs that tie the structure together).

During the inspection, no significant damage to the surrounding ground was noted. No effect to the structure due to ground conditions was considered in the quantitative assessment.

9 Survey

No level or verticality surveys were carried out as there was no evidence of settlement or displacement observed during the inspection. CCC may wish to undertake a level survey as part of any subsequent detailed damage investigations.

10 Detailed Seismic Capacity Assessment

10.1 Assessment Methodology

The buildings have had their seismic capacities assessed using the Detailed Assessment Procedures in the NZSEE 2006 AISPBE guidelines and NZS 4230:2004, based on the drawings and site measurements.

The structures have suffered minor damage. The post-damage capacities are not considered to have been significantly diminished from their original capacity.

10.2 Assumptions

The following assumptions were used in our quantitative assessment:

- Reinforcing steel yield strength, fy = 275 MPa (as stated on the drawings)
- Mesh reinforcing yield strength, fy = 485 MPa (as stated on the drawings)
- Concrete compressive strength, f'c = 20 MPa (as stated on the drawings)
- Masonry compressive bending strength, f'm = 4.8 MPa
- Young's Modulus of masonry, Em = 10.3 GPa
- Young's Modulus of plasterboard, Ep = 2 GPa
- All walls act in their primary axes only on the ground floor, except for forces induced due to self-weight only, and cantilever in their minor axis on the first floor.
- Soil ultimate bearing pressure, fb=240MPa (including ϕ=0.8 for overstrength earthquake actions) (assumed 'good ground' as per NZS 3604).

10.3 Critical Structural Weaknesses

The following Critical Structural Weaknesses have been identified:

- No reinforcement ties between ground slab and perimeter foundations.
- No horizontal reinforcement in external concrete masonry block walls.

10.4 Seismic Parameters

The seismic design parameters based on current design requirements from NZS 1170.5:2004 and the NZBC clause B1 for this building are:

- Site soil class: D – NZS 1170.5:2004, Clause 3.1.3, Soft Soil
- Site hazard factor, Z = 0.3 – NZBC, Clause B1 Structure, Amendment 11 effective from 19 May 2011
- Return period factor Ru = 1 – NZS 1170.5:2004, Table 3.5, Importance Level 2 structure with a 50 year design life.
- Near fault factor N(T,D) = 1 – NZS 1170.5:2004, Clause 3.1.6, Distance more than 20 km from fault line.

10.5 Results of Seismic Assessment

Block A

The results of our quantitative assessment indicate the building has a seismic capacity of 34%NBS. Table 10.1 presents the evaluated seismic capacity in terms of %NBS of the individual structural systems in each building direction.

Table 10.1: Summary of Seismic Assessment of Structural Systems – Block A

Item	Loading Direction	Ductility, μ	Seismic Capacity	Notes
Overall %NBS adopted from DEE	**Longitudinal**	**1.25**	**34%NBS**	**Governed by first floor concrete masonry walls out of plane flexure**
Ground floor concrete masonry block wall in-plane	Transverse	1.25	53 94	Shear capacity Flexural capacity
Ground floor concrete masonry block wall out-of-plane	Both	1.25	>100 >100	Shear capacity Flexural capacity
Ground floor concrete masonry block wall in-plane	Longitudinal	2.0	79 39	Shear capacity Flexural capacity
First floor concrete masonry block wall in-plane	Transverse	1.25	>100 >100	Shear capacity Flexural capacity
First floor concrete masonry block wall out-of-plane	Longitudinal	1.25	>100 34	Shear capacity Flexural capacity
First floor timber framed walls	Longitudinal	1.25	39	Bracing capacity
Foundations	Transverse	1.0	51	Bearing/overturning
Foundations	Longitudinal	1.25	34	Bearing/overturning

1st floor slab to concrete block wall Connection	Transverse Longitudinal	1.0 1.25	42 36	Includes overstrength from wall loads above.

Note:

- Ductility factors are in accordance with values recommended in the NZSEE 2006 AISPBE guidelines.
- Reinforced masonry walls transverse have vertical reinforcing D12@600 and are fully filled but have no horizontal reinforcing therefore μ=1.25.
- Reinforced masonry walls longitudinal have vertical reinforcing D12@600 and are fully filled, and have horizontal reinforcing D16@800, therefore μ=2.0.
- The first floor timber system and cantilever block walls was considered a 'Part' for seismic force calculations as per NZS 1170.5 Section 8.

Block B

The results of our quantitative assessment indicate the building has a seismic capacity of 38%NBS. Table 10.2 presents the evaluated seismic capacity in terms of %NBS of the individual structural systems in each building direction.

Table 10.2: Summary of Seismic Assessment of Structural Systems – Block B

Item	Loading Direction	Ductility, μ	Seismic Capacity	Notes
Overall %NBS adopted from DEE	**Longitudinal**	**1.25**	**38%NBS**	**Governed by first floor concrete masonry block wall out of plane flexure**
Ground floor concrete masonry block wall in-plane	Transverse	1.25	52 99	Shear capacity Flexural capacity
Ground floor concrete masonry block wall out-of-plane	Both	1.25	>100 >100	Shear capacity Flexural capacity
Ground floor concrete masonry block wall in-plane	Longitudinal	2.0	84 42	Shear capacity Flexural capacity
First floor concrete masonry block wall in-plane	Transverse	1.25	>100 >100	Shear capacity Flexural capacity
First floor concrete masonry block wall out-of-plane	Longitudinal	1.25	>100 38	Shear capacity Flexural capacity
First floor timber framed walls	Longitudinal	1.25	40	Bracing capacity
Foundations	Transverse	1.0	51	Bearing/overturning
Foundations	Longitudinal	1.25	34	Bearing/overturning

1st floor slab to wall Connection	Transverse Longitudinal	1.0 1.25	52 38	Shear friction, includes overstrength from wall loads above.

Note:

- Ductility factors are in accordance with values recommended in the NZSEE 2006 AISPBE guidelines.
- Reinforced masonry walls transverse have vertical reinforcing D12@600 and are fully filled but have no horizontal reinforcing therefore μ=1.25.
- Reinforced masonry walls longitudinal have vertical reinforcing D12@600 and are fully filled, and have horizontal reinforcing D16@800, therefore μ=2.0.
- The first floor timber system and cantilever block walls was considered a 'Part' for seismic force calculations as per NZS 1170.5 Section 8.

10.6 Discussion of results

The key findings of the assessment are as follows:

Block A

- First floor masonry walls in the longitudinal loading direction, 34%NBS, governed by out-of-plane flexure

Based on the results of our Quantitative Assessment, the Block A is Earthquake Risk as the seismic capacity was assessed to be between 34% and 67%NBS, and is classified as Seismic Grade C.

Block B

- First floor masonry walls in the longitudinal loading direction, 38%NBS, governed by out-of-plane flexure

Based on the results of our Quantitative Assessment, the Block B is Earthquake Risk as the seismic capacity was assessed to be between 34% and 67%NBS, and is classified as Seismic Grade C.

11 Recommendations

11.1 Occupancy

In order for the owner to make an informed decision about the on-going use and occupancy of their buildings the following information is presented in line with the Department of Building and Housing document 'Guidance for engineers assessing the seismic performance of non-residential and multi-unit residential buildings in greater Christchurch', June 2012.

The buildings are considered to be earthquake risk, having an assessed capacity between 34 and 67%NBS, and is classified as Seismic Grade C. The risk of collapse of an earthquake prone building of this grade is considered to be 5 to 10 times greater than that of an equivalent new building.

No significant damage or hazards were identified to the seismic or gravity load resisting system that would further reduce its ability to resist further loads and therefore no restrictions on use or occupancy are recommended.

11.2 Further Investigations, Survey or Geotechnical Work

It is recommended that:

- A full damage assessment on both buildings is carried out for insurance purposes.
- A verticality and level survey could be carried out to determine the extent of settlement of the buildings for insurance purposes.

11.3 Damage Reinstatement

According to the recent CCC Instructions to Engineers document (16 October 2012), Council's insurance provides for repairing damaged elements to a condition substantially as new. We suggest you consult further with your insurance advisor.

12 Design Features Report

Repairs will be required to reinstate the existing structural system. A repair methodology has not been prepared at this stage. No new load paths are expected as a result of the repairs required however may be developed as a result of strengthening.

13 Limitations

The following limitations apply to this engagement:

- Beca and its employees and agents are not able to give any warranty or guarantee that all defects, damage, conditions or qualities have been identified.
- Inspections are primarily limited to visible structural components. Appropriate locations for invasive inspection, if required, will be based on damage patterns observed in visible elements, and review of the construction drawings and structural system. As such, there will be concealed structural elements that will not be directly inspected.
- The inspections are limited to building structural components only.
- Inspection of building services, pipework, pavement, and fire safety systems is excluded from the scope of this report.
- Inspection of the glazing system, linings, carpets, claddings, finishes, suspended ceilings, partitions, tenant fit-out, or the general water tightness envelope is excluded from the scope of this report.
- The assessment of the lateral load capacity of the building is limited by the completeness and accuracy of the drawings provided. Assumptions have been made in respect of the geotechnical conditions at the site and any aspects or material properties not clear on the drawings. Where these assumptions are considered material to the outcome further investigations may be recommended. It is noted the assessment has not been exhaustive, our analysis and calculations have focused on representative areas only to determine the level of provision made. At this stage we have not undertaken any checks of the gravity system, wind load capacity, or foundations.
- The information in this report provides a snapshot of building damage at the time the detailed inspection was carried out. Additional inspections required as a result of significant aftershocks are outside the scope of this work.

This report is of defined scope and is for reliance by CCC only, and only for this commission. Beca should be consulted where any question regarding the interpretation or completeness of our inspection or reporting arises.

Appendix A

Photographs

Figure 1: Site Plan (North is to top of page)

Photo 1: Torrens Road Housing Complex – view from north. Block A is on the left and Block B is on the right.

Photo 2: Block A – View from north.

Photo 3: Block B – View from north.

Photo 4: Block B – View from east.

Photo 5: Block B – View from west. Detail is typical for Block A also.

Photo 6: Typical stairwell.

Photo 7: Underside of typical first floor concrete balcony

Damage Description: Cracking of concrete balcony.

Photo 8: Landing at top of stairway

Damage Description: potential movement between wall and floor.

Photo 9: Window in stairway.

Damage Description: Cracking of internal wall linings (typical).

Photo 10: Storage room at top of stairs.

Damage Description: Cracking of wall linings (typical).

Photo 11: Typical cornice detail.

Damage Description: Separation of wall and ceiling linings (typical).

Photo 12: Wall lining above entrance doorway.

Damage Description: Cracking of internal wall linings (typical).

Photo 13: Typical wall junction in stairwell.

Damage Description: Separation of wall and ceiling linings (typical).

Photo 14: Typical junction of transverse concrete masonry block wall and longitudinal timber framed wall with weatherboard cladding.

Damage Description: Separation of wall and ceiling linings (typical).

Photo 15: Separation of wall lining and architrave.

Damage Description: Evidence of building movement – gap between lining and architrave. (dark shadow is the opening/gap – finger width 10-15mm)

Photo 16: External pavement at entrance of under-stair storage area at rear of Block B.

Damage Description: Cracking of concrete. This cracking was typical for all entrances to under-stair storage.

Photo 17: External pavement at entrance of under-stair storage area at rear of Block B (see Photo 16).

Damage Description: Cracking of concrete. This cracking was typical for all entrances to under-stair storage.

Photo 18: Sloping of external pavement at rear of Block A.

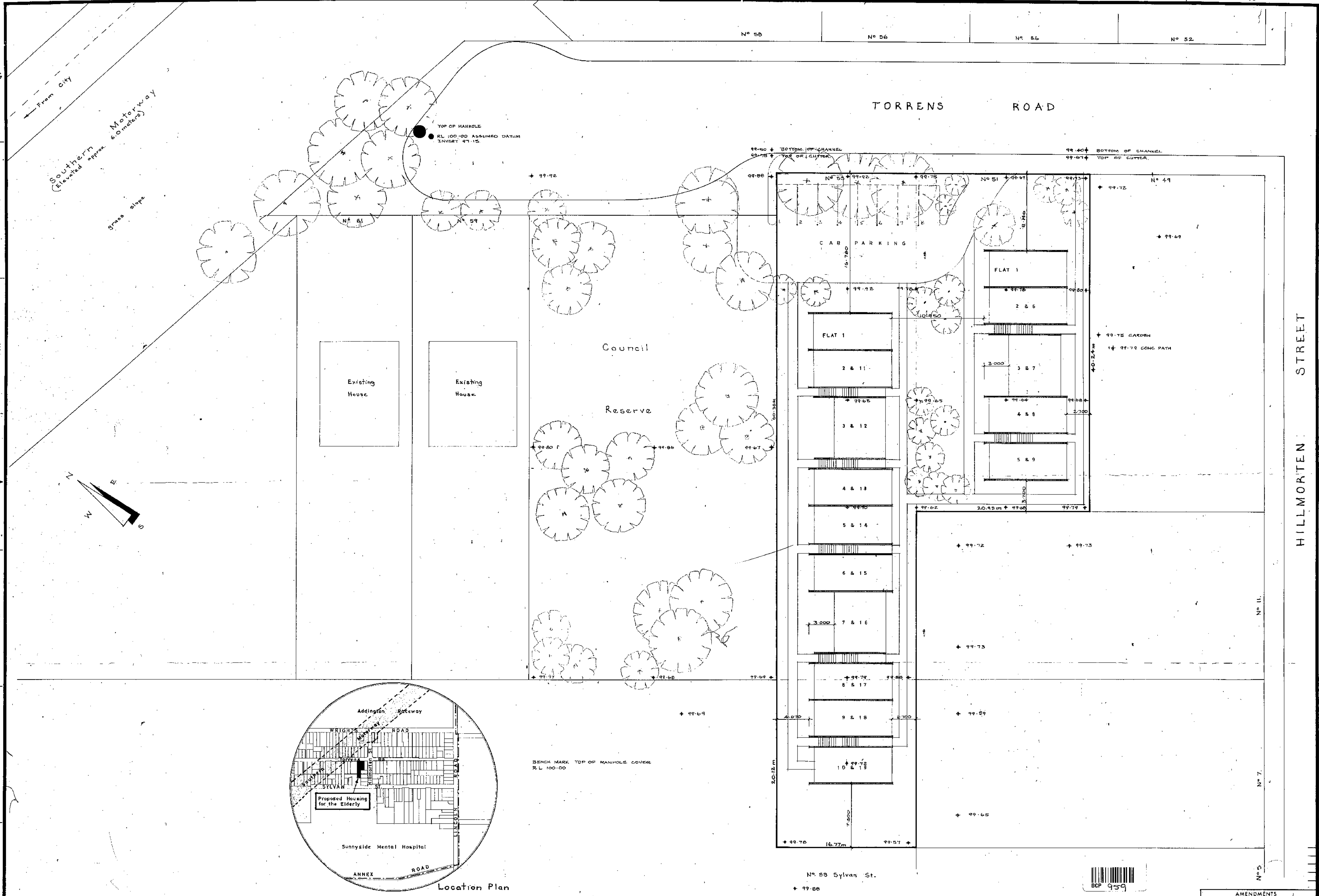
Damage Description: Differential settlement of external ground.

Photo 19: External pavement at front of Block A.

Damage Description: Cracking of concrete and local subsidence of ground.

Appendix B

Existing Drawings



APPROVED		NAME	DATE
	SURVEYED		
.... COUNTY ENGINEER	DRAWN	P. W. P. J. B.	10-77
DATE	TRACED	P. W. P. J. B.	10-77
	CHECKED		
	DESIGNED	L. Wooding, ANZIA	9-77
	D.C. CHCK.		

DATUM ....
BENCH MK. ....
LEVEL BK No .... P. ....
FIELD BK No .... P. ....

53 and 51 TORRENS ROAD — SKETCH PLAN

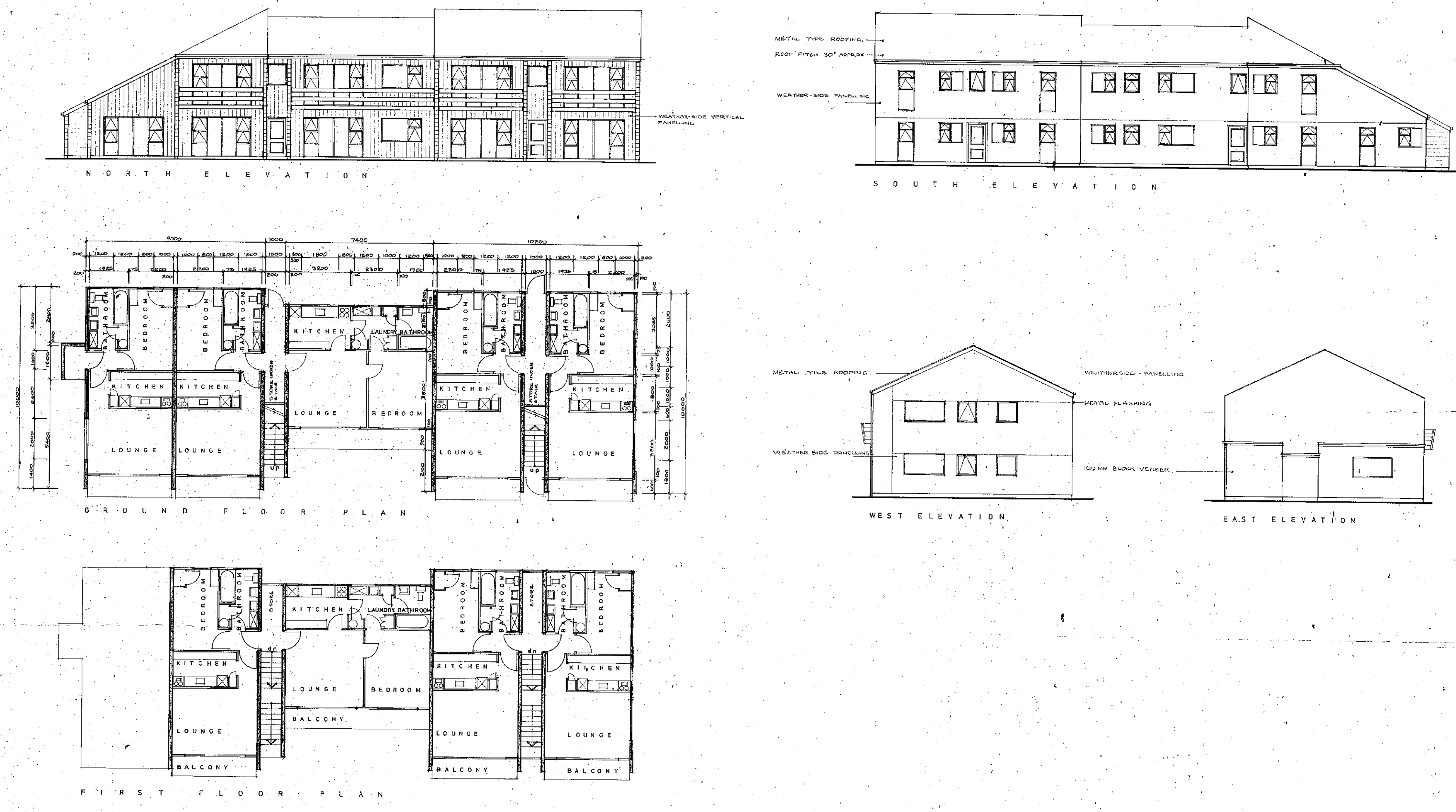
HOUSING FOR THE ELDERLY

WAIMAIRI COUNTY COUNCIL

SCALE
SITE PLAN 1:200

AMENDMENTS
SHEET SIZE A1
PLAN No.
2573
SHEET 1

BCP 959



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	DRAWN	P. Bangma.	10-77	LEVEL BK No .... p........
COUNTY ENGINEER	TRACED	P. Bangma.	10-77	FIELD BK No .... p........
DATE	CHECKED			
	DESIGNED	L. Wooding. ANZIA	9-77	
	DES. CHCK.			

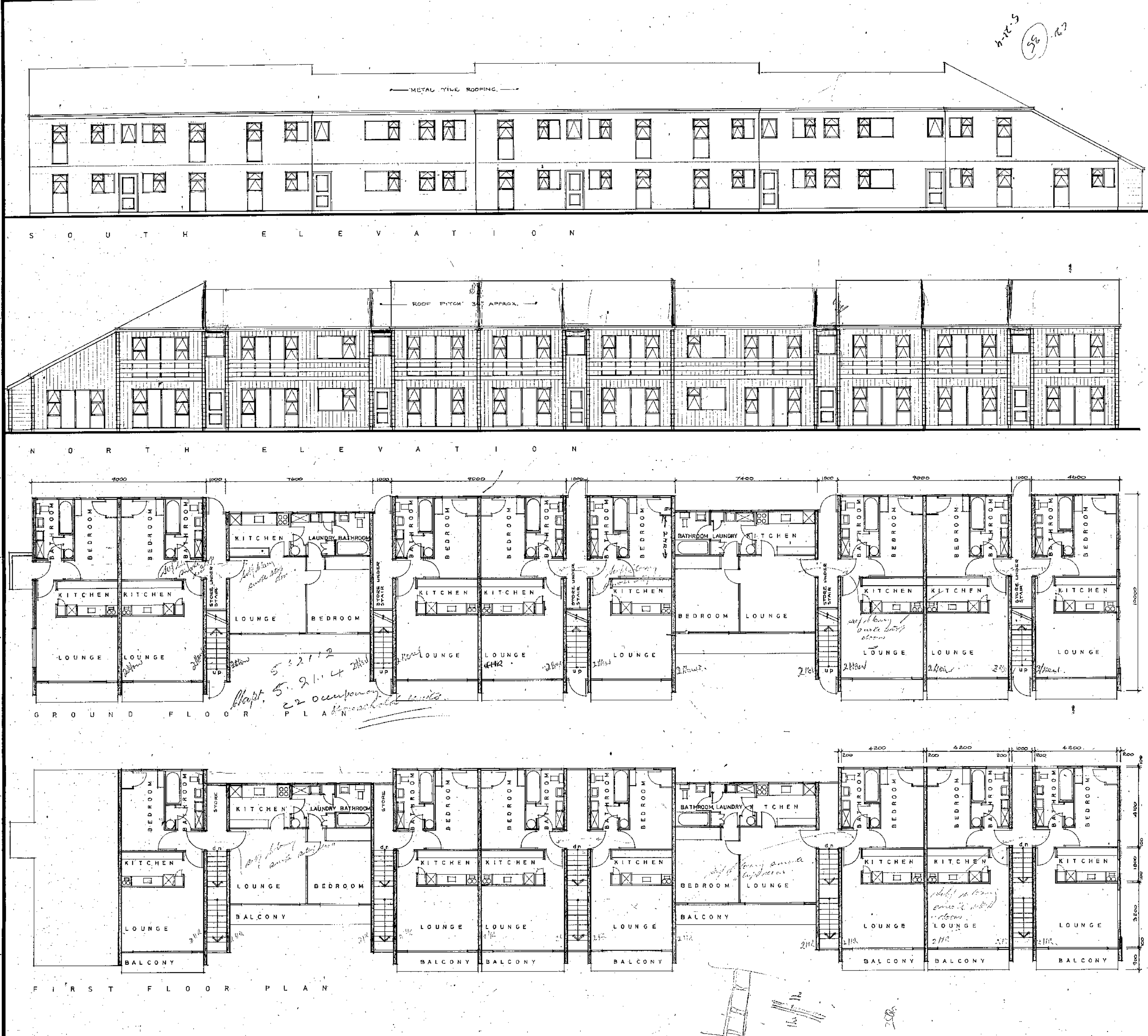
53 and 51 TORRENS ROAD — SKETCH PLAN
HOUSING FOR THE ELDERLY

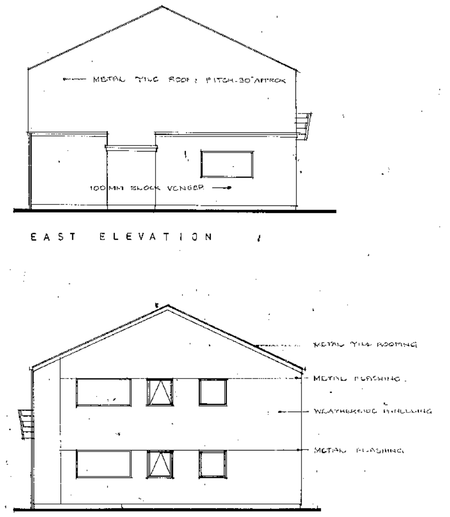
BLOCK A.

WAIMAIRI COUNTY COUNCIL

SCALE
ELEVATIONS 1:100
FLOOR PLANS 1:100

AMENDMENTS
SHEET SIZE A1
PLAN No.
2573
SHEET 2 OF 3 SHEETS





[illegible] with Mr L. Wooding 9/2/78.

1. Classification of Occupancy. Group C2. (5.21.4.)
2. 1 Hour F.R.R. wall where indicated on plans. [illegible] NZS 1900 Chap. 5.21. cl. (8) [illegible]
3. Floors separating units [illegible] in accordance with NZS 1900 Chap. 5.21.4 [illegible]
4. [illegible]
5. [illegible]
6. Where doors of flats [illegible] they shall require to be self-closing [illegible] doors, as indicated on plans. (5.21.6)

APPROVED		NAME	DATE
	SURVEYED		
	DRAWN	P. Bangma	10-77
COUNTY ENGINEER	TRACED	P. Bangma	10-77
DATE	CHECKED		
	DESIGNED	L. Wooding, ANZIA	9-77
	DES. CHCK.		

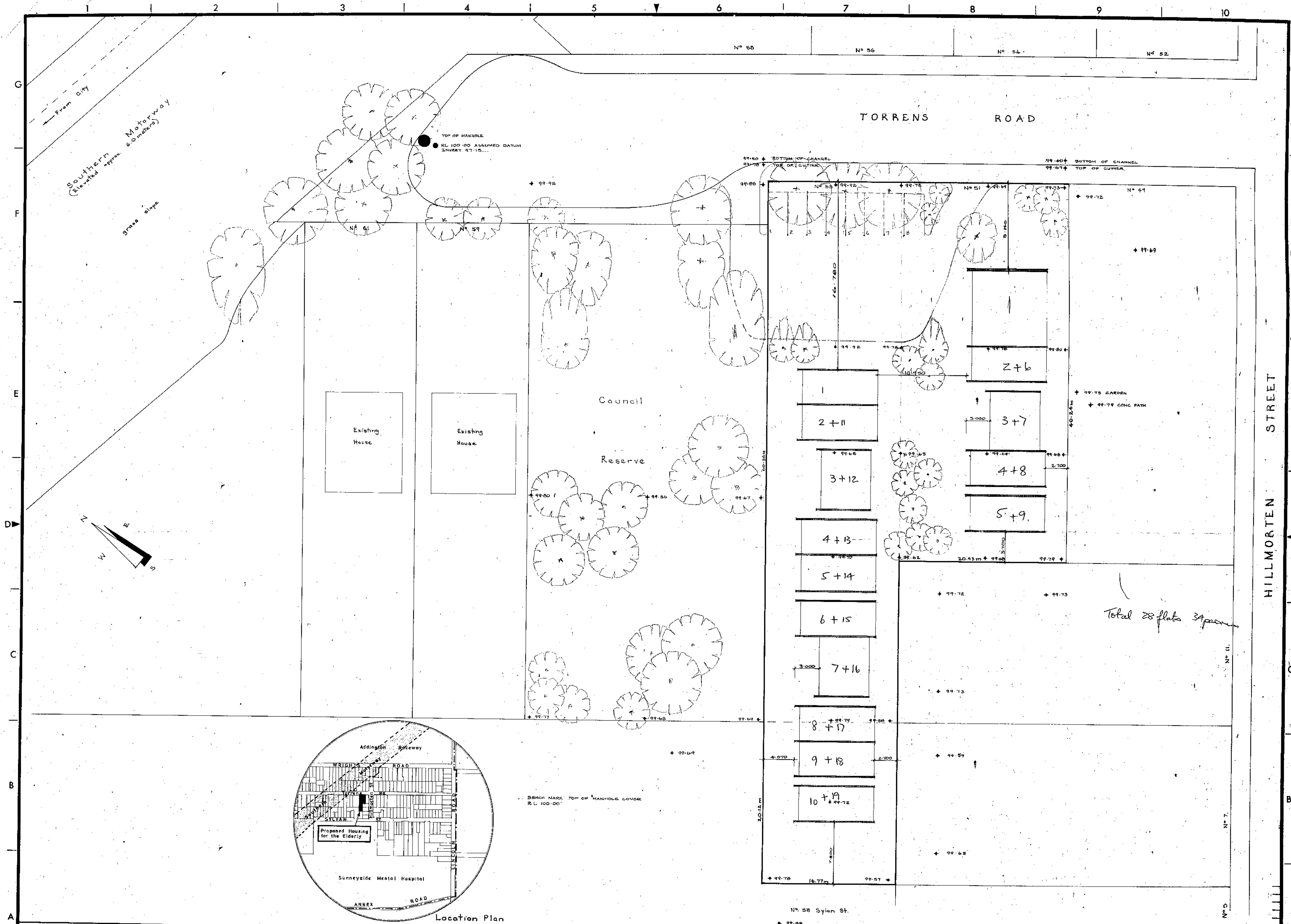
DATUM ....
BENCH MK. ....
LEVEL BK No .... P..........
FIELD BK No .... P..........

53 and 51 TORRENS ROAD — SKETCH PLAN
HOUSING FOR THE ELDERLY

WAIMAIRI COUNTY COUNCIL

SCALE
ELEVATIONS 1:100
FLOOR PLANS 1:100

AMENDMENTS
SHEET SIZE A1
PLAN No.
2573
SHEET 3 OF 3 SHEETS



APPROVED		NAME	DATE
	SURVEYED		
	DRAWN	P. W. P J B.	10-77
COUNTY ENGINEER	TRACED	P. W. P J B.	10-77
DATE	CHECKED		
	DESIGNED	L. Wooding ANZIA	9-77
	DES. CHCK.		

DATUM ....
BENCH MK. ....
LEVEL BK No .... P........
FIELD BK No .... P........

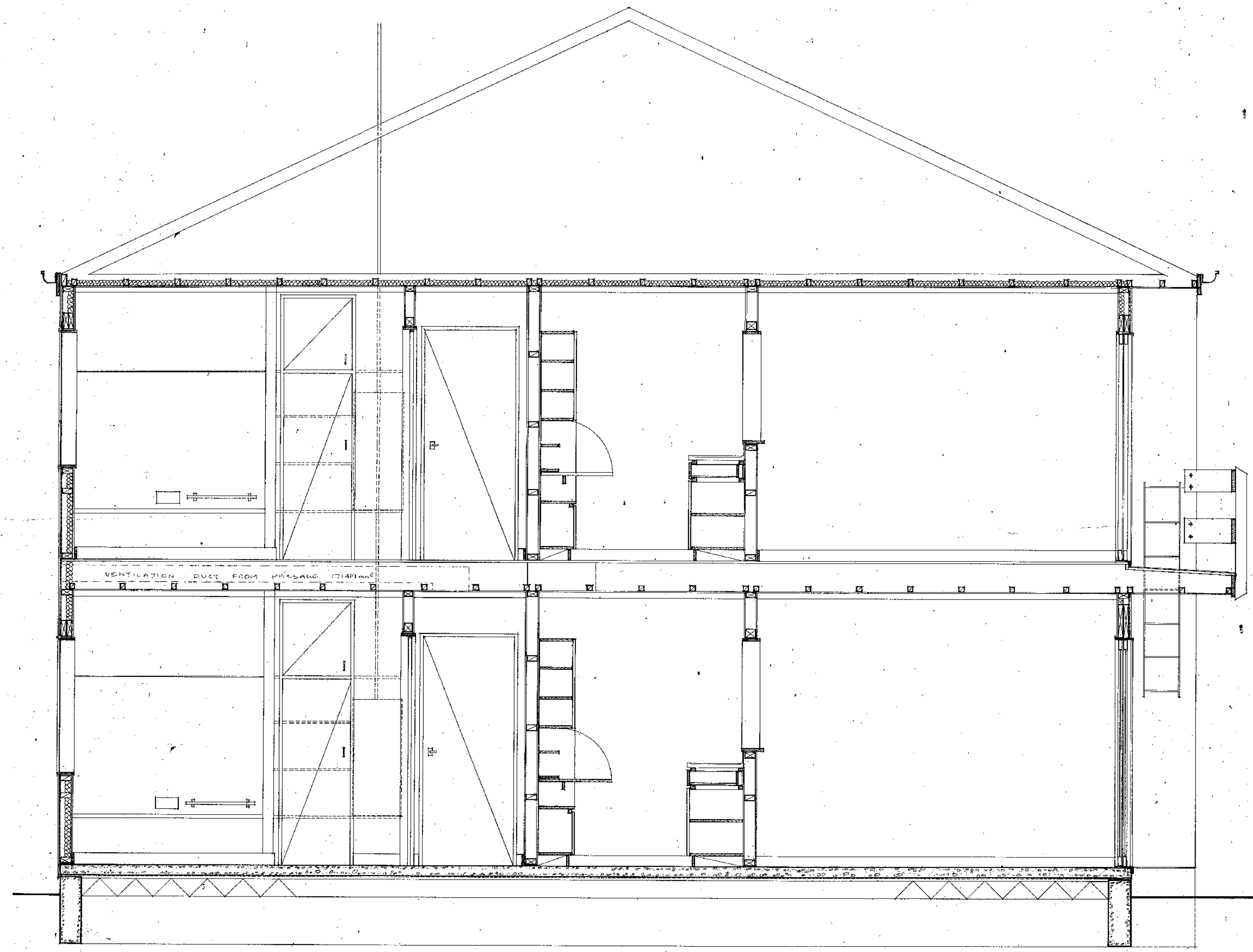
53 and 51 TORRENS ROAD — SKETCH PLAN

HOUSING FOR THE ELDERLY

WAIMAIRI COUNTY COUNCIL

SCALE: SITE PLAN 1:200

AMENDMENTS
SHEET SIZE A1
PLAN No. 2573
SHEET 1 OF 2 SHEETS



APPROVED		NAME	DATE	
	SURVEYED			DATUM ....
.... COUNTY ENGINEER	DRAWN	P Bangma.	10-77	BENCH MK. ....
DATE	TRACED	P Bangma.	10-77	LEVEL BK No .... P........
	CHECKED			FIELD BK No .... P........
	DESIGNED	L Wooding ANZIA	9-77	
	DES. CHCK.			

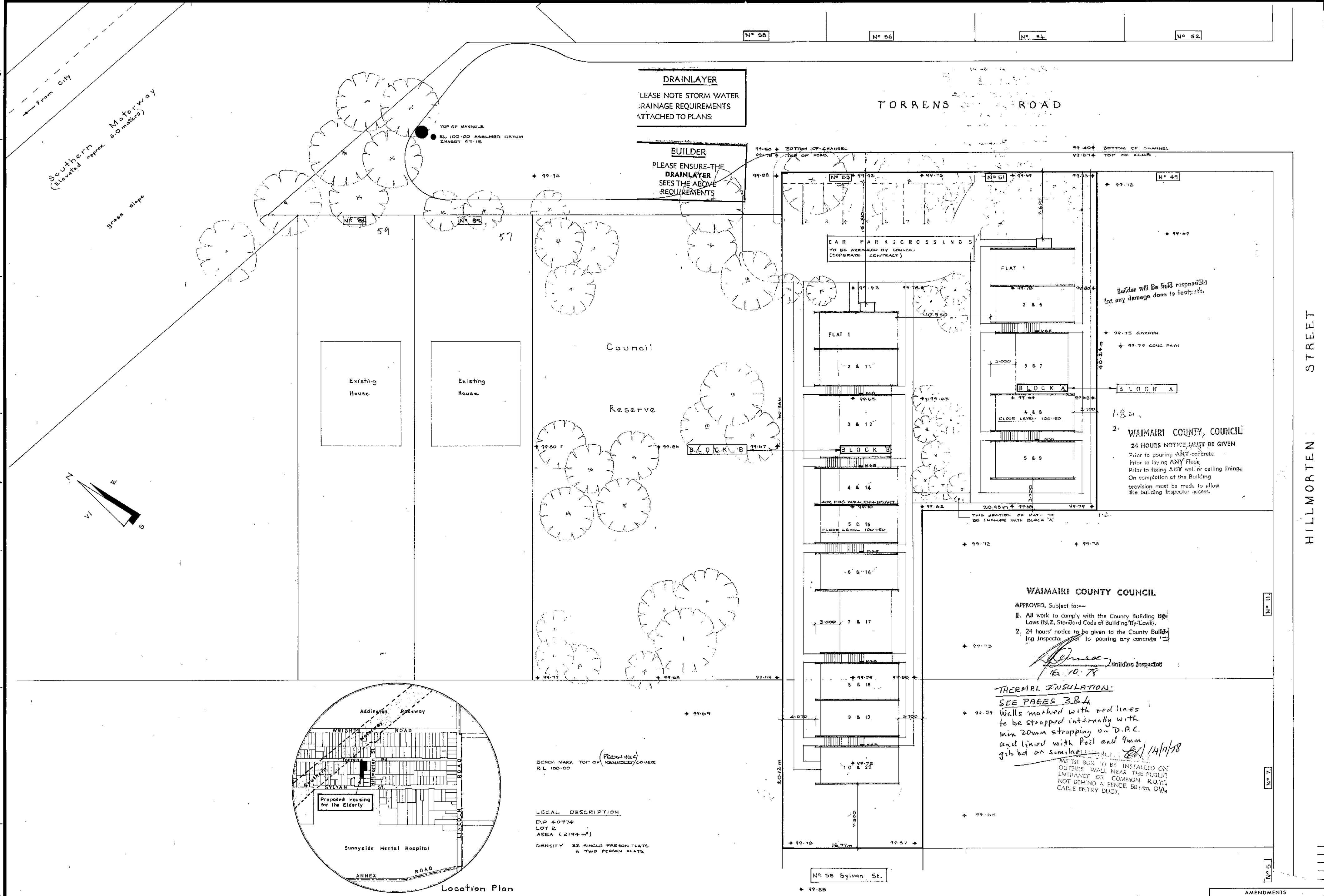
53 and 51 TORRENS ROAD —

HOUSING FOR THE ELDERLY

WAIMAIRI COUNTY COUNCIL

SCALE: CROSS-SECTION 1:20

AMENDMENTS
SHEET SIZE A1
PLAN No. 2573
SHEET 4 OF SHEETS



APPROVED		NAME	DATE
COUNTY ENGINEER	SURVEYED		
DATE 22-3-78	DRAWN	P. W. P. J. B.	10-77
	TRACED	P. W. P. J. B.	10-77
	CHECKED	P. Wills	9-78
	DESIGNED	L. Wooding, ANZIA	9-77
	DES. CHCK.		

DATUM ......
BENCH MK. ......
LEVEL BK No ...... P. ......
FIELD BK No ...... P. ......

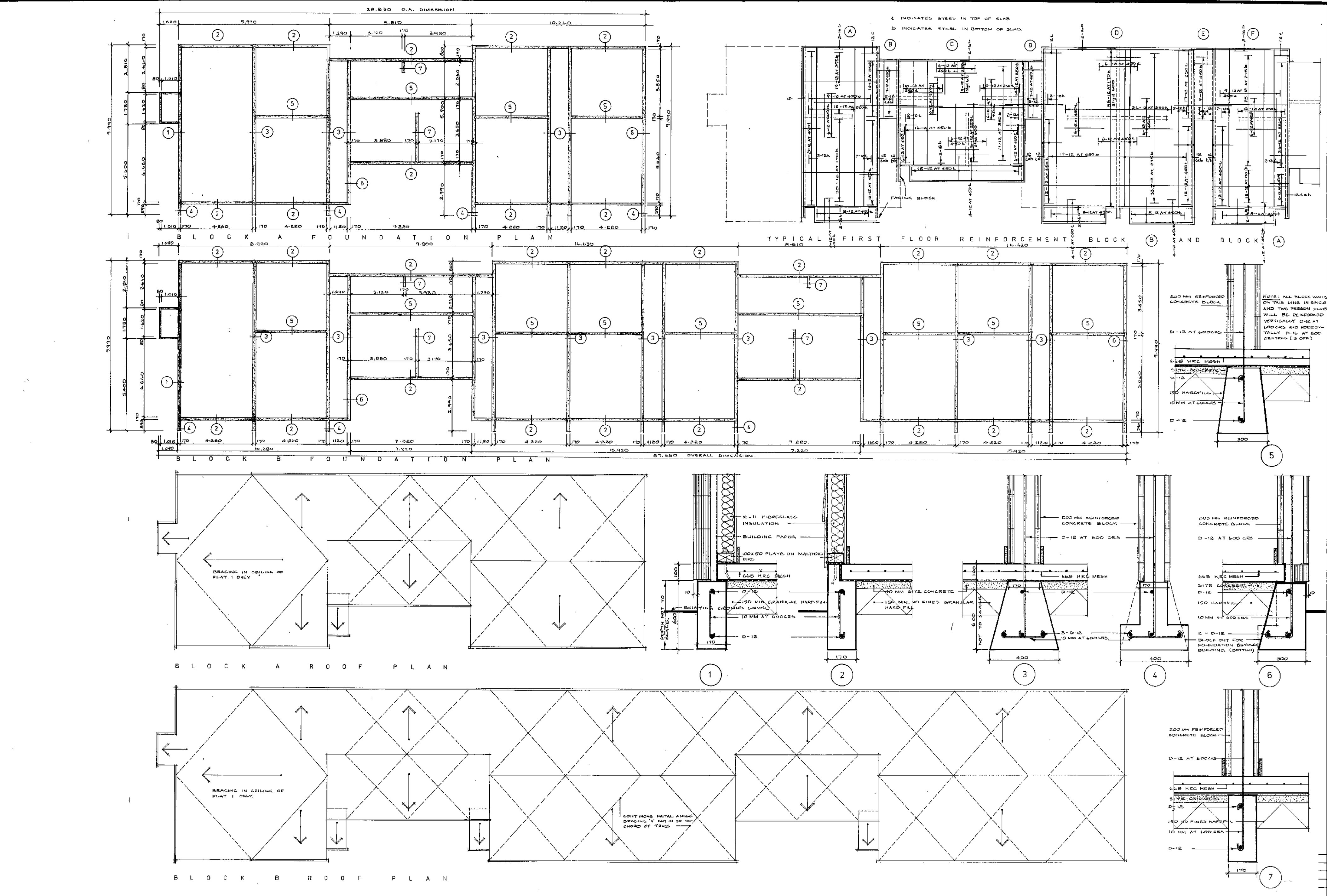
53 and 51 TORRENS ROAD — SITE PLAN

HOUSING FOR THE ELDERLY

WAIMAIRI COUNTY COUNCIL

SCALE: SITE PLAN 1:200

AMENDMENTS
SHEET SIZE A1
PLAN No. 2573
SHEET 1 OF 10 SHEETS



APPROVED		NAME	DATE	
COUNTY ENGINEER	SURVEYED			DATUM ....
DATE 21-3-78	DRAWN	P Bongma.	7-78	BENCH MK. ....
	TRACED	P Bongma.	8-78	LEVEL BK No .... P........
	CHECKED	P. Wills	9-78	FIELD BK No .... P........
	DESIGNED	L. Wooding.ANZIA		
	DES. CHCK.			

53 and 51 TORRENS ROAD — FOUNDATION AND ROOF PLANS
HOUSING FOR THE ELDERLY

WAIMAIRI COUNTY COUNCIL

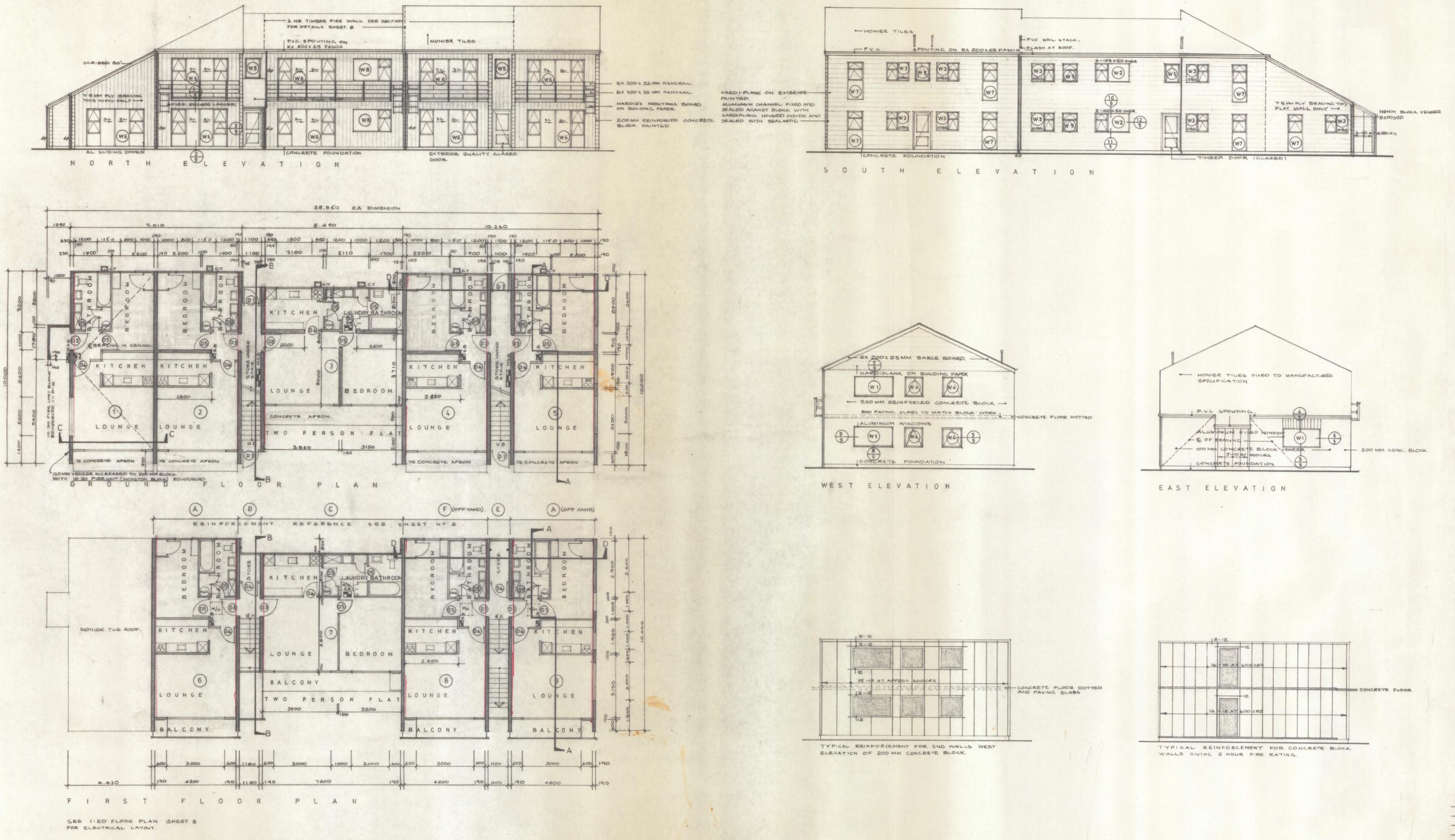
SCALE	
FOUNDATION PLAN	1:100
ROOF PLAN	1:100
FOUNDATION DETAILS	1:10

AMENDMENTS

SHEET SIZE A1

PLAN No. 2573

SHEET 2 OF 10 SHEETS



APPROVED		NAME	DATE
COUNTY ENGINEER	SURVEYED		
DATE 22-9-78	DRAWN	P Bangma.	7-78
	TRACED	P Bangma.	8-78
	CHECKED	P. Wills	9-78
	DESIGNED	L Wooding, ANZIA	5-77
	DES. CHCK.		

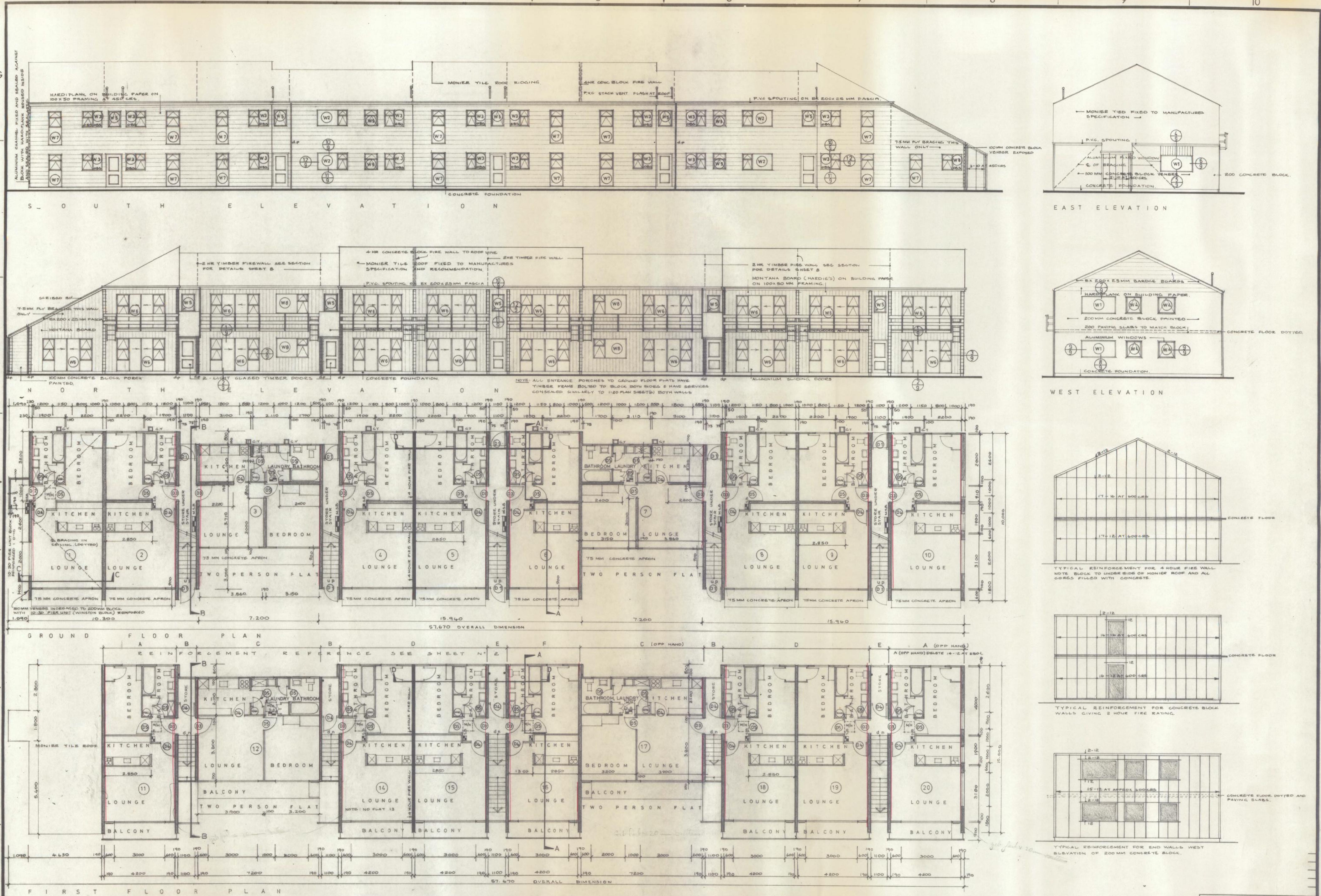
DATUM ....
BENCH MK. ....
LEVEL BK No .... P ....
FIELD BK No .... P ....

53 and 51 TORRENS ROAD — FLOOR PLAN & ELEVATIONS
HOUSING FOR THE ELDERLY
BLOCK A.

WAIMAIRI COUNTY COUNCIL

SCALE
ELEVATIONS 1:100
FLOOR PLANS 1:100

AMENDMENTS
SHEET SIZE A1
PLAN No.
2573
SHEET 3 OF 10 SHEETS



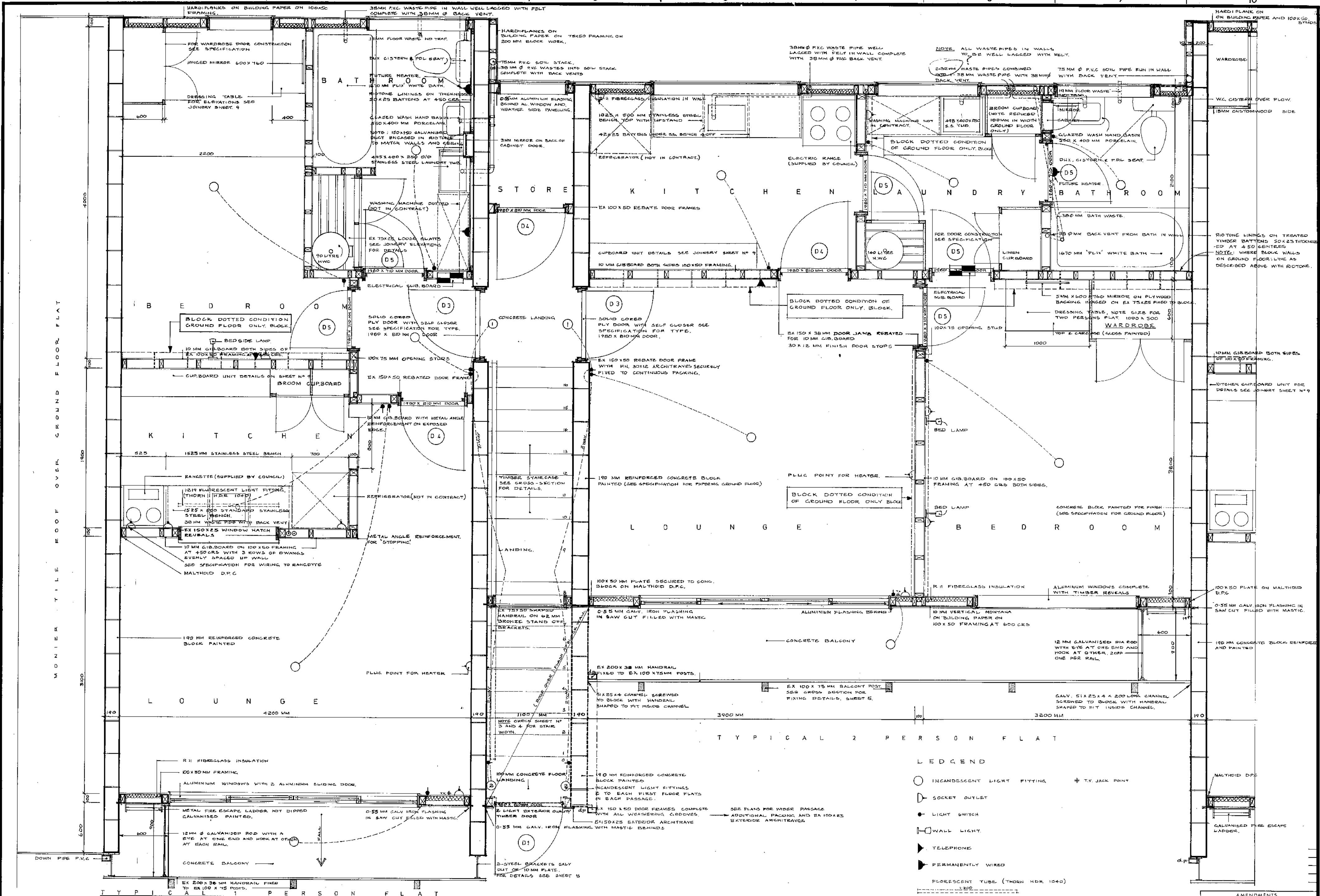
APPROVED		NAME	DATE	DATUM ....
COUNTY ENGINEER	SURVEYED			BENCH MK. ....
DATE 22-9-79	DRAWN	P Bangma	7-78	LEVEL BK No .... P........
	TRACED	P Bangma	8-78	FIELD BK No .... P........
	CHECKED	P. Wills	9-78	
	DESIGNED	L Wooding, ANZIA	9-77	
	DES. CHCK.			

53 and 51 TORRENS ROAD — FLOOR PLAN & ELEVATIONS
HOUSING FOR THE ELDERLY
BLOCK 'B'

WAIMAIRI COUNTY COUNCIL

SCALE
ELEVATIONS 1:100
FLOOR PLANS 1:100

AMENDMENTS
SHEET SIZE A1
PLAN No.
2573
SHEET 4 OF 10 SHEETS



APPROVED		NAME	DATE
COUNTY ENGINEER	SURVEYED		
DATE 22-9-78	DRAWN	P. Bongma	7 – 78
	TRACED	P. Bongma	8 – 78
	CHECKED	P. Wills	9 – 78
	DESIGNED	L. Wooding, ANZIA	
	DES. CHCK.		

DATUM ....
BENCH MK. ....
LEVEL BK No .... P. ....
FIELD BK No .... P. ....

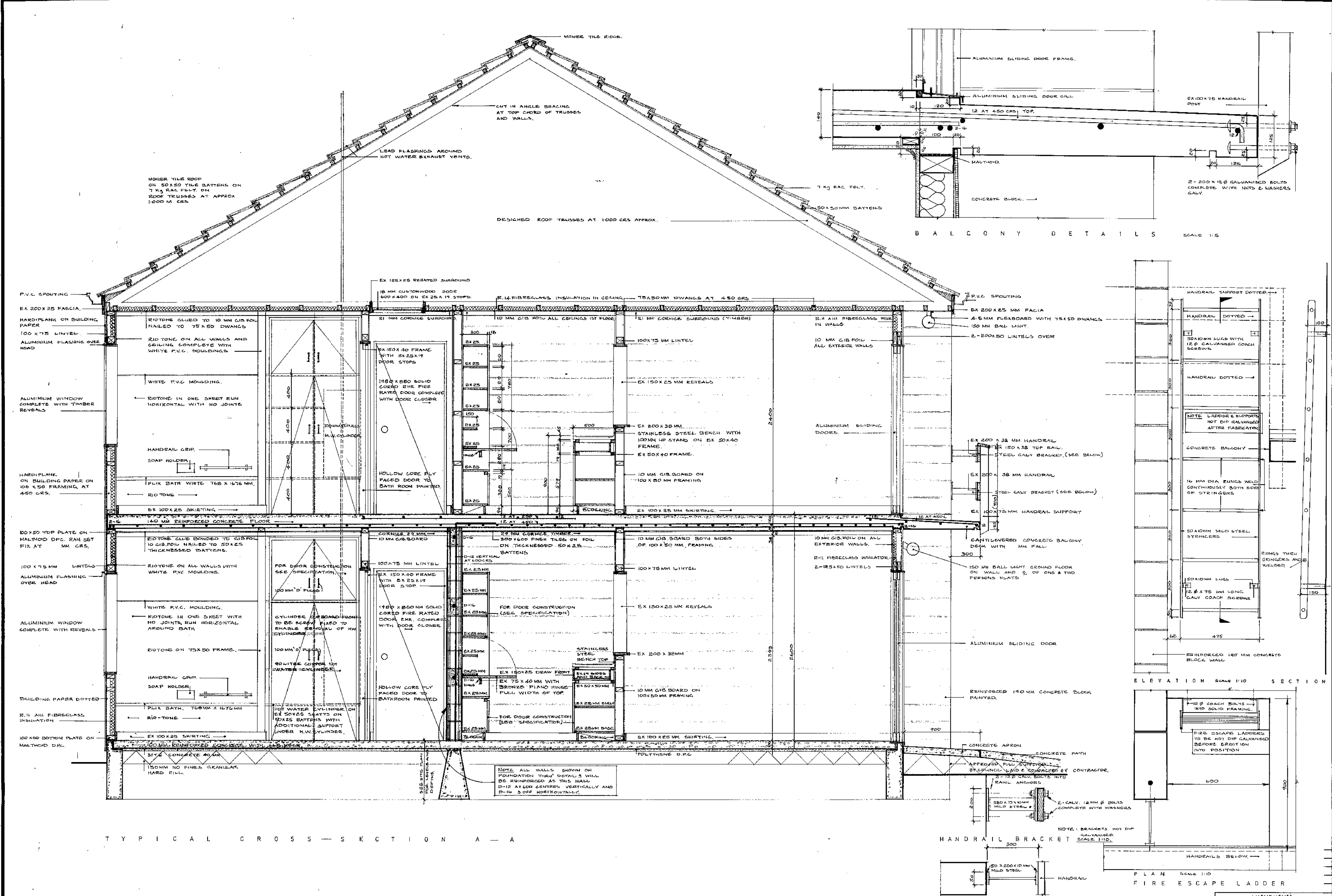
53 and 51 TORRENS ROAD — TYPICAL FLOOR PLANS (REFER SHEETS 3 & 4 FOR FULL LAYOUTS)

HOUSING FOR THE ELDERLY

WAIMAIRI COUNTY COUNCIL

SCALE: TYPICAL FLOOR PLANS 1:20

AMENDMENTS
SHEET SIZE A1
PLAN No. 2573
SHEET 5 OF 10 SHEETS



APPROVED		NAME	DATE
COUNTY ENGINEER	SURVEYED		
DATE 22-9-78	DRAWN	P. Bangma.	7-78
	TRACED	P. Bangma.	8-78
	CHECKED	P. Willis	9-78
	DESIGNED	L. Wooding. ANZIA	
	DES. CHCK.		

DATUM ....
BENCH MK. ....
LEVEL BK No .... P. ....
FIELD BK No .... P. ....

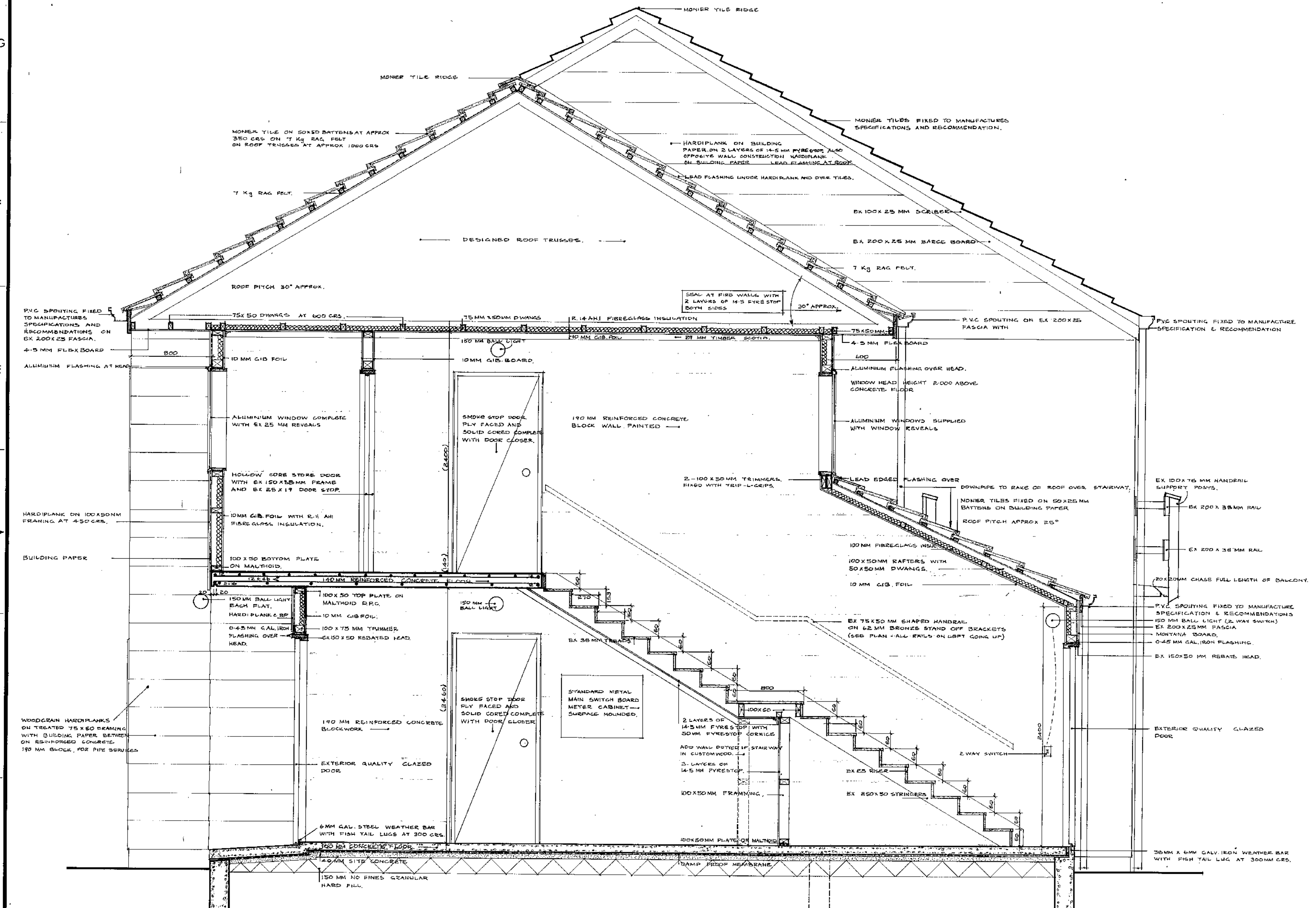
53 and 51 TORRENS ROAD — CROSS SECTION & DETAILS

HOUSING FOR THE ELDERLY

WAIMAIRI COUNTY COUNCIL

SCALE
CROSS-SECTION 1:20
BALCONY DETAILS
FIRE ESCAPE LADDER

AMENDMENTS
SHEET SIZE A1
PLAN No. 2573
SHEET 6 OF 10 SHEETS



T Y P I C A L   C R O S S – S E C T I O N   B – B

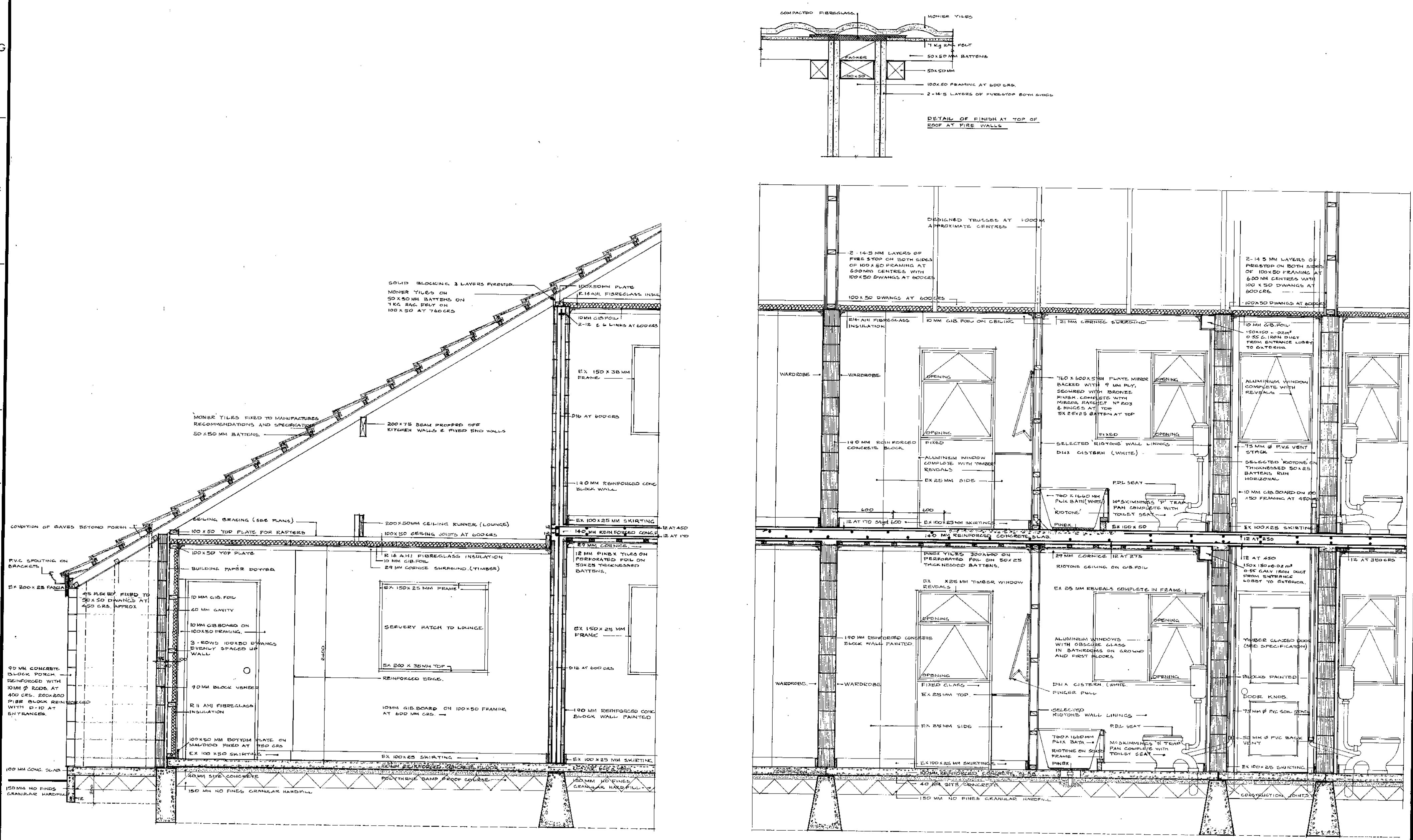
APPROVED		NAME	DATE	
[signature]	SURVEYED			DATUM ....
COUNTY ENGINEER	DRAWN	P Bongma.	7 – 78	BENCH MK. ....
DATE ...22-9-78..........	TRACED	P Bongma.	8 – 78	LEVEL BK No .... P..........
	CHECKED	P. Wills	9 – 78	FIELD BK No .... P..........
	DESIGNED	L. Woodinganzia		
	DES. CHCK.			

53 and 51 TORRENS ROAD — TYPICAL CROSS–SECTION
HOUSING FOR THE ELDERLY

WAIMAIRI COUNTY COUNCIL

SCALE: CROSS–SECTION 1:20

AMENDMENTS
SHEET SIZE A1
PLAN No. 2573
SHEET 7 OF 10 SHEETS



TYPICAL CROSS-SECTION C—C

TYPICAL CROSS-SECTION D—D

APPROVED		NAME	DATE
COUNTY ENGINEER	SURVEYED		
DATE 22-9-78	DRAWN	P Bangma.	7-78
	TRACED	P Bangma.	8-78
	CHECKED	P Wills	9-78
	DESIGNED	L Wooding ANZIA	
	DES. CHCK.		

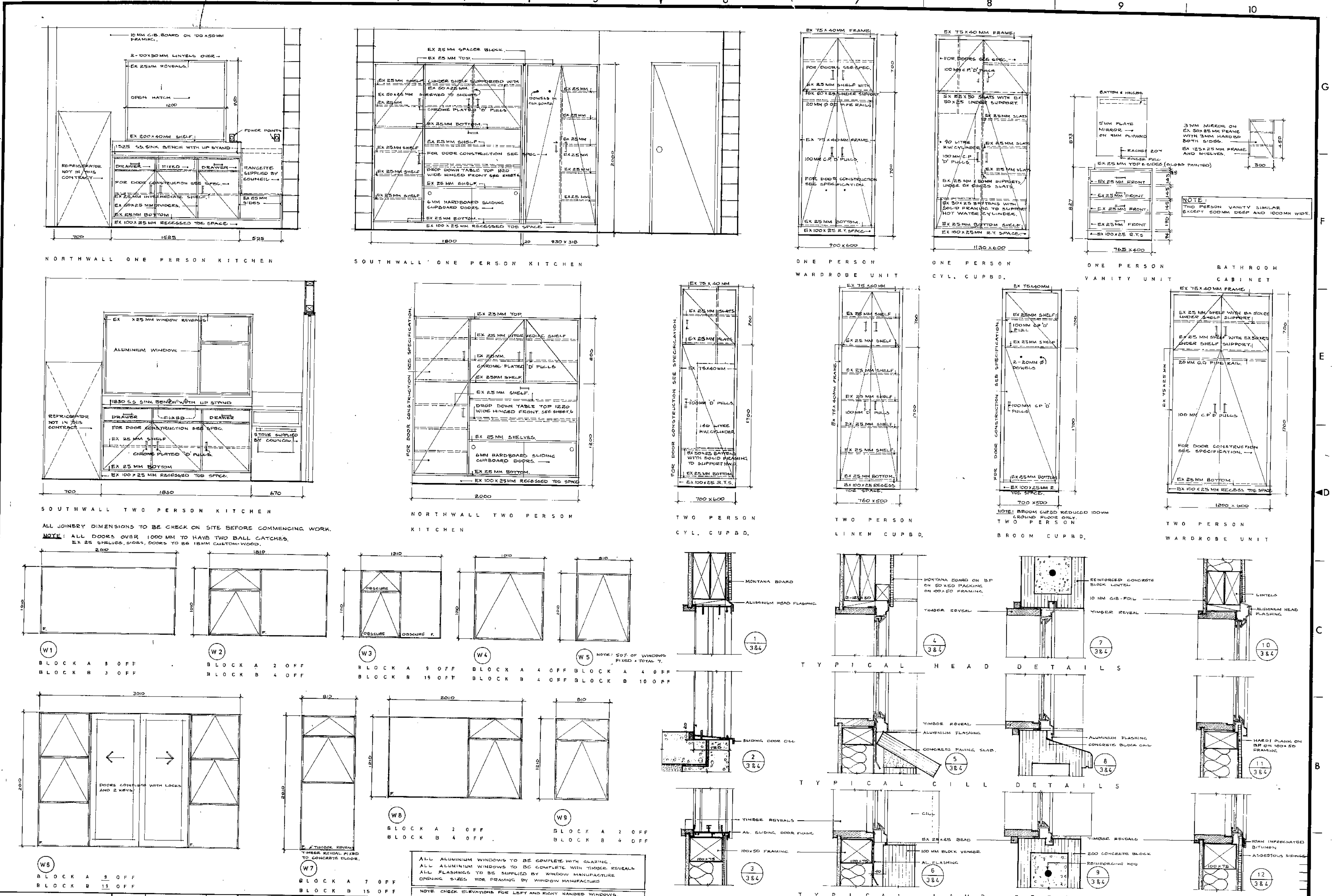
DATUM ....
BENCH MK. ....
LEVEL BK No .... P ....
FIELD BK No .... P ....

53 and 51 TORRENS ROAD — TYPICAL CROSS-SECTIONS
HOUSING FOR THE ELDERLY

WAIMAIRI COUNTY COUNCIL

SCALE: CROSS-SECTIONS 1:20

AMENDMENTS
SHEET SIZE A1
PLAN No. 2573
SHEET 8 OF 10 SHEETS



APPROVED		NAME	DATE
COUNTY ENGINEER	SURVEYED		
DATE 24-8-78	DRAWN	P. Bongma.	7-78
	TRACED	P. Bongma.	8-78
	CHECKED	P. Willis	9-78
	DESIGNED	L. Wooding ANZIA	
	DES. CHCK.		

DATUM ....
BENCH MK. ....
LEVEL BK No .... P ....
FIELD BK No .... P ....

53 and 51 TORRENS ROAD — JOINERY ELEVATIONS
HOUSING FOR THE ELDERLY

WAIMAIRI COUNTY COUNCIL

SCALE
JOINERY ELEVATION 1:20
WINDOW SCHEDULE AND DETAILS

AMENDMENTS
SHEET SIZE A1
PLAN No. 2573
SHEET 9 OF 10 SHEETS

Appendix C

CERA DEE Summary Data

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Block A	Reviewer:	David Whittaker
	Unit / No: / Street	CPEng No:	123089
Building Address:	53 Torrens Road, Hillmorton	Company:	Beca
Legal Description:	Torrens Road	Company project number:	5323355
		Company phone number:	643663521
	Degrees / Min / Sec		
GPS south:		Date of submission:	
GPS east:		Inspection Date:	11/12/2012
		Revision:	
Building Unique Identifier (CCC):	PRO 0480-001	Is there a full report with this summary?	yes

Site

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

Building

No. of storeys above ground:	2	single storey = 1	Ground floor elevation (Absolute) (m):	
Ground floor split?	no		Ground floor elevation above ground (m):	
Storeys below ground	0			
Foundation type:	raft slab		if Foundation type is other, describe:	
Building height (m):	7.20		height from ground to level of uppermost seismic mass (for IEP only) (m):	5.7
Floor footprint area (approx):	230			
Age of Building (years):	32		Date of design:	1976-1992
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	multi-unit residential		Brief strengthening description:	
Use (upper floors):	multi-unit residential			
Use notes (if required):				
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber truss	truss depth, purlin type and cladding	2.2m, timber battens with tiles.
Floors:	concrete flat slab	slab thickness (mm)	140
Beams:			
Columns:			
Walls:	fully filled concrete masonry	#N/A	

Lateral load resisting structure

Lateral system along:	lightweight timber framed walls	**Note: Define along and across in detailed report!**		
Ductility assumed, μ:	2.00		note typical wall length (m)	27.6
Period along:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	fully filled CMU			
Ductility assumed, μ:	1.25		note total length of wall at ground (m):	9.4
Period across:	0.40	##### enter height above at H31	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	

Separations:

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

Non-structural elements

Stairs:	other (specify)	describe	Timber.
Wall cladding:	other light	describe	Gib lining longitudinally.
Roof Cladding:	Heavy tiles	describe	Roof tiles.
Glazing:	aluminium frames		Aluminium frames with timber reveals.
Ceilings:	fibrous plaster, fixed		Gib upper floor and Pinex tiles lower floor.
Services(list):			

Available documentation

Architectural	full	original designer name/date	Waimairi County Council, 1978
Structural	full	original designer name/date	Waimairi County Council, 1978
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

Damage

Site: (refer DEE Table 4-2)

Site performance:	Good	Describe damage:	Minor cracking of linings and mortar.
Settlement:	none observed	notes (if applicable):	
Differential settlement:	none observed	notes (if applicable):	
Liquefaction:	none apparent	notes (if applicable):	
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	slight	notes (if applicable):	Movement of structure evident.

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	Minimal structural damage.
	Describe (summary):	Minimal structural damage.		
Across	Damage ratio:	0%		
	Describe (summary):	Minimal structural damage.		
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	no	Describe:	

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

Recommendations

	Level of repair/strengthening required:		Describe:	
	Building Consent required:		Describe:	
	Interim occupancy recommendations:		Describe:	
Along	Assessed %NBS before e'quakes:	34%	0% %NBS from IEP below	If IEP not used, please detail assessment methodology: Quantitative Calculations - force based
	Assessed %NBS after e'quakes:	34%		
Across	Assessed %NBS before e'quakes:	42%	0% %NBS from IEP below	
	Assessed %NBS after e'quakes:	42%		

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): 1976-1992

h_n from above: 5.7m

Seismic Zone, if designed between 1965 and 1992: B

not required for this age of building

not required for this age of building

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

Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0	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: 0.30

Z_{1992}, from NZS4203:1992: 0.8

Hazard scaling factor, **Factor B:** 3.333333333

2.4 Return Period Scaling Factor

Building Importance level (from above): 2

Return Period Scaling factor from Table 3.1, **Factor C**: 1.00

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	1.25	1.25
Ductility scaling factor: =1 from 1976 onwards; or =kμ, if pre-1976, fromTable 3.3:	1.00	1.00
Ductiity Scaling Factor, **Factor D**:	1.00	1.00

2.6 Structural Performance Scaling Factor:

	along	across
Sp:	0.925	0.925
Structural Performance Scaling Factor **Factor E**:	1.081081081	1.081081081

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

	along	across
$\%NBS_b$:	**0%**	**0%**

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

3.1. Plan Irregularity, factor A: insignificant 1

3.2. Vertical irregularity, Factor B: insignificant 1

3.3. Short columns, Factor C: insignificant 1

3.4. Pounding potential

Pounding effect D1, from Table to right 1.0

Height Difference effect D2, from Table to right 1.0

Therefore, Factor D: 1

3.5. Site Characteristics 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	1.0	1.0
Rationale for choice of F factor, if not 1		

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

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

	Along	Across
3.7. Overall Performance Achievement ratio (PAR)	**1.00**	**1.00**
4.3 PAR x (%NBS)b: PAR x Baselline %NBS:	**0%**	**0%**

4.4 Percentage New Building Standard (%NBS), (before) **0%**

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Block B	Reviewer:	David Whittaker
	Unit / No: / Street	CPEng No:	123089
Building Address:	53 Torrens Road, Hillmorton	Company:	Beca
Legal Description:	Torrens Road	Company project number:	5323355
		Company phone number:	643663521
	Degrees / Min / Sec		
GPS south:		Date of submission:	
GPS east:		Inspection Date:	11/12/2012
		Revision:	
Building Unique Identifier (CCC):	PRO 0480-002	Is there a full report with this summary?	yes

Site

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

Building

No. of storeys above ground:	2	single storey = 1	Ground floor elevation (Absolute) (m):	
Ground floor split?	no		Ground floor elevation above ground (m):	
Storeys below ground	0			
Foundation type:	raft slab		if Foundation type is other, describe:	
Building height (m):	7.20		height from ground to level of uppermost seismic mass (for IEP only) (m):	5.7
Floor footprint area (approx):	470			
Age of Building (years):	32		Date of design:	1976-1992
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	multi-unit residential		Brief strengthening description:	
Use (upper floors):	multi-unit residential			
Use notes (if required):				
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber truss	truss depth, purlin type and cladding	2.2m, timber battens with tiles.
Floors:	concrete flat slab	slab thickness (mm)	140
Beams:			
Columns:			
Walls:	fully filled concrete masonry	#N/A	

Lateral load resisting structure

Lateral system along:	lightweight timber framed walls	**Note: Define along and across in**		
Ductility assumed, μ:	2.00	**detailed report!**	note typical wall length (m)	56.2
Period along:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	fully filled CMU			
Ductility assumed, μ:	1.25		note total length of wall at ground (m):	9.4
Period across:	0.40	##### enter height above at H31	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	

Separations:

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

Non-structural elements

Stairs:	other (specify)	describe	Timber.
Wall cladding:	other light	describe	Gib lining longitudinally.
Roof Cladding:	Heavy tiles	describe	
Glazing:	aluminium frames		Aluminium frames with timber reveals.
Ceilings:	fibrous plaster, fixed		Gib upper floor and Pinex tiles lower floor.
Services(list):			

Available documentation

Architectural	full	original designer name/date	Waimairi County Council, 1978
Structural	full	original designer name/date	Waimairi County Council, 1978
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

Damage

Site: (refer DEE Table 4-2)

Site performance:	Good	Describe damage:	Minor cracking of linings and mortar.
Settlement:	none observed	notes (if applicable):	
Differential settlement:	none observed	notes (if applicable):	
Liquefaction:	none apparent	notes (if applicable):	
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	slight	notes (if applicable):	Movement of structure evident.

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	Minimal structural damage.
	Describe (summary):	Minimal structural damage.		
Across	Damage ratio:	0%		
	Describe (summary):	Minimal structural damage.		
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	no	Describe:	

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

Recommendations

	Level of repair/strengthening required:			Describe:	
	Building Consent required:			Describe:	
	Interim occupancy recommendations:			Describe:	
Along	Assessed %NBS before e'quakes:	38%	0% %NBS from IEP below	If IEP not used, please detail assessment methodology:	from detailed calcultions - force based
	Assessed %NBS after e'quakes:	38%			
Across	Assessed %NBS before e'quakes:	52%	0% %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): 1976-1992

h_n from above: 5.7m

Seismic Zone, if designed between 1965 and 1992: B

not required for this age of building

not required for this age of building

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

Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0	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:	0.30
Z_{1992}, from NZS4203:1992	0.8
Hazard scaling factor, **Factor B:**	3.333333333

2.4 Return Period Scaling Factor

Building Importance level (from above):	2
Return Period Scaling factor from Table 3.1, **Factor C**:	1.00

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	1.25	1.25
Ductility scaling factor: =1 from 1976 onwards; or =kμ, if pre-1976, fromTable 3.3:	1.00	1.00
Ductiity Scaling Factor, **Factor D**:	1.00	1.00

2.6 Structural Performance Scaling Factor:

Sp:	0.925	0.925
Structural Performance Scaling Factor **Factor E**:	1.081081081	1.081081081

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

%NBS$_b$:	**0%**	**0%**

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

3.1. Plan Irregularity, factor A:	insignificant	1
3.2. Vertical irregularity, Factor B:	insignificant	1
3.3. Short columns, Factor C:	insignificant	1

3.4. Pounding potential

Pounding effect D1, from Table to right 1.0

Height Difference effect D2, from Table to right 1.0

Therefore, Factor D: 1

Table for selection of D1	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
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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
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Height difference < 2 storeys	1	1	1

3.5. Site Characteristics 1

3.6. Other factors, Factor F

	Along	Across
For ≤ 3 storeys, max value =2.5, otherwise max valule =1.5, no minimum	1.0	1.0
Rationale for choice of F factor, if not 1		

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

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

3.7. Overall Performance Achievement ratio (PAR)	**1.00**	**1.00**
4.3 PAR x (%NBS)b: PAR x Baselline %NBS:	**0%**	**0%**

4.4 Percentage New Building Standard (%NBS), (before) **0%**

Appendix D

Previous Reports and Assessments

Christchurch Eq. RAPID Assessment Form - LEVEL 1

Inspector Initials: Ray C
Territorial Authority: Christchurch City
Date of Inspection: 4-3
Time:
Exterior Only
Exterior and Interior

Building Name
Short Name:
Address: 83 Torrens ~~[illegible]~~ St Hillmorton
GPS Co-ordinates:
Contact Name:
Contact Phone:
Storeys at and above ground level: 2
Below ground level:
Total gross floor area (m²):
Year built:
No of residential Units: 1
Photo Taken: Yes No

Type of Construction
- [x] Timber frame
- [ ] Steel frame
- [ ] Tilt-up concrete
- [ ] Concrete frame
- [ ] RC frame with masonry infill
- [ ] Concrete shear wall
- [ ] Unreinforced masonry
- [x] Reinforced masonry
- [ ] Confined masonry
- [ ] Other:

Primary Occupancy
- [x] Dwellings
- [ ] Other residential
- [ ] Public assembly
- [ ] School
- [ ] Religious
- [ ] Commercial/ Offices
- [ ] Industrial
- [ ] Government
- [ ] Heritage Listed
- [ ] Other

Investigate the building for the conditions listed below:

Overall Hazards / Damage	Minor/None	Moderate	Severe
Collapse, partial collapse, off foundation	☐	☐	☐
Building or storey leaning	☐	☐	☐
Wall or other structural damage	☐	☐	☐
Overhead falling hazard	☐	☐	☐
Ground movement, settlement, slips	☐	☐	☐
Neighbouring building hazard	☐	☐	☐
Other	☐	☐	☐

Comments
Dwellings are habitable units 1 - 8? This is Chch State & the tenant has advised that these have been assessed already no indication of damage

Choose a posting based on the evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance.

INSPECTED GREEN [x] RESTRICTED USE YELLOW [ ] UNSAFE RED [ ]

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended
- [ ] Barricades are needed (state location):
- [ ] Level 2 or detailed engineering evaluation recommended
  - [ ] Structural
  - [ ] Geotechnical
  - [ ] Other:
- [ ] Other recommendations:

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☐	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: Ray Currie
Date & Time
ID

Inspection ID ______ *(Office Use Only)* 75076505