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Detailed Engineering Evaluation

Quantitative Report

Monavale Gatehouse

Fendalton Road, Christchurch

Prepared For:

Christchurch City Council

Ref: 1606
31 July 2013

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MONAVALE GATEHOUSE

FENDALTON ROAD, CHRISTCHURCH

DETAILED ENGINEERING EVALUATION

31 JULY 2013

FOR:

CHRISTCHURCH CITY COUNCIL

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DETAILED ENGINEERING EVALUATION

31 JULY 2013

FOR:

MONAVALE GATEHOUSE

AT:

FENDALTON ROAD, CHRISTCHURCH

Preamble

This report covers our assessment of the structural condition of the Monavale Gatehouse building at Fendalton Road, Christchurch, following the magnitude 6.3 earthquake on 4 September 2010, 22nd February 2011 and 13th June 2011. Our assessment is based on a visual inspection of the outside and inside where it was deemed to be safe to enter. This was carried out on the June 2011 and July 2011 with other visits since to confirm findings.

This report describes the damage observed, and comments on remedial work options for both temporary securing of the building, and long term repair where appropriate. This report also covers a detailed structural strength assessment and provides some investigation and assumptions that will allow an assessment to be made as to whether to reconstruct or demolish. It does not cover any detailed design or specification of remedial works or temporary securing.

A Detailed Engineering Evaluation procedure (DEE) has recently been developed by CERA to provide consistent, comprehensive and auditable guidelines which help restore confidence in the remaining building stock in Canterbury. We have used these guidelines to form the basis for our detailed engineering evaluation.

The DEE process follows a two step process, firstly a qualitative assessment then a quantitative assessment, if necessary.

The qualitative assessment involves visual review of the structure and its conditions in order to ascertain whether the structure does or does not fall within required capacity limitations without completing any complex analysis.

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The quantitative assessment involves analytically calculating the capacity of the structure in terms of the current code requirements i.e. to estimate the percentage of new building strength available (%NBS).

The overall objective of this assessment is to determine if a strengthening solution is required or not. This report covers a qualitative assessment.

More specifically, this report covers:

- Describes the existing building, its construction, and structural system
- Outlines the level of investigation undertaken and where information was obtained
- Summarises earthquake damage caused by the recent Canterbury earthquakes
- Reviews the building's performance in the recent Canterbury earthquakes
- Identifies critical structural weaknesses
- Assesses the building's seismic strength relative to New Building Standard (NBS), commonly referred to as "current code"
- Proposes repair works to reinstate the building as close as practically possible to pre earthquake levels.

2.0 Scope of Investigation

In June 2011 and again in July 2011, and subsequent visits to continually assess damage or movement and verify findings.

We visually inspected the building including:

- The exterior from ground level
- The interior

Existing building plans were not available to be reviewed and therefore were unable been utilized as part of this report.

Preliminary and detailed Geotechnical investigations and reports completed by Land Development and Exploration Ltd have been obtained.

We have reviewed these and included their recommendations into our reinstatement designs.

This report is based on our assessment of the building at the time it was inspected. Photos attached in Appendix A are indicative of the damage and findings. Any subsequent loading by aftershocks, or high winds, may initiate further damage.

3.0 Building Description

General description:
The Monavale Gatehouse is a two-storey unreinforced brick homestead built in 1905. In 1948, a single storey timber add-on was constructed in the North-West corner. There is a single storey brick and timber shed immediately adjacent to the West of the main house.

The Gatehouse is listed as a Category 2 Heritage building in the Christchurch City Plan and Historic Plans Trust. The building was being used as a residential dwelling, but is currently unoccupied due to earthquake damage.

Roof construction:
Clay tiles on timber purlins and rafters with lath and plaster ceiling to undersides.

External Wall construction:
Cavity brick construction with plastered finish to exterior.

Internal Wall construction:
Brick wall construction to part and timber framed walls line with lath and plaster with some hardboard linings.

First Floor construction:
Timber tongue and grooved flooring on timber joists with lath and plaster ceilings under.

Ground Floor construction:
Timber tongue and grooved flooring on timber joists and bearers.

Foundations:
Concrete ring foundation to external walls with concrete piles internally.

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Structural System

Gravity Structural System:
The gravity structural system can be described as simple beams supported on walls. Clay tiles sit on battens and rafters transferring their load to brick walls with tongue & grooved flooring laid over timber joists sitting on brickwork.

Lateral Structural System:
The lateral structural system consists of nominal timber diaphragms to roof and first floor transferring loads from face loaded brick walls to in-plane brick walls acting in shear to concrete ring foundations.

5.0 Existing Structural Strengthening

No additional strengthening has been carried out on this structure.

6.0 Strength

The strength of the building has been determined as a % NBS using methodologies provided by NZSEE. A "Preliminary Detailed Assessment", which includes calculations, has been completed as opposed to an IEP ("Initial Evaluation Procedure") as this is deemed more accurate. We have compared the design code level at that time to that of today as an estimate at this time. Our assessments are as follows:

Assessment Parameters:

Before September 2010:
The strength of the building before September 2010 is estimated as

Hazard factor 0.3 (post 19th May 2011) **21% NBS**

On day of inspection:
The strength of the building on the day of inspection is estimated as

Hazard factor 0.3	Across	**10% NBS**	(estimated only)
	Along	**15% NBS**	(estimated only)
Single %NBS in current state		**10% NBS**	(estimated only)

It must be understood that this strength is based on the overall building strength and not individual elements.

Strength of Building after reconstruction is completed:

Hazard factor 0.3 > **67% NBS**

7.0 Areas of Structural Vulnerability

The areas of Structural Vulnerability include:

- Brick Chimneys.
- Narrow width brick walls at north wall bay window
- Lack of connection between floor/roof and walls.

8.0 Damage Description

Damage caused by the earthquakes to the Monavale Gatehouse is described below. Refer to Appendix B for marked-up drawings indicating damaged locations.

i. *Damage to front porch:*

- The upper half of the front brick porch has moved outwards and shifted anti-clockwise.

- A horizontal crack with up to a 70mm offset through one of the porch columns, and cracking (up to 10mm wide) to the porch arches.

ii. *Damage to exterior brick walls:*

- Cracks to Eastern brick walls. From the interior, the East wall has a lean outwards slightly.

- Significant cracks to Northern brick wall adjacent bay window. There is up to a 10mm offset across the crack to the upper-right of the window. From the interior, the North-West corner has moved West and outwards. This wall continues to move and deteriorate.

- Cracking to South and West walls. Cracks are visible both externally and internally.

iii. ***Collapse of brick chimneys:***

- Both brick chimneys have collapsed off the building.
- The rear chimney has collapsed through the roof of the dining room addition. This room has been deconstructed.
- The gable dormer at the West rear chimney has collapsed with the chimney.

Interior damage:

- General cracking of plaster linings to ground floor walls.
- Significant cracking of plaster linings to ground floor walls adjacent chimneys
- Significant cracking of first floor lath and plaster walls and ceilings. Lath and plaster ceilings have spalled in some locations.

Other damage:

- Lateral spreading of ground to the East towards the Avon River. Loss of several roof tiles.
- Settlement to local areas particularly the single storey dining area.

Foundations:

- Minor cracking to exterior strip foundation supporting brickwork.
- Settlement and major cracking to dining room addition foundations.

Floor:

- Settlement of the building has caused unevenness in the ground floor.

Building Settlement:

- The level survey suggests that the building has settled evenly over its width by up to 150mm across the total length.

9.0 Recommended Additional Investigations

We recommend that the following further investigations be carried out. These can be in conjunction with the reconstruction works:

Vertical level survey of North-West and North walls.

10.0 Immediate Securing of the Building

The following works were required by Structex to mitigate immediate hazards, temporarily secure the building, and provide weather tightness: these have been completed.

- Remove loose chimney bricks to remove any fall hazard. Plywood line chimney roof openings and flash to provide weather-tightness.
- Repair tile roof locally where required to provide weather-tightness. Rrefix loose tiles to remove any fall hazard.
- Photograph and document timber dining extension, then take down to floor level and clear debris. Plywood line exposed internal walls and flash to provide weather-tightness where appropriate.
- Prop front porch by constructing a braced frame inside the porch from steel angles. Fix to porch concrete slab and arches.
- Clamp return walls adjacent North brick wall by bolting through with RB16 Reidbar, just above first floor level, to timber framing and plywood each side.
- Maintain existing cordons around the building.

Due care, safety equipment and precautions must be taken when carrying out the above work. Maintain awareness of fall hazards and escape routes if entering the building. The Gatehouse is a Heritage building therefore, retain Heritage features where possible.

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11.0 Long Term Repair

This section outlines options for repair to restore the building to its pre-earthquake condition. Options for repair and/or strengthening will need to be discussed with the owner, and will be subject to revised local authority legislation.

1. ***Foundations and Floors:***

    - Survey foundation levels around the perimeter of the building to determine the extent of differential settlement, if any. If differential settlement has occurred, the following options can be considered:

a) if the floor slope from differential settlement is less than *1 in 400*, no re-levelling action is necessary. Cracks to the foundation wall can be repaired as per the next bullet point.

b) if the floor slope exceeds *1 in 400*, re-levelling is recommended. This can be done by either: jacking up the house, grouting underneath and re-piling; or reconstructing the foundation wall as appropriate. Alternatively foundations can be jacked using a structural resin injected into the soil (e.g. Uretek).

Re-levelling requires thorough consideration. While re-levelling may close some cracks, it may cause or open others. Any additional damage will require repair as outlined below:

Seal all cracks in concrete foundation wall larger than 0.2mm with a pressure injected epoxy (e.g. Sikadur injectokit and Sikadur52, or similar). Seal smaller cracks by painting over with a brushable crack filler (e.g. Resene Brushable Crack Filler).

2. ***Front Porch:***

Either:

a) Blow-out debris between cracks, and attempt to push porch arches back into place. Failing this, take down porch to cracked level and reconstruct. Note this will not restore the porch to above 67%NBS

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b) Deconstruct and reconstruct from reinforced concrete plastered to suit.

3. *Exterior Brick Walls:*

a) Northern wall and returns: deconstruct and reconstruct from reinforced concrete with exterior plastered surface and new foundation.

b) For other walls below first floor level install new reinforced concrete piers at regular intervals with reinforced capping beam at first floor level and tie into existing brickwork.

c) Above first floor level deconstruct and reconstruct from lightweight timber framed construction.

4. *Chimneys:*

Reconstruct fallen chimneys using lightweight replicas in the form of plaster over plywood on timber framing with modern steel flues.
Reconstruct/repair damage gable dormer to match that which existed prior to the earthquake.

5. *Dining Extension:*

Reconstruct timber dining extension to match that which existed prior to the earthquake.
Deconstruct and reconstruct new reinforced concrete ring foundation.
Level remainder of floor.
Break out and reinstate sunken concrete porch steps.

6. *General:*

Seal cracks to low height balustrades using a pressure injected epoxy, and re-plaster over to match with existing surface profile.

Repair all cracked arch lintels by stitching with Helifix Helibars and Cemties in accordance with Helifix specifications. Re-plaster over to match original surface.

Remove cracked/peeling/bubbled wallpaper to expose damaged Internal walls linings. Repair as appropriate using one of the following:

a) Grind-out v-shape into cracked plaster. Re-plaster and overlay crack with fibreglass reinforcing mesh. Re-plaster over to provide a smooth finish.

b) Overlay lath and plaster with Braceline GIB. Fix through to timber framing in accordance with GIB specifications.

c) Remove lath and plaster walls and replace with Braceline GIB, **or** plaster over corru-lath/rib-lath.

In all cases, wall ties and hold-down straps should be installed in accordance with GIB braced wall and ceiling diaphragm specifications.

Realign, re-fix and re-paint racked door frames and architraves.

Repair cracks to adjacent shed brick wall by stitching together with Helifix Helibars in accordance with Helifix specifications. Re-point mortar and re- paint to match existing.

Repair notes:

i) Sika pressure-injected epoxies must be installed by a Sika certified contractor. Contact Sika for a list of certified applicators.

ii) " *Refer Department of* Building *and Housing repair guidance document 2010 for foundation* wall *repair method statements as a guide.*

iii) For Helifix specifications, refer to: www.helifix.co.nz/masonryrepairdetails.html. Where the repair differs from online specifications, contact Helifix for further information.

7. To Mitigate Lateral Spread:

Install a new 3.0m deep 1310UB40 steel piles (at 800crs) palisade wall just beyond the Eastern side, adjacent to the access road, down to and into the gravel layer as a minimum. See also the recommendations in the report prepared by LDE.

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The costs associated with the repairs would require the appropriate professional to visit the site to view the extent of damage.

12.0 Elements Not Inspected

The following is a list of elements not specifically inspected:

Soils (although the Geotechnical report completed by LDE has been reviewed and its recommendations implemented.)

Depth of existing foundations was not determined.

13.0 Applicability

Recommendations and opinions in this report are based on data and records obtained from Christchurch City Council, plus the non-destructive and destructive visual inspections. Although there is nothing to suggest otherwise, the nature and continuity of the structure hidden from sight (e.g. reinforcing steel, bolt depths etc.) is inferred but it must be appreciated that actual conditions could vary.

Findings presented in this report are for the sole use of the client. The findings may not contain sufficient information for use by other parties, and as such should not be relied upon unless discussed with Structural Concepts Ltd. We have exercised our services in a professional manner using a degree of care and skill normally, under similar circumstances, by reputable consultants practicing in this field at this time. No other warranty, expressed or implied, is made as to the professional advice presented in this report.

Prepared By:

Garry Newton
BE(Civil), MIPENZ(Civil,Structural), CPEng, IntPE

Managing Director

On behalf of Structural Concepts Ltd

APPENDIX A

MONAVALE GATEHOUSE
FENDALTON ROAD, CHRISTCHURCH

PHOTOGRAPHS

Please note that the photographs provided in this report are not high quality and are for providing information that shows the indicative damage found around the building for structural engineering assessment only.

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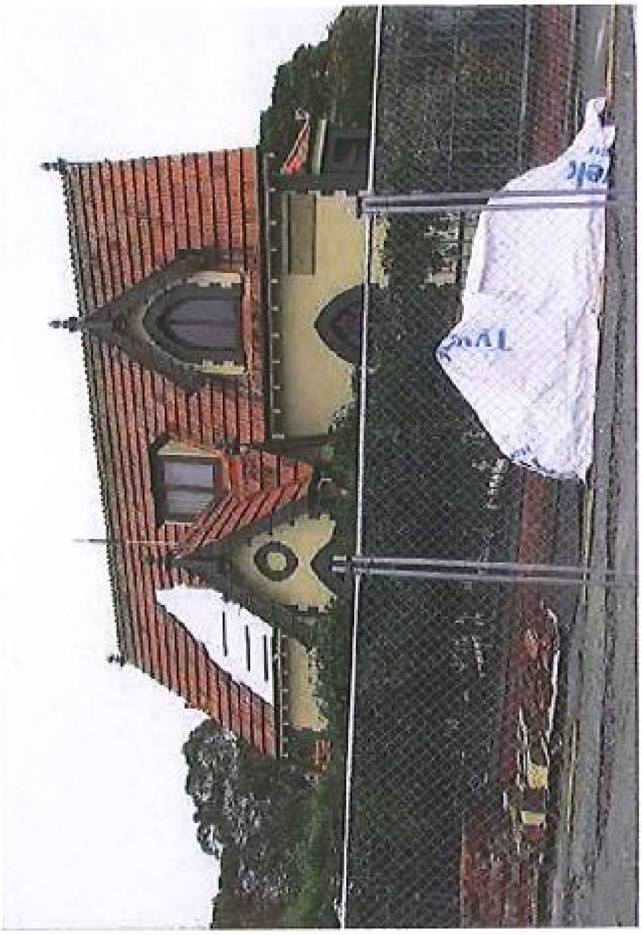


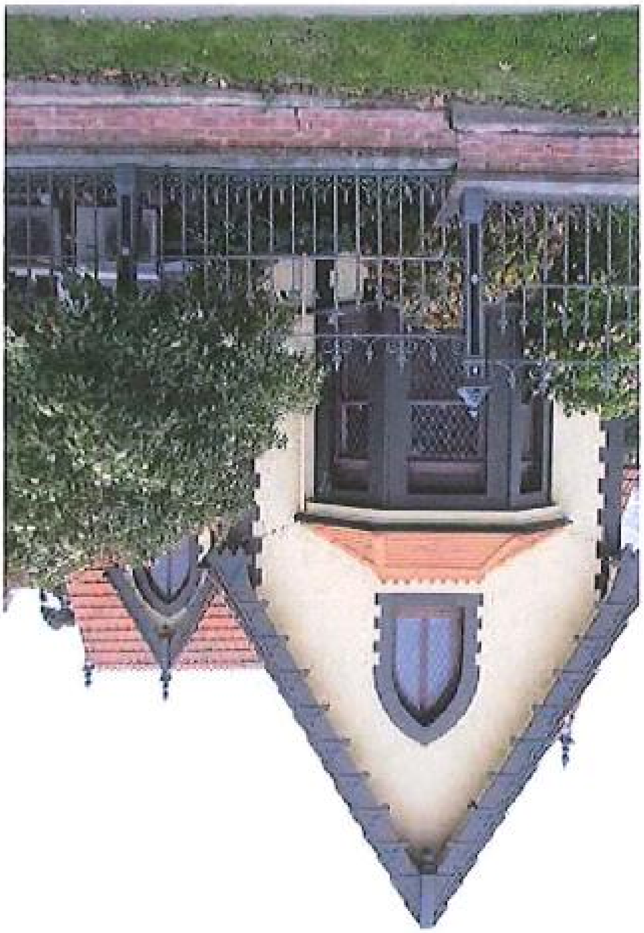


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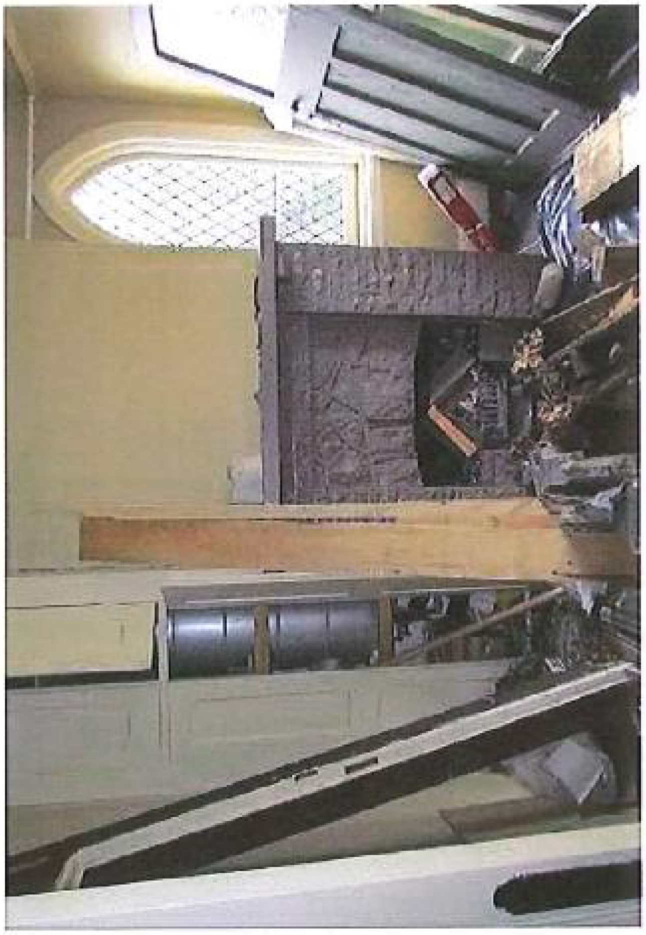
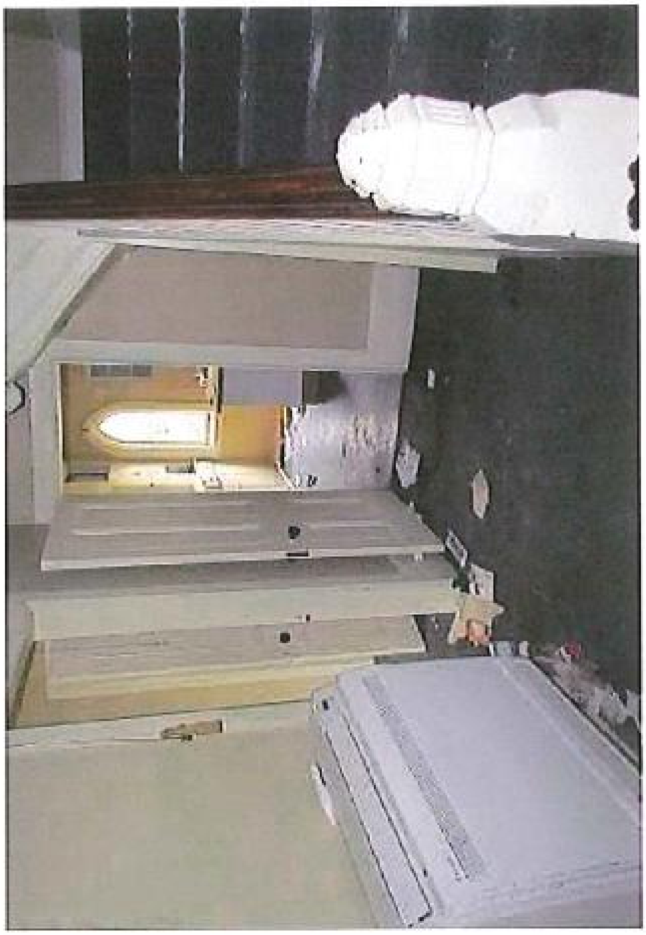

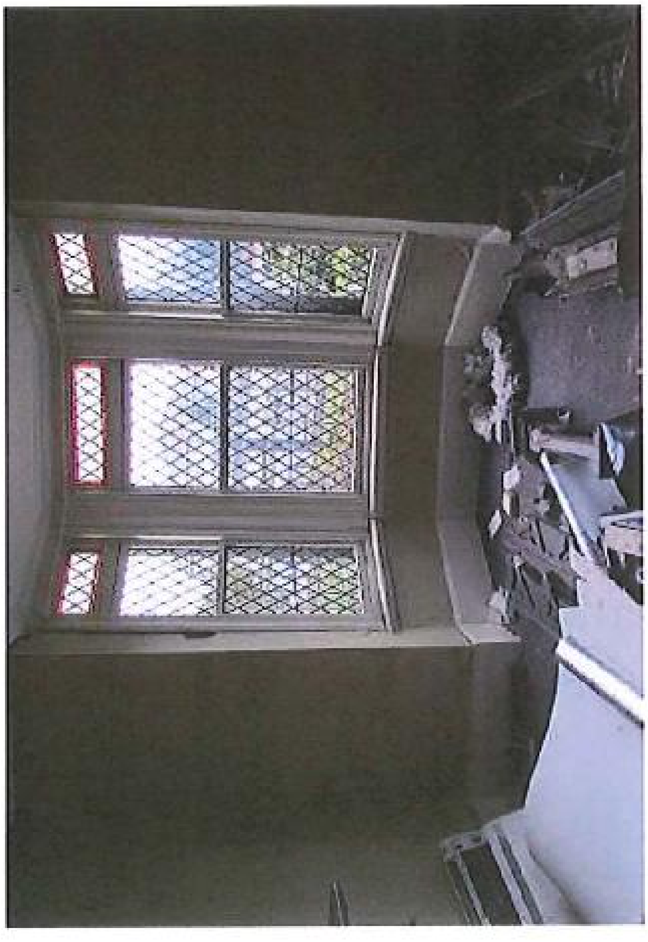

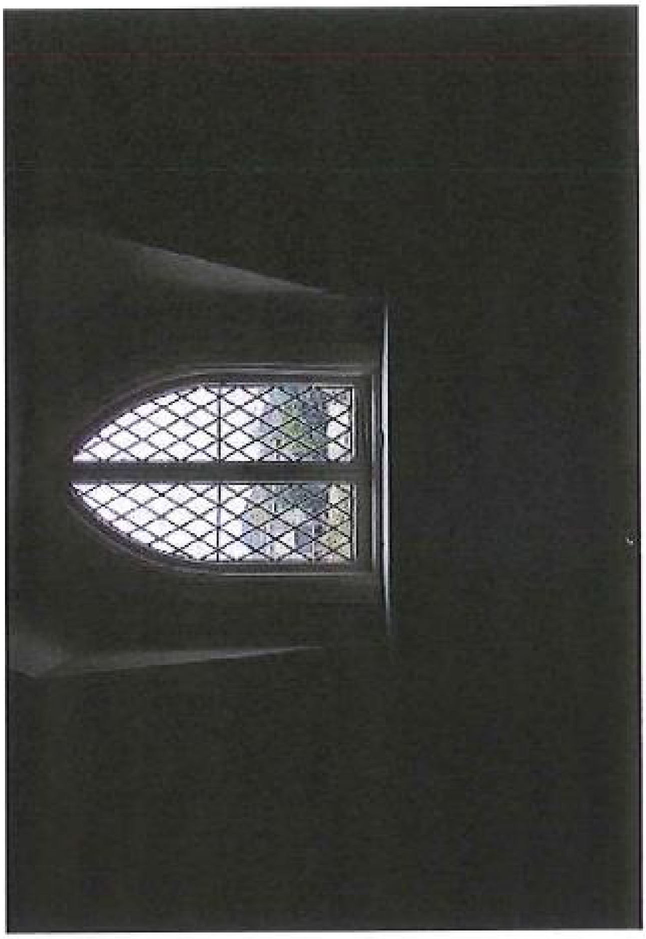





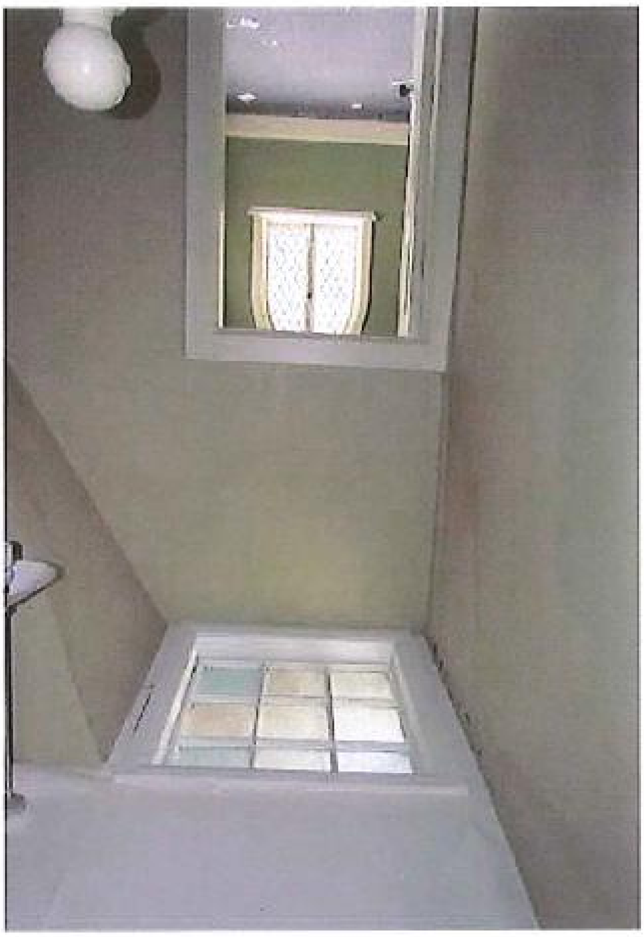

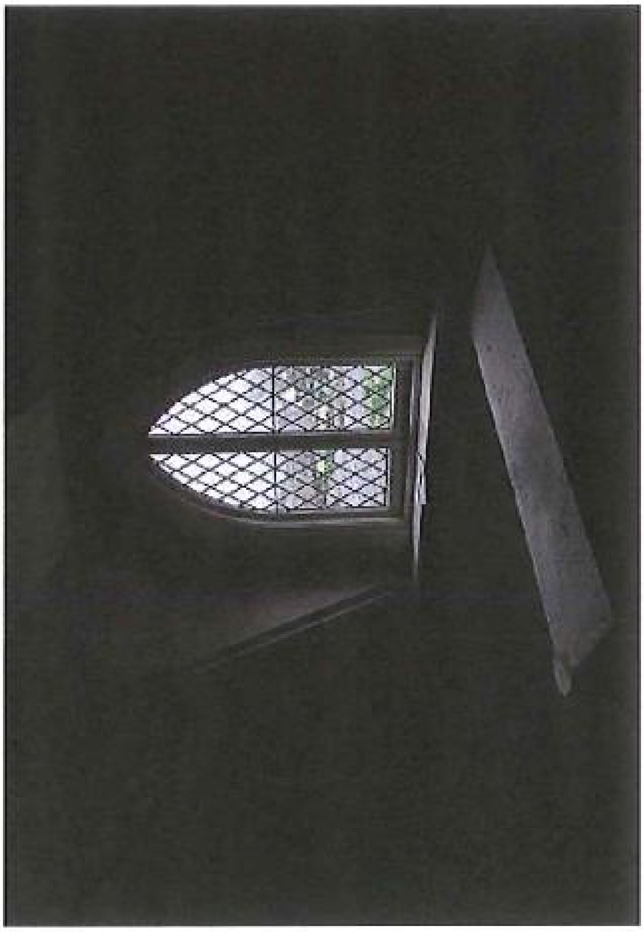

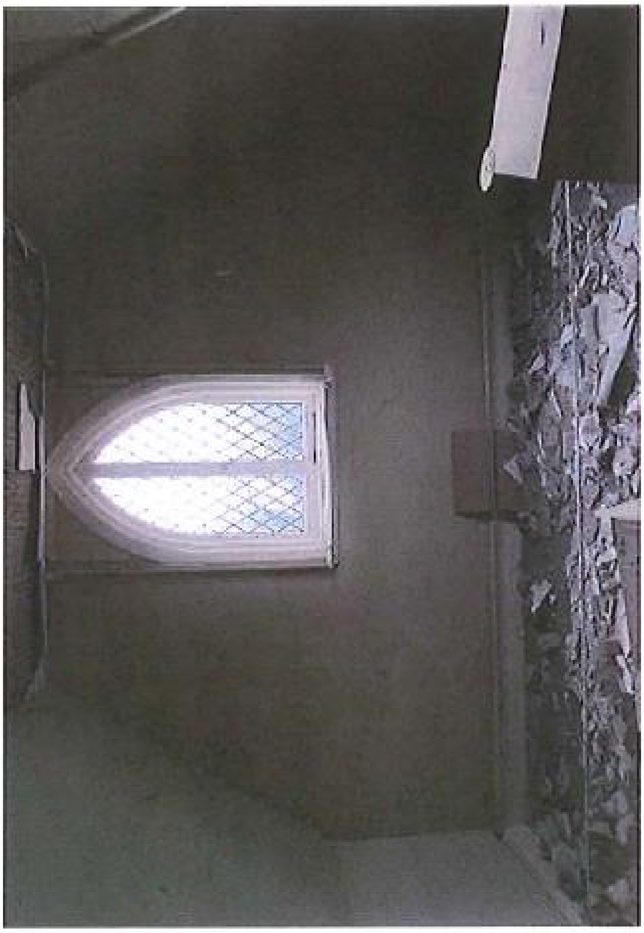

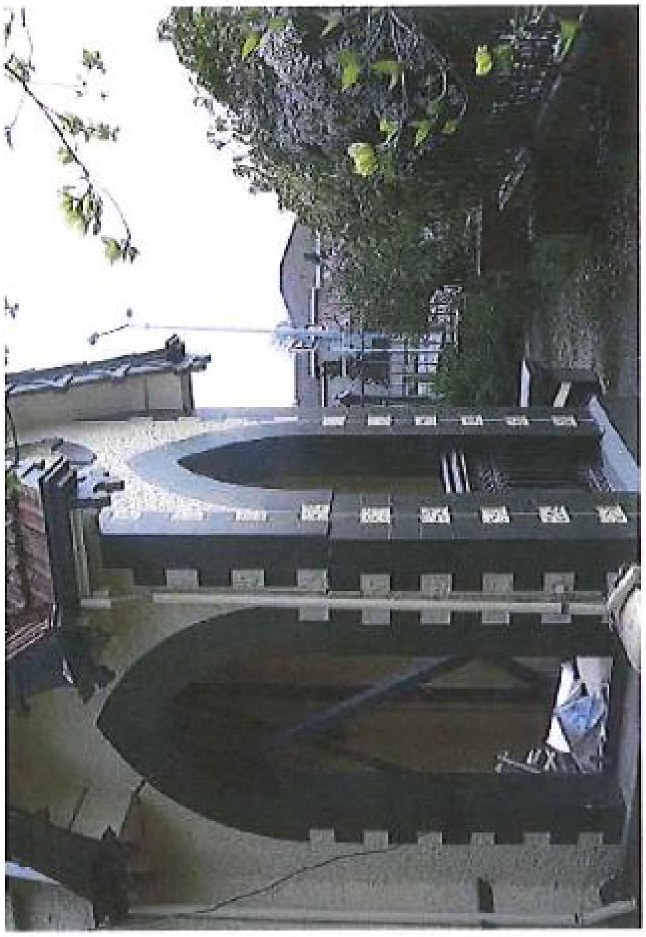



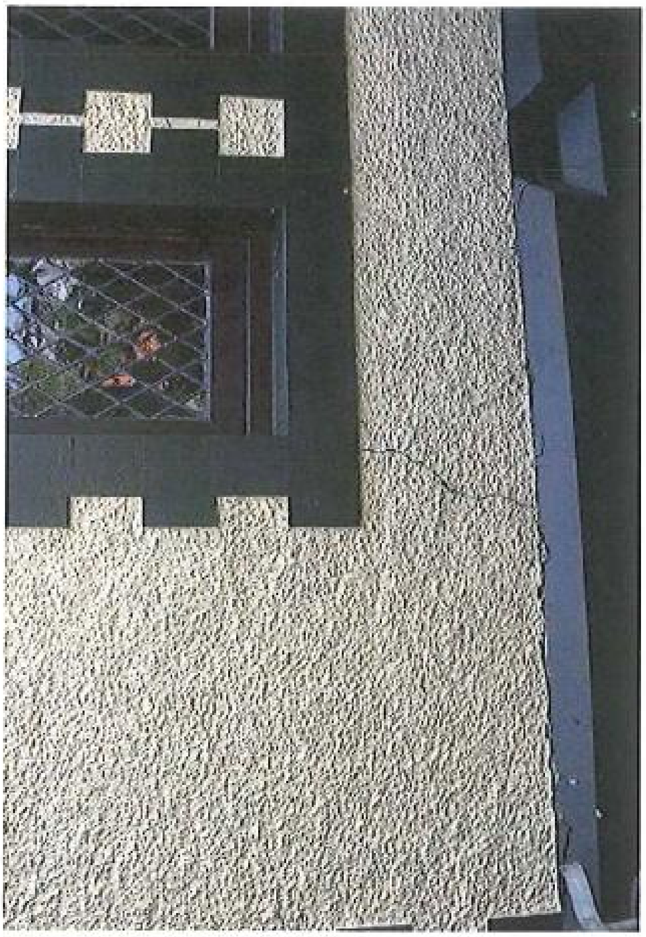

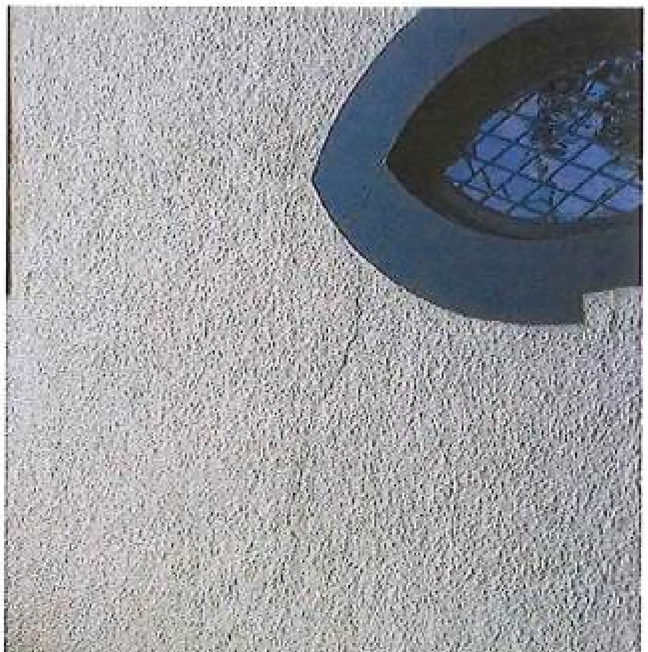

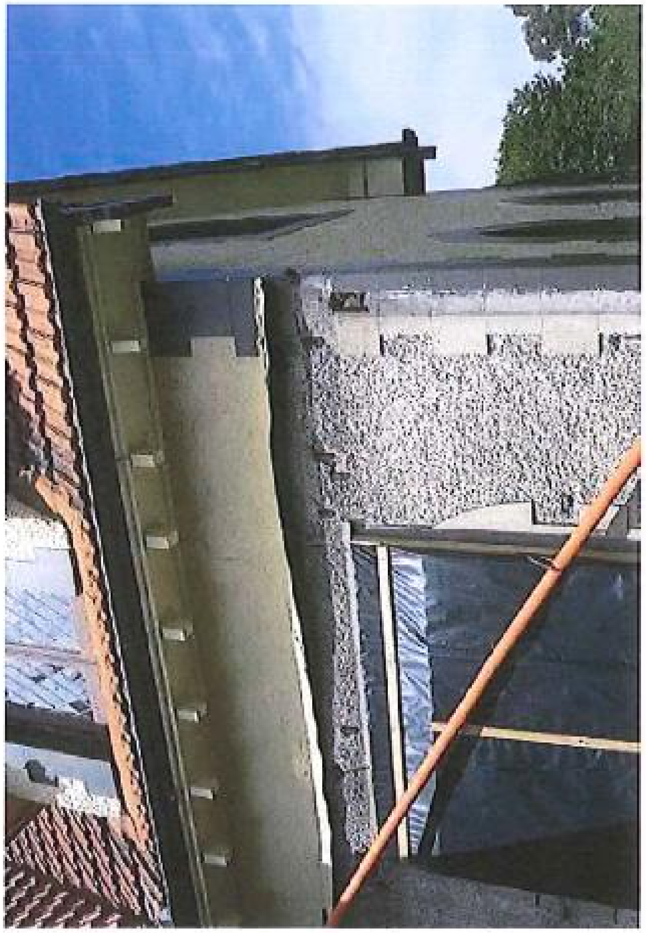


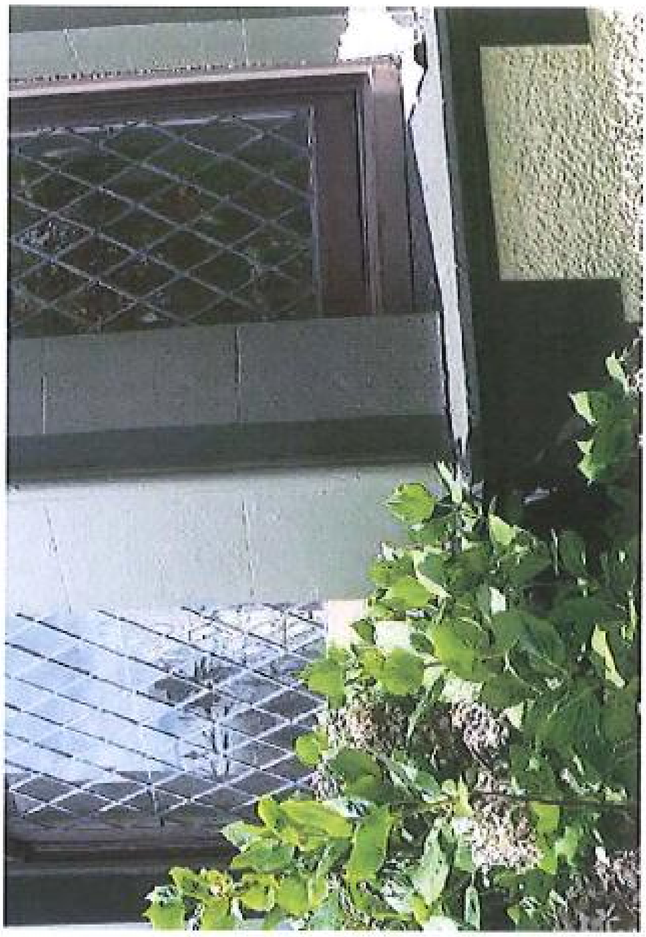

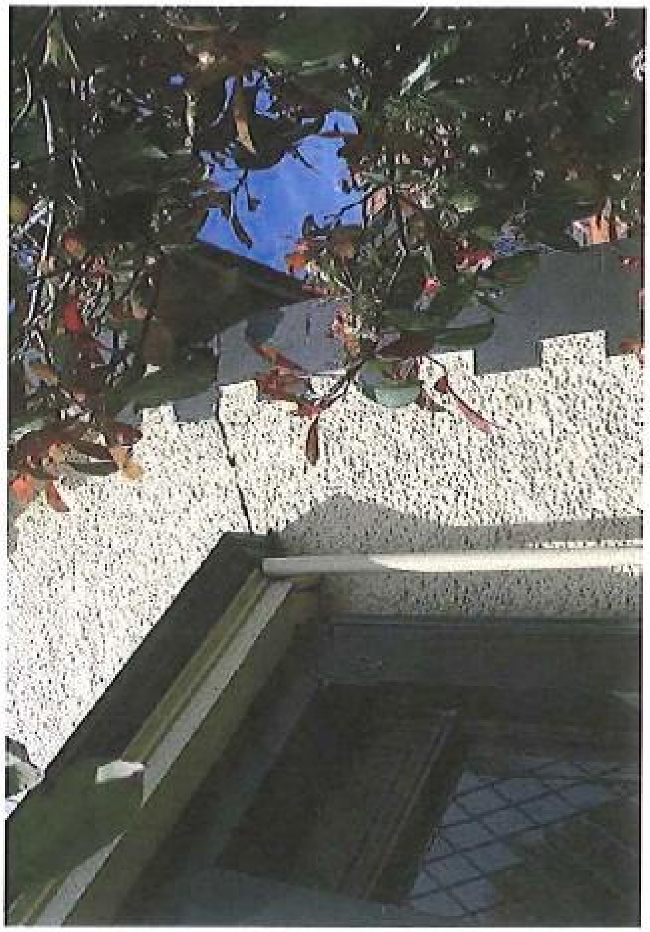





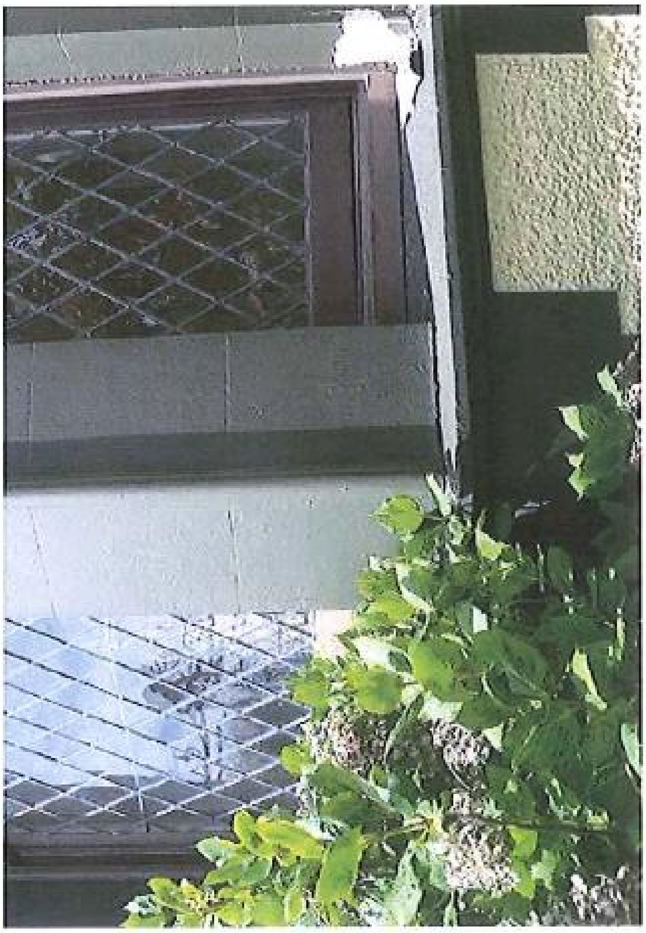

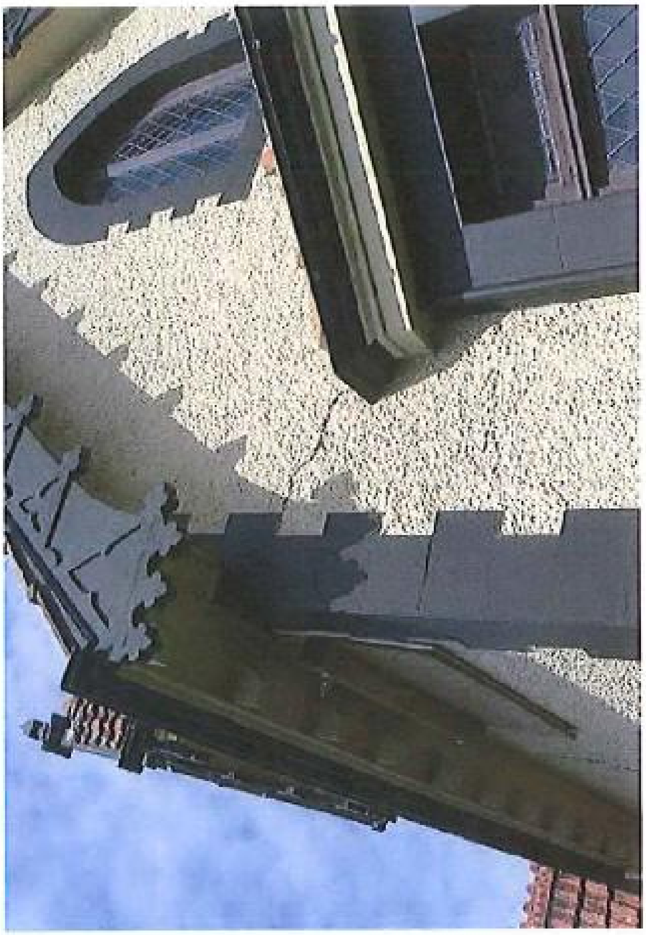


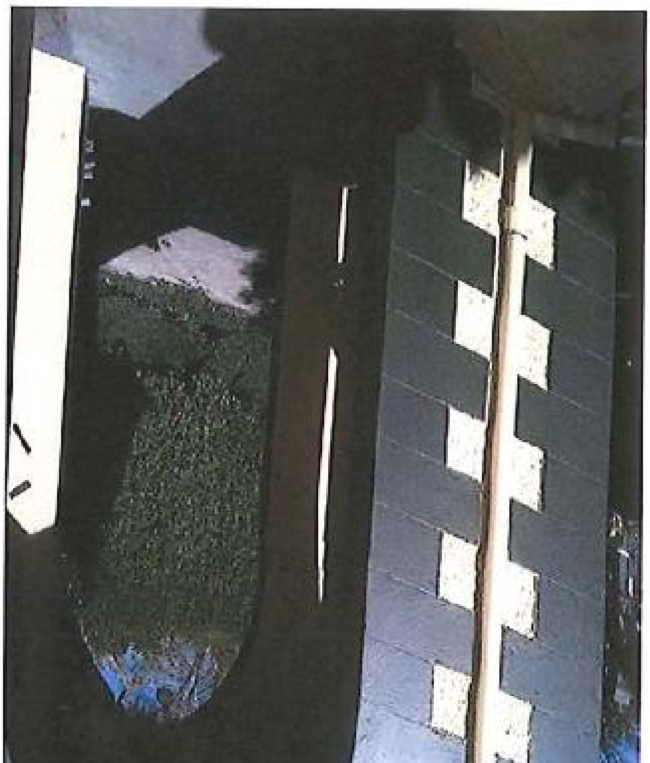


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APPENDIX B

MONAVALE GATEHOUSE
FENDALTON ROAD, CHRISTCHURCH

MARKED-UP DRAWING INDICATING DAMAGED LOCATIONS

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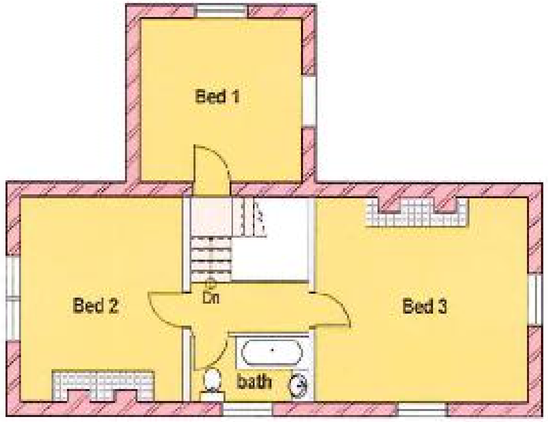
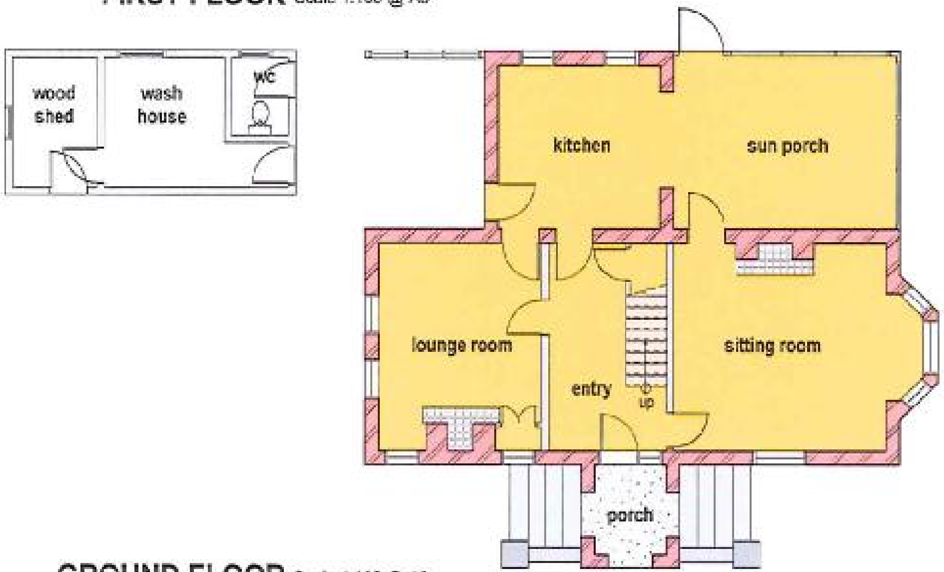


FIRST FLOOR Scale 1:100 @ A3



GROUND FLOOR Scale 1:100 @ A3

REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF MONAVALE GATE HOUSE CHRISTCHURCH

Existing Floor Plans

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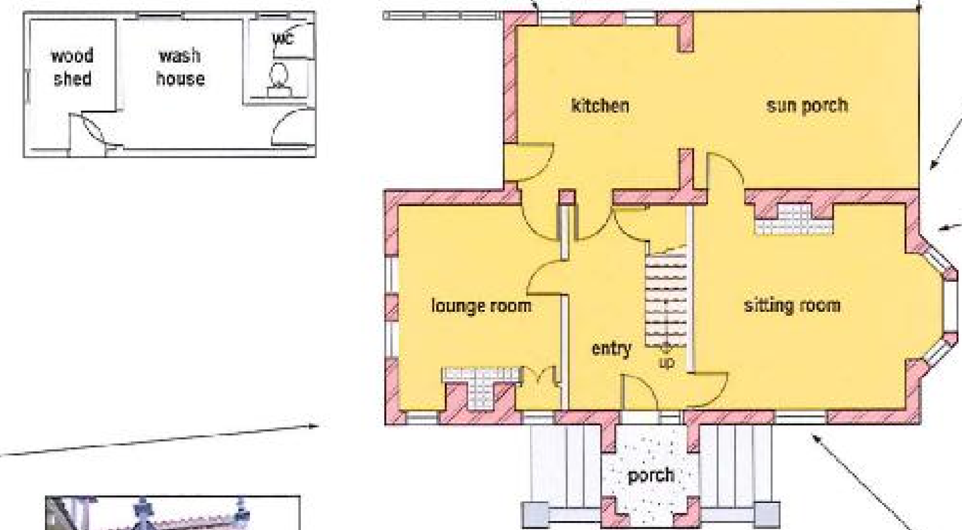
SCL NUMBER 1606
SHEET 100 REV 0


typical damage to foundations

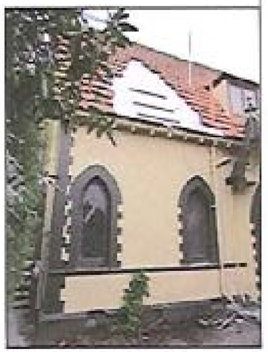

chimney and sun room damage


typical brickwork damage at corner




typical damage above windows


typical damage above windows


damage to chimney and dormer roof


damage to entry porch

REV	DATE	DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF MONAVALE GATE HOUSE CHRISTCHURCH

Photo Reference Ground Floor

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SCL NUMBER 1606
SHEET 110
REV 0

DATE 11/09/12

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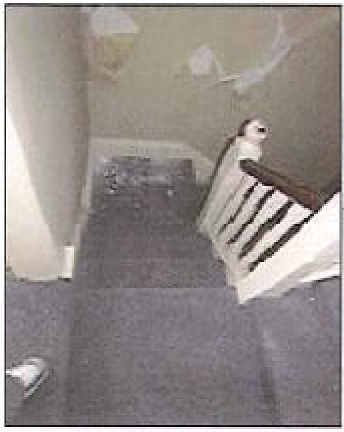
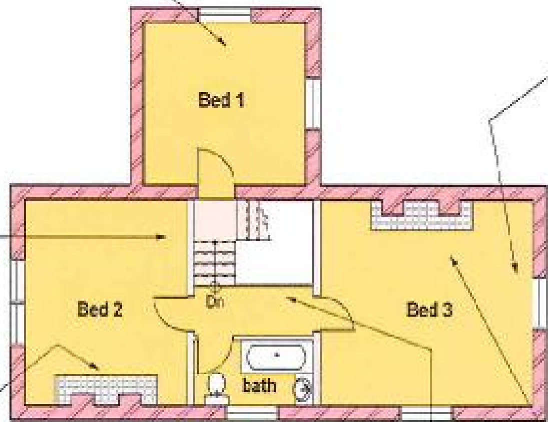
typical ceiling damage



typical wall damage in stairwell

chimney damage



typical ceiling damage in stairwell

chimney and ceiling damage

chimney and ceiling damage to bedroom 3

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Photo Reference First Floor

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SHEET 111 REV 0

REV DATE DESCRIPTION

DATE 110512 VM2012 A3 | DES - GN | DRG TT/GJA | STRUCTURAL CONCEPTS | E: info@structuralconcepts.co.nz | P: +64 6 8350011 | F: +64 6 8350013 | 55 DUNLOP RD, PO BOX 3815, ONEKAWA, NAPIER 4142, NEW ZEALAND |

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APPENDIX C

MONAVALE GATEHOUSE
FENDALTON ROAD, CHRISTCHURCH

NEW WORKS and EXAMPLES

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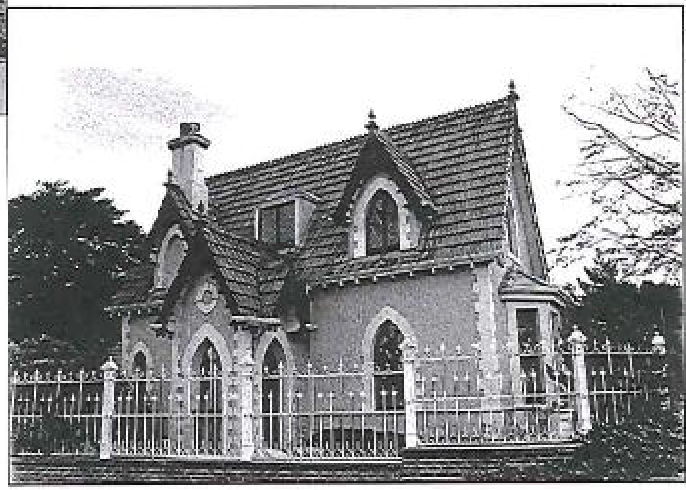
SEISMIC STRENGTHENING OF MONAVALE GATEHOUSE CHRISTCHURCH



Sheet Number	Revision	Sheet Title
000	0	Cover Sheet
010	0	Site Plan
100	0	Existing Floor Plans
110	0	Photo Reference Ground Floor
111	0	Photo Reference First Floor
150	0	Deconstruction Ground Floor Plan
151	0	Deconstruction First Floor Plan
152	0	Deconstruction Roof Plan
180	0	Existing North and East Elevations
181	0	Existing South and West Elevations
200	0	Proposed Ground Floor Plan
201	0	Proposed First Floor Plan
202	0	Proposed Roof Plan
280	0	Proposed North and East Elevations
281	0	Proposed South and West Elevations
300	0	Proposed Foundation Plan
310	0	Proposed Roof Framing Plan
400	0	Section A-A
401	0	Section B-B
500	0	Structural Details
501	0	Structural Details
502	0	Structural Details
503	0	Structural Details
504	0	Structural Details
505	0	Structural Details
506	0	Structural Details
510	0	Chimney Elevations
550	0	Crack Stiching Details
600	0	Cladding Details
601	0	Cladding Details
602	0	Cladding Details
650	0	Window Schedule

REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

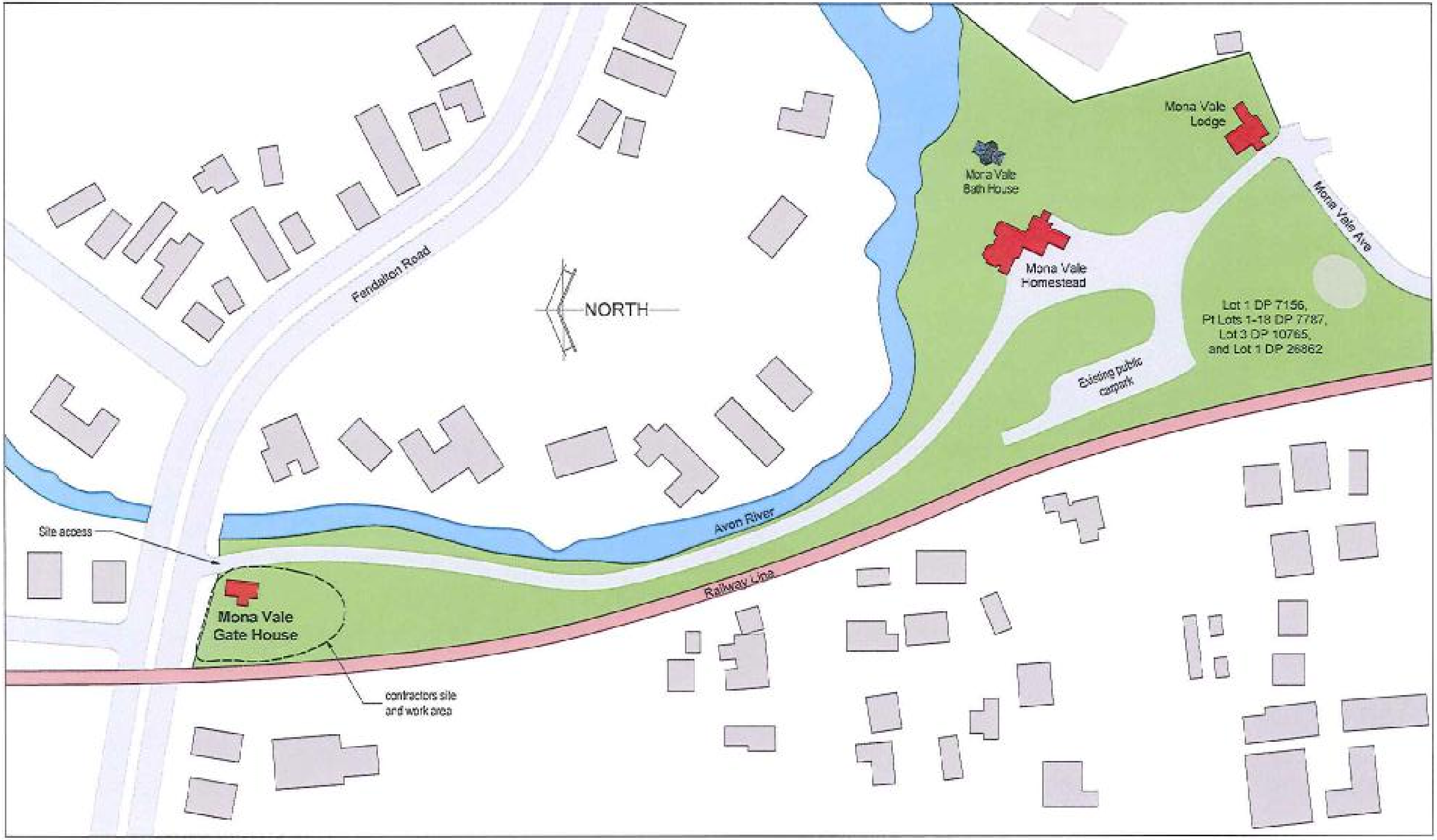
SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Cover Sheet

emajineer
Structural Concepts

SCL NUMBER 1606
SHEET 000 REV 0

| STRUCTURAL CONCEPTS | E: info@structuralconcepts.co.nz | P: +64 6 8420111 | F: +64 6 8420113 | 55 DUNLOP RD, PO BOX 3315, ONEKAWA, NAPIER 4142, NEW ZEALAND |

DATE 11/09/12 VW2012 A3 | DES - GN | DRG TT/DM



REV DATE DESCRIPTION

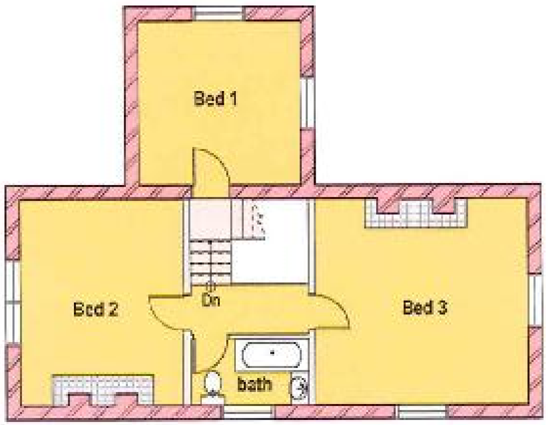
CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Site Plan

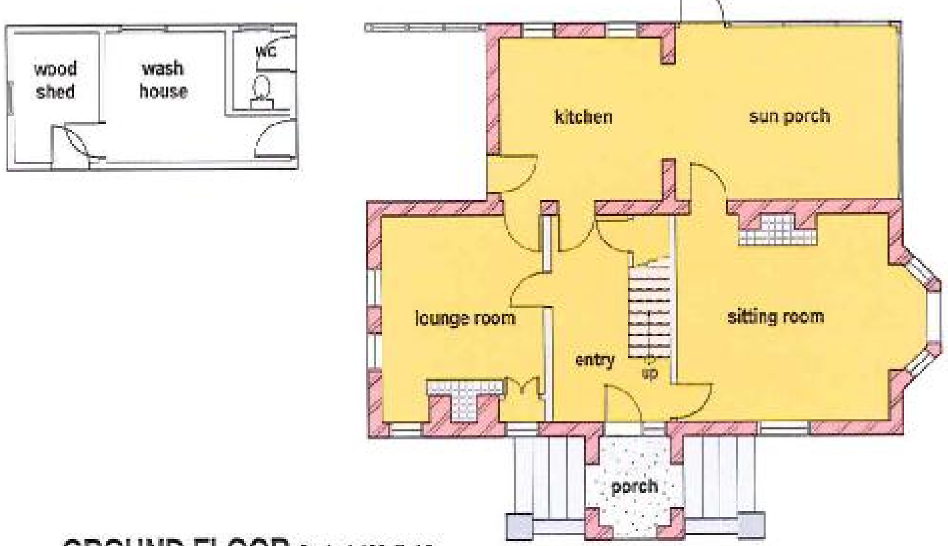
emajineer
Structural Concepts

SCL NUMBER 1606
SHEET 010 REV 0

DATE 11/09/12 W/2012 A3 | DES - GN | DRG T1/DA | STRUCTURAL CONCEPTS | E: info@structuralconcepts.co.nz | P: +64 6 8420113 | F: +64 6 8420111 | 55 DUNLOP RD, PO BOX 3315, ONEKAWA, NAPIER 4142, NEW ZEALAND |



FIRST FLOOR Scale 1:100 @ A3



GROUND FLOOR Scale 1:100 @ A3

REV	DATE	DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Existing Floor Plans

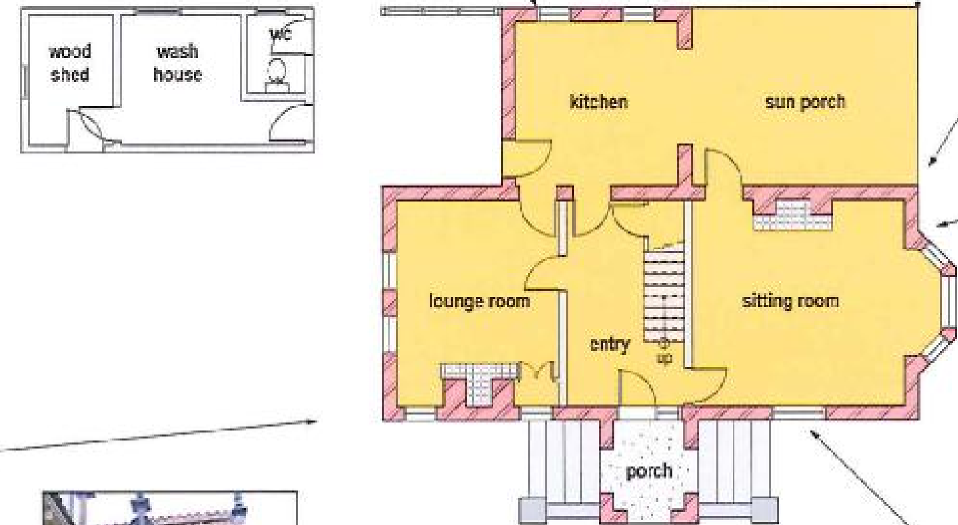
emajineer
Structural Concepts

SCL NUMBER 1606
SHEET 100 REV D

typical damage to foundations

chimney and sun room damage

typical brickwork damage at corner



typical damage above windows

typical damage above windows

damage to chimney and dormer roof

damage to entry porch

REV DATE DESCRIPTION

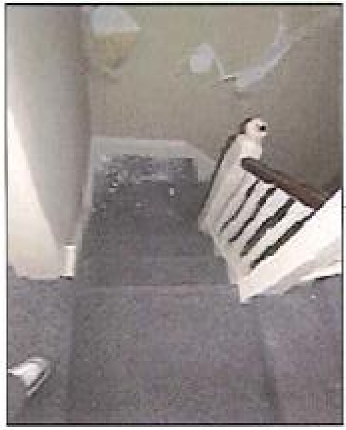
CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Photo Reference Ground Floor

emajineer
Structural Concepts

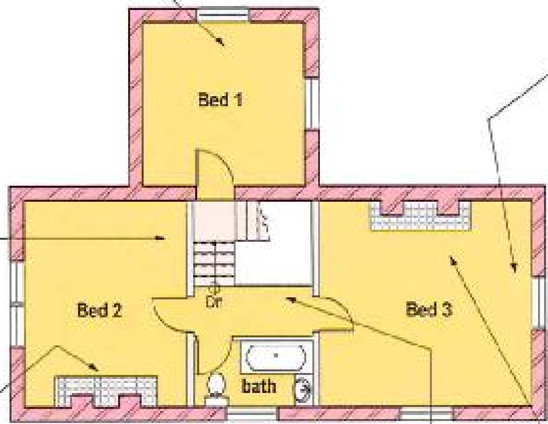
SCL NUMBER 1606
SHEET 110 REV 0

typical ceiling damage



typical wall damage in stairwell

chimney damage



chimney and ceiling damage

typical ceiling damage in stairwell

chimney and ceiling damage to bedroom 3

REV DATE DESCRIPTION

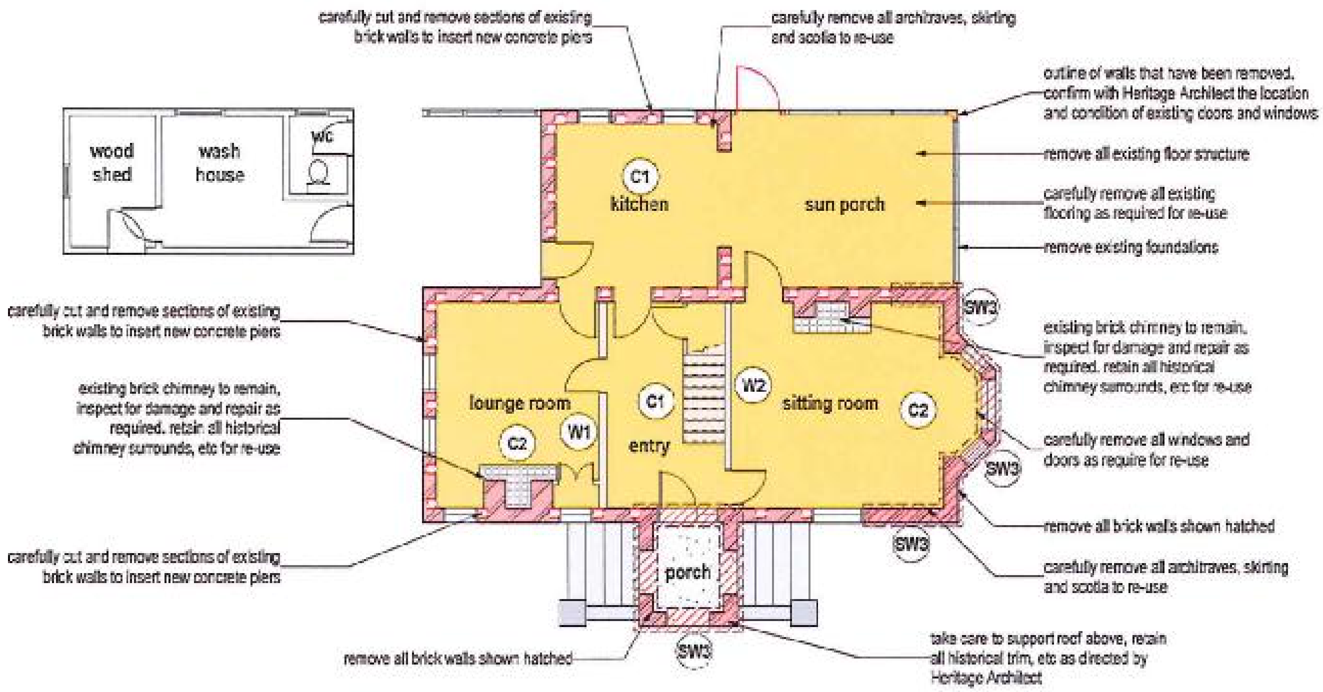
CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF MONAVALE GATE HOUSE CHRISTCHURCH

Photo Reference First Floor

emajineer
Structural Concepts

SOL NUMBER 1606
SHEET 111 REV 0



DECONSTRUCTION PLAN KEY:

- some existing brick and internal timber walls, and ceilings to remain, repair cracks and damage to plaster work as below:

(C1) Minor ceiling cracking - grind out 'V' shape along cracks to ceiling, re-plaster and overlay crack with fibreglass reinforcing mesh, plaster to provide smooth finish

(C2) Major ceiling cracking - grind out 'V' shape along cracks to ceiling, remove loose plaster. replace large gaps with Braceline Gib or similar, overlay joints between old plaster and new Gib with fibreglass reinforcing mesh, plaster area to provide smooth finish

(SC3) Repair ceiling lining - strip back plaster to timber lath, remove all loose plaster. replace bare areas with Braceline Gib or similar over existing lath, overlay joints between old plaster and new Gib with fibreglass reinforcing mesh, plaster area to a smooth finish

(W1) Minor wall cracking - grind out 'V' shape along cracks to walls, remove loose plaster. re-plaster and overlay crack with fibreglass reinforcing mesh, plaster to provide smooth finish

(W2) Major wall cracking - remove cracked, peeling or bubbled wallpaper, grind out 'V' shape along cracks, remove loose plaster. replace large gaps with Braceline Gib or similar, overlay joints between old plaster and new Gib with fibreglass reinforcing mesh, plaster area to provide smooth finish

(SW3) Remove walls - remove all brick walls, retain bricks as directed by Heritage Architect. take care to support floors and roof above, retain items for re-use as shown, and as directed by Heritage Architect

NOTE: new wall thickness to match existing, and be located in exact location as existing walls. confirm framing size on site, and adjust to suit

GENERAL SCOPE OF WORKS DECONSTRUCTION:

- remove sections of lower brick walls as shown on plans, in order to replace with concrete walls.
- cut out and remove sections of brick walls as shown on plans to allow for new concrete piers.
- remove all upper level brick walls down to upper floor level, to allow for timber framed walls as shown
- remove chimney to ceiling level of ground floor, to allow to be replaced with timber frame, see details.
- remove all areas of damaged and broken ceilings to allow for new ceilings to be installed.
- remove and retain all roof tiles, flashings, cappings, etc to roof as required to install new roof diaphragm.
- generally ensure all structure is supported as required. contractor to determine extent of damage to all items on site, and confirm removal of all damaged items with Heritage Architect.

DECONSTRUCTION GROUND FLOOR PLAN

Scale 1:100 @ A3

REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

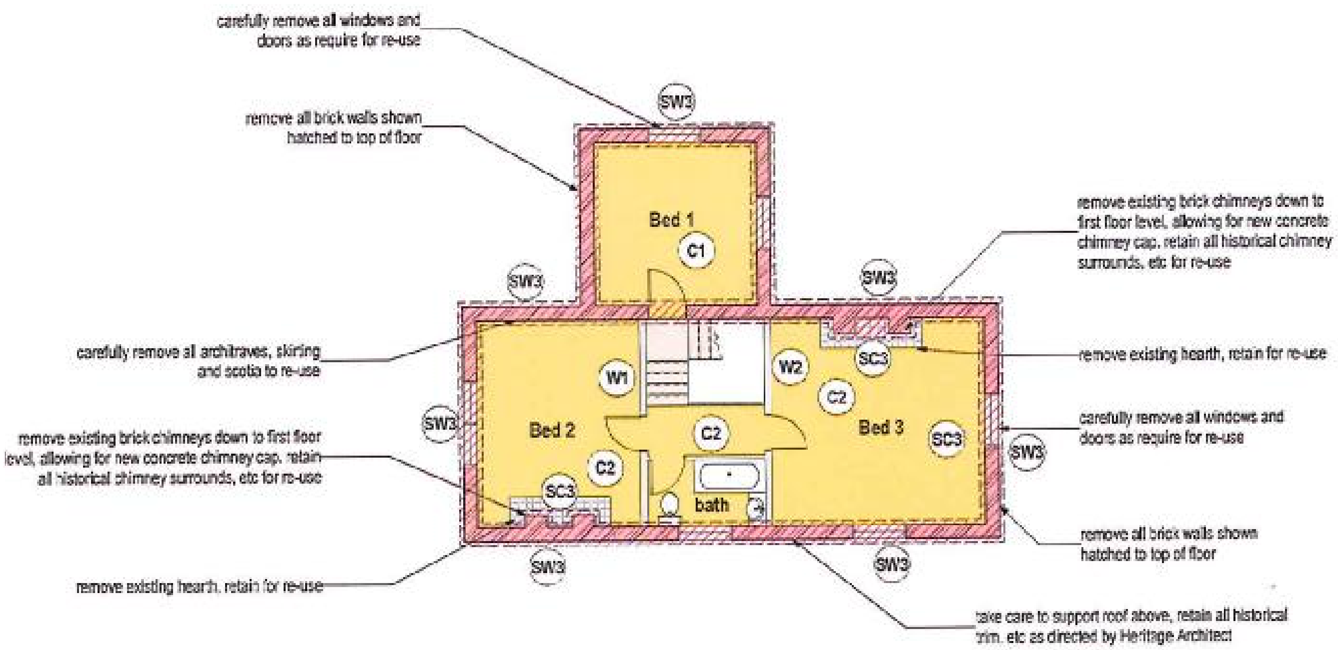
SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Deconstruction Ground Floor Plan

emajineer Structural Concepts

SCL NUMBER 1606
SHEET 150 REV 0

DATE 1/2012 | V1/2012 A3 | DES - GN | DRG TUIDA

| STRUCTURAL CONCEPTS | E: info@structuralconcepts.co.nz | P: +64 6 8 2011 | F: +64 6 8 2013 | 55 DUNLOP RD PO BOX 3015, ONEKAWA, NAPIER 4142 NEW ZEALAND |



DECONSTRUCTION PLAN KEY:

- some existing brick and internal timber walls, and ceilings to remain. repair cracks and damage to plaster work as below:

(C1) Minor ceiling cracking - grind out 'V' shape along cracks to ceiling. re-plaster and overlay crack with fibreglass reinforcing mesh, plaster to provide smooth finish

(C2) Major ceiling cracking - grind out 'V' shape along cracks to ceiling, remove loose plaster, replace large gaps with Braceline Gib or similar, overlay joints between old plaster and new Gib with fibreglass reinforcing mesh, plaster area to provide smooth finish

(SC3) Repair ceiling lining - strip back plaster to timber lath, remove all loose plaster, replace bare areas with Braceline Gib or similar over existing lath, overlay joints between old plaster and new Gib with fibreglass reinforcing mesh, plaster area to a smooth finish

(W1) Minor wall cracking - grind out 'V' shape along cracks to walls, remove loose plaster, re-plaster and overlay crack with fibreglass reinforcing mesh, plaster to provide smooth finish

(W2) Major wall cracking - remove cracked, peeling or bubbled wallpaper, grind out 'V' shape along cracks, remove loose plaster, replace large gaps with Braceline Gib or similar, overlay joints between old plaster and new Gib with fibreglass reinforcing mesh, plaster area to provide smooth finish

(SW3) Remove walls - remove all brick walls, retain bricks as directed by Heritage Architect, take care to support floors and roof above, retain items for re-use as shown, and as directed by Heritage Architect

NOTE: new wall thickness to match existing, and be located in exact location as existing walls. confirm framing size on site, and adjust to suit

GENERAL SCOPE OF WORKS DECONSTRUCTION:

- remove sections of lower brick walls as shown on plans, in order to replace with concrete walls.
- cut out and remove sections of brick walls as shown on plans to allow for new concrete piers.
- remove all upper level brick walls down to upper floor level, to allow for timber framed walls as shown
- remove chimney to ceiling level of ground floor, to allow to be replaced with timber frame, see details.
- remove all areas of damaged and broken ceilings to allow for new ceilings to be installed.
- remove and retain all roof tiles, flashings, cappings, etc to roof as required to install new roof diaphragm.
- generally ensure all structure is supported as required. contractor to determine extent of damage to all items on site, and confirm removal of all damaged items with Heritage Architect.

DECONSTRUCTION FIRST FLOOR PLAN

Scale 1:100 @ A3

REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Deconstruction First Floor Plan

emajineer
Structural Concepts

SCL NUMBER 1606
SHEET 151 REV 0

DATE 11/05/12

VW2012 A3 [DEB-C2] [DRG TITLE]

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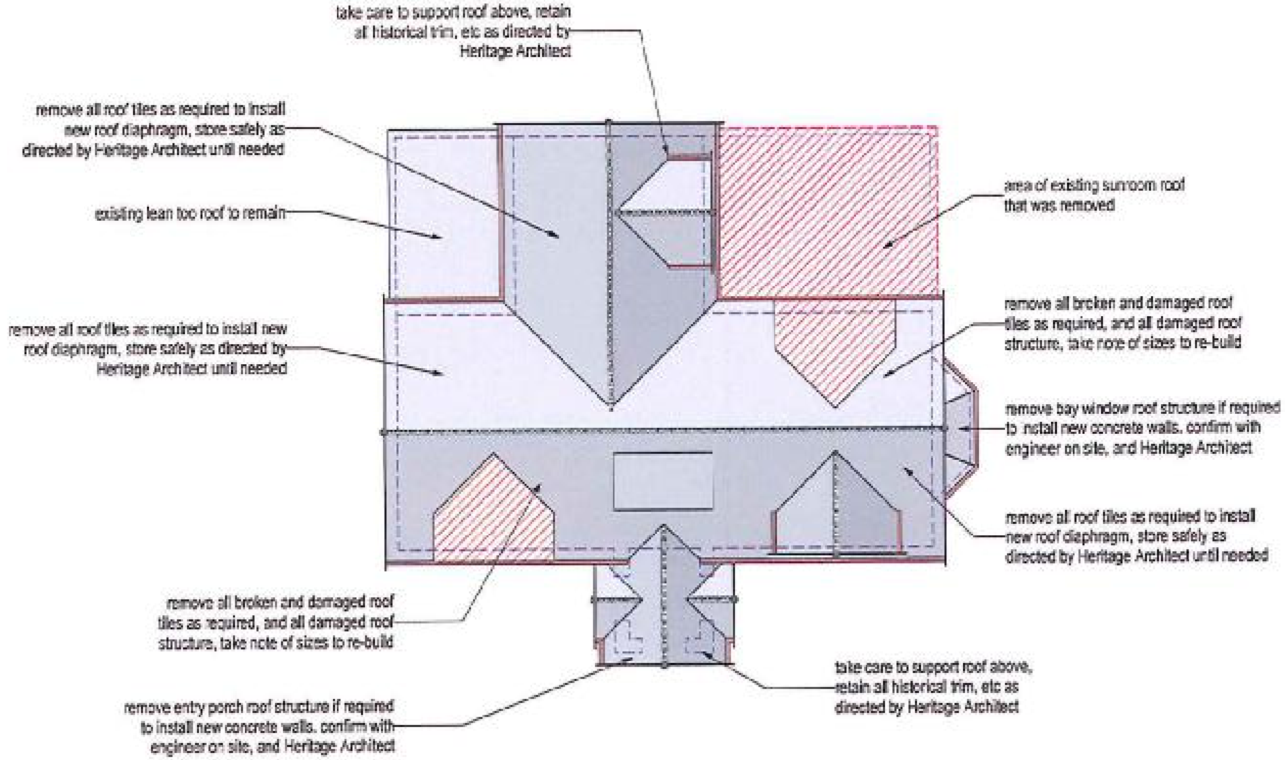

DECONSTRUCTION ROOF PLAN

Scale 1:100 @ A3

GENERAL SCOPE OF WORKS DECONSTRUCTION:

- remove sections of lower brick walls as shown on plans, in order to replace with concrete walls.
- cut out and remove sections of brick walls as shown on plans to allow for new concrete piers.
- remove all upper level brick walls down to upper floor level, to allow for timber framed walls as shown
- remove chimney to ceiling level of ground floor, to allow to be replaced with timber frame. see details.
- remove all areas of damaged and broken ceilings to allow for new ceilings to be installed.
- remove and retain all roof tiles, flashings, cappings, etc to roof as required to install new roof diaphragm.
- generally ensure all structure is supported as required. contractor to determine extent of damage to all items on site, and confirm removal of all damaged items with Heritage Architect.

REV	DATE	DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Deconstruction Roof Plan

emajineer
Structural Concepts

SC NUMBER 1606
SHEET 152 REV 0

DATE 11/5/12

V1/2012 A3 | DES-GN | DRG TITLE

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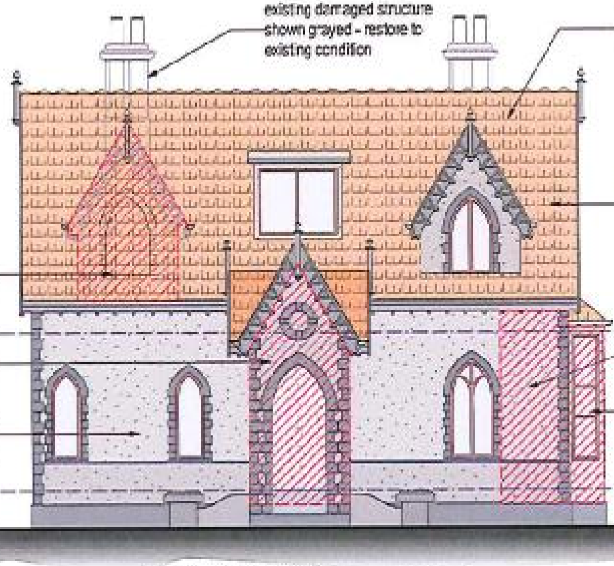
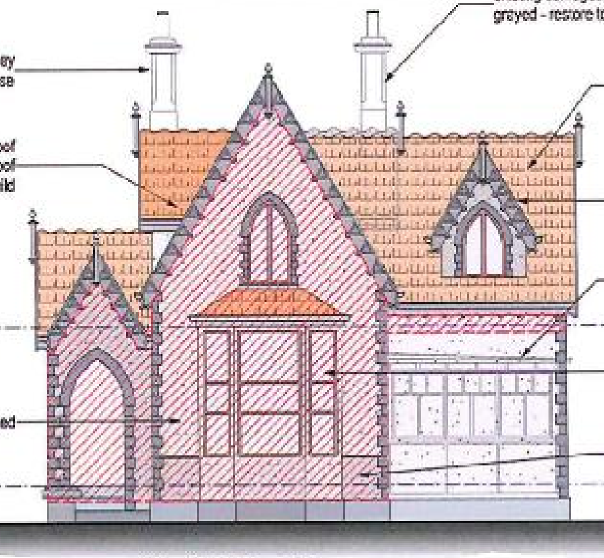


East Elevation Scale 1:100 @ A3



North Elevation Scale 1:100 @ A3

GENERAL SCOPE OF WORKS DECONSTRUCTION:

- remove sections of lower brick walls as shown on plans, in order to replace with concrete walls.
- cut out and remove sections of brick walls as shown on plans to allow for new concrete piers.
- remove all upper level brick walls down to upper floor level, to allow for timber framed walls as shown
- remove chimney to ceiling level of ground floor, to allow to be replaced with timber frame, see details.
- remove all areas of damaged and broken ceilings to allow for new ceilings to be installed.
- remove and retain all roof tiles, flashings, cappings, etc to roof as required to install new roof diaphragm.
- generally ensure all structure is supported as required. contractor to determine extent of damage to all items on site, and confirm removal of all damaged items with Heritage Architect.

REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

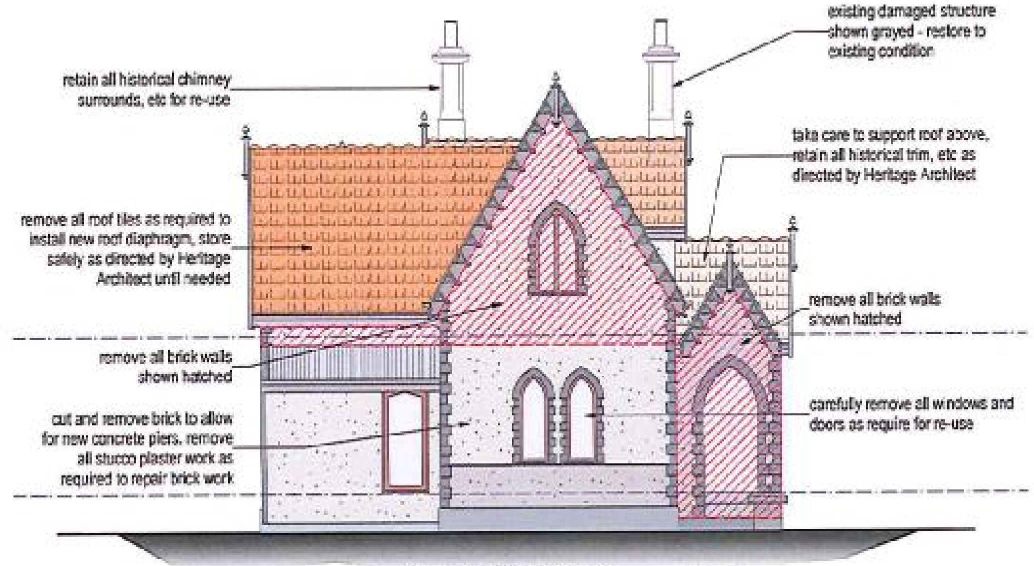
SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Existing North and East Elevations

emajineer
Structural Concepts

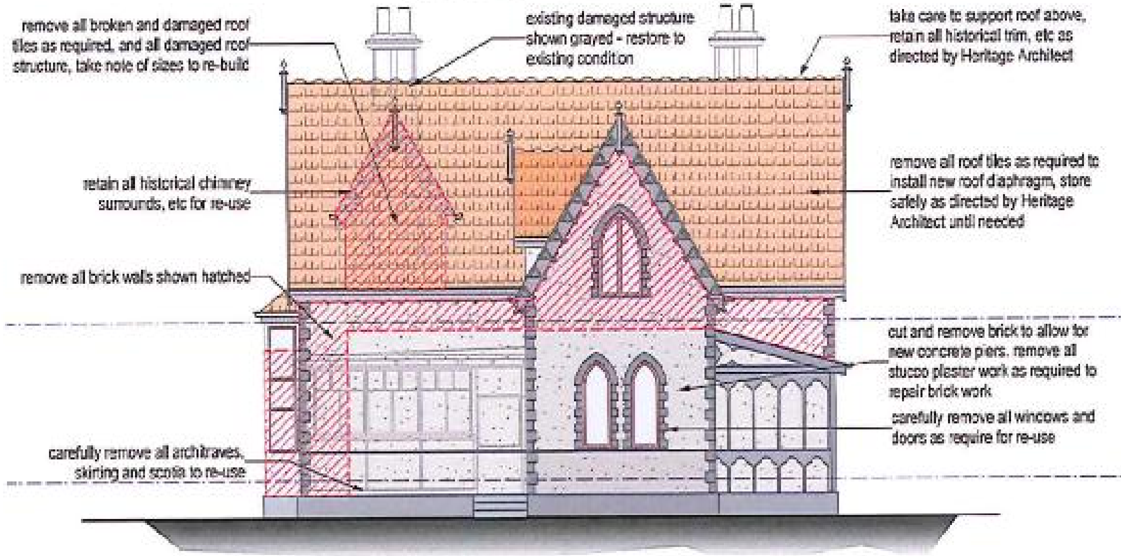
DOC NUMBER 1606
SHEET 180 REV 0

DATE 11/05/12 W2012 A3 | DES - G1 | DRG T/10A

| STRUCTURAL CONCEPTS | E: info@structuralconcepts.co.nz | P: +64 6 8432011 | F: +64 6 8432013 | 95 DUNLOP RD, PO BOX 3315, ONEKAWA, NAPIER 4142, NEW ZEALAND |



South Elevation Scale 1:100 @ A3



West Elevation Scale 1:100 @ A3

GENERAL SCOPE OF WORKS DECONSTRUCTION:

- remove sections of lower brick walls as shown on plans, in order to replace with concrete walls.
- cut out and remove sections of brick walls as shown on plans to allow for new concrete piers.
- remove all upper level brick walls down to upper floor level, to allow for timber framed walls as shown
- remove chimney to ceiling level of ground floor, to allow to be replaced with timber frame, see details.
- remove all areas of damaged and broken ceilings to allow for new ceilings to be installed.
- remove and retain all roof tiles, flashings, cappings, etc to roof as required to install new roof diaphragm.
- generally ensure all structure is supported as required. contractor to determine extent of damage to all items on site, and confirm removal of all damaged items with Heritage Architect.

REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

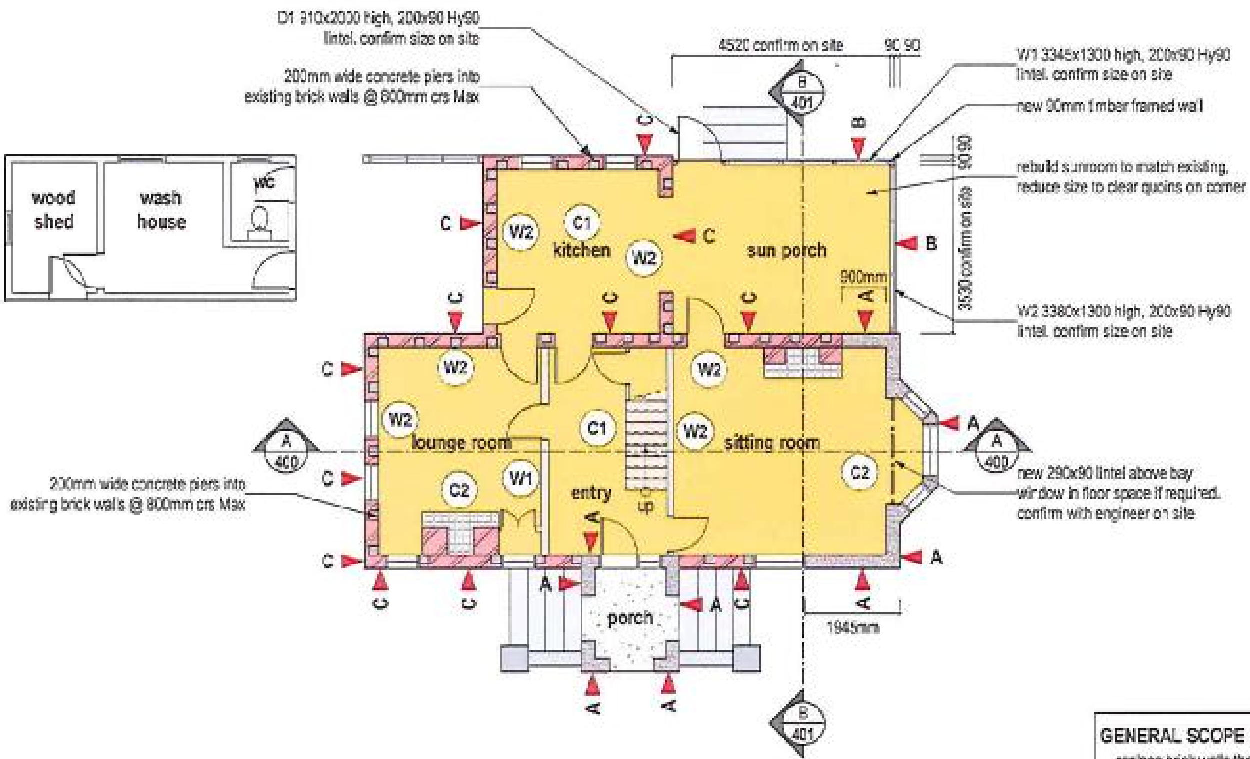
SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Existing South and West Elevations

emajineer
Structural Concepts

SCL NUMBER 1606
SHEET 181 REV 0

DATE 11/06/12 VW2012 A3 | DES - GV | DRG T/Y/A

| STRUCTURAL CONCEPTS | E: info@structuralconcepts.co.nz | P: +64 6 8420011 | F: +64 6 8420013 | 95 DUNLOP RD, PO BOX 3315, ONEKAWA, NAPIER 4142, NEW ZEALAND |



PROPOSED GROUND FLOOR PLAN

Scale 1:100 @ A3

STRUCTURAL PLAN KEY:

A - new solid concrete walls to match existing thickness to replace all lower floor double brick exterior walls.
- HD12 bars @ 200 crs horizontal, and HD16 bars @ 150mm crs vertical - see details
- Line interior walls with 13mm Gib board
- exterior cladding to be Stucco plaster to match existing

B - new 45mm MSG8 H1.2 timber framing, total width to match existing removed brick walls: studs @ 400 crs and dwangs @ 800 crs, 90x45 framing to replace damaged timber walls to sun room.
- one layer of 13mm Gib Ultraline to the inside face, and one layer of 7mm bracing ply element to the outside face of timber framed exterior wall.
- install H3.2 cavity battens over building wrap over ply bracing.
- exterior cladding to be Stucco plaster on fibre cement sheets.

C - existing brick walls, repair cracking with Helibar crack stitching system as per manufacture's specification. Install concrete piers into brick walls as detailed.

- existing internal timber walls and ceilings to remain, confirm extent of damage on site. repair cracks and damage to plaster work as below:

(C1) Minor ceiling cracking - grind out 'V' shape along cracks to ceiling, re-plaster and overlay crack with fibreglass reinforcing mesh, plaster to provide smooth finish

(C2) Major ceiling cracking - grind out 'V' shape along cracks to ceiling, remove loose plaster. replace large gaps with Braceline Gib or similar, overlay joints between old plaster and new Gib with fibreglass reinforcing mesh, plaster area to provide smooth finish

(SC3) Repair ceiling lining - strip back plaster to timber lath. remove all loose plaster. replace bare areas with Braceline Gib or similar over existing lath, overlay joints between old plaster and new Gib with fibreglass reinforcing mesh, plaster area to a smooth finish

(W1) Minor wall cracking - grind out 'V' shape along cracks to walls, remove loose plaster. re-plaster and overlay crack with fibreglass reinforcing mesh, plaster to provide smooth finish

(W2) Major wall cracking - remove cracked, peeling or bubbled wallpaper, grind out 'V' shape along cracks, remove loose plaster. replace large gaps with Braceline Gib or similar, overlay joints between old plaster and new Gib with fibreglass reinforcing mesh, plaster area to provide smooth finish

NOTE: new wall thickness to match existing, and be located in exact location as existing walls. confirm framing size on site, and adjust to suit

GENERAL SCOPE OF WORKS RECONSTRUCTION:

- replace brick walls that have been removed with concrete walls.
- replace upper level brick walls with timber framed walls in locations as shown and detailed on the plans.
- install floor diaphragm over top of existing first floor flooring to all rooms. remove and make good part ceilings as required, as per details.
- install roof diaphragm to rafters as detailed. replace with Gib board over ceiling battens (install new battens if required)
- generally repair all cracked plaster to timber walls. finish of all walls and ceilings to be confirmed with the Heritage Architect.
- replace existing chimney with timber frame as detailed, and install new roof tiles and roof structure to roof as required, make good, ensure roof is weather-tight.
- rebuild sun room with new structure as detailed.
- ensure all doors and windows open and close properly. replace broken glass as required.
- generally ensure all structure, finishes, plumbing, electrical and joinery items are repaired or replaced as required. contractor to determine extent of damage to all items on site, and confirm repair and replacement of all items with Heritage Architect.

REV	DATE	DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

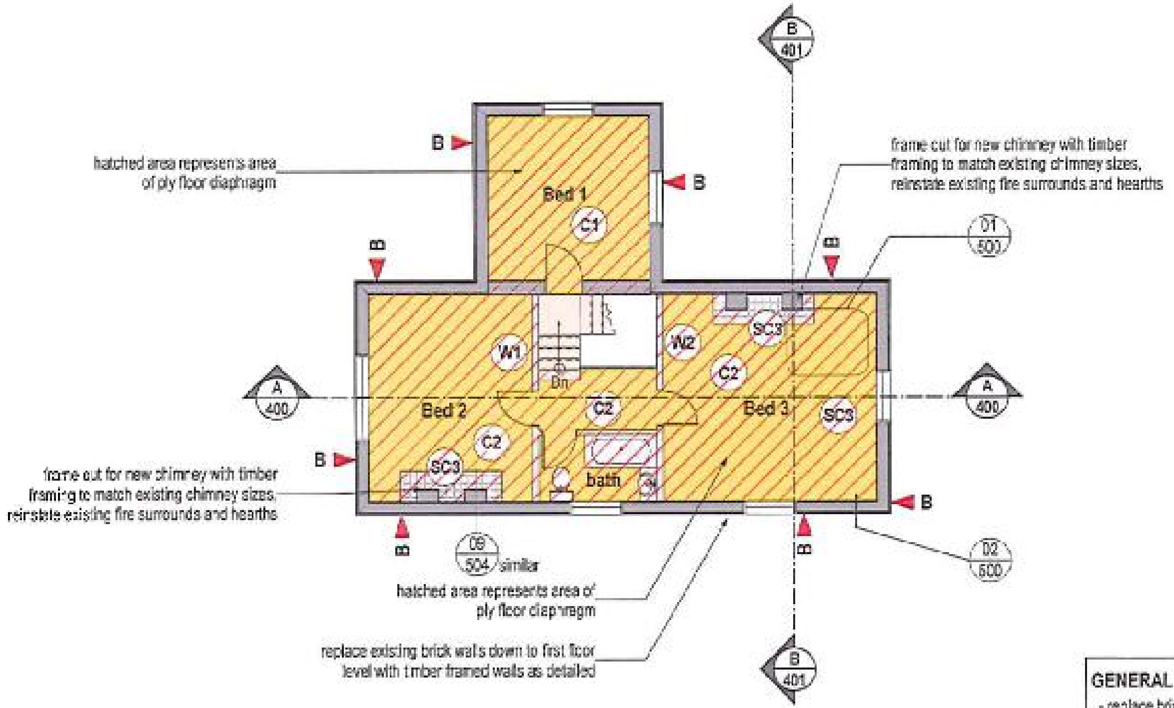
SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Proposed Ground Floor Plan

emajineer
Structural Concepts

SCL NUMBER 1606
SHEET 200
REV 0

DATE 18/06/12 | VW2012 A3 | DES - GN | DRG TH/JA

| STRUCTURAL CONCEPTS | E info@structuralconcepts.co.nz | P: +61 6 8129111 | F: +61 6 8120113 | 55 DUNLOP RD, PO BOX 3345, ONEKAWA, NAPIER 4142, NEW ZEALAND |



PROPOSED FIRST FLOOR PLAN

Scale 1:100 @ A3

STRUCTURAL PLAN KEY:

A - new solid concrete walls to match existing thickness to replace all lower floor double brick exterior walls.
- HD12 bars @ 200 crs horizontal, and HD16 bars @ 150mm crs vertical - see details
- Line interior walls with 13mm Gib board
- exterior cladding to be Stucco plaster to match existing

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(SC3) Repair ceiling lining - strip back plaster to timber lath, remove all loose plaster. replace bare areas with Braceline Gib or similar over existing lath, overlay joints between old plaster and new Gib with fibreglass reinforcing mesh, plaster area to a smooth finish

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NOTE: new wall thickness to match existing, and be located in exact location as existing walls. confirm framing size on site, and adjust to suit.

GENERAL SCOPE OF WORKS RECONSTRUCTION:

- replace brick walls that have been removed with concrete walls.
- replace upper level brick walls with timber framed walls in locations as shown and detailed on the plans.
- install floor diaphragm over top of existing first floor flooring to all rooms. remove and make good part ceilings as required, as per details.
- install roof diaphragm to rafters as detailed. replace with Gib board over ceiling battens (install new battens if required)
- generally repair all cracked plaster to timber walls. finish of all walls and ceilings to be confirmed with the Heritage Architect.
- replace existing chimney with timber frame as detailed, and install new roof tiles and roof structure to roof as required, make good, ensure roof is weather-tight.
- rebuild sun room with new structure as detailed.
- ensure all doors and windows open and close properly. replace broken glass as required.
- generally ensure all structure, finishes, plumbing, electrical and joinery items are repaired or replaced as required. contractor to determine extent of damage to all items on site, and confirm repair and replacement of all items with Heritage Architect.

REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Proposed First Floor Plan

emajineer
Structural Concepts

SCL NUMBER 1606
SHEET 201 REV 0

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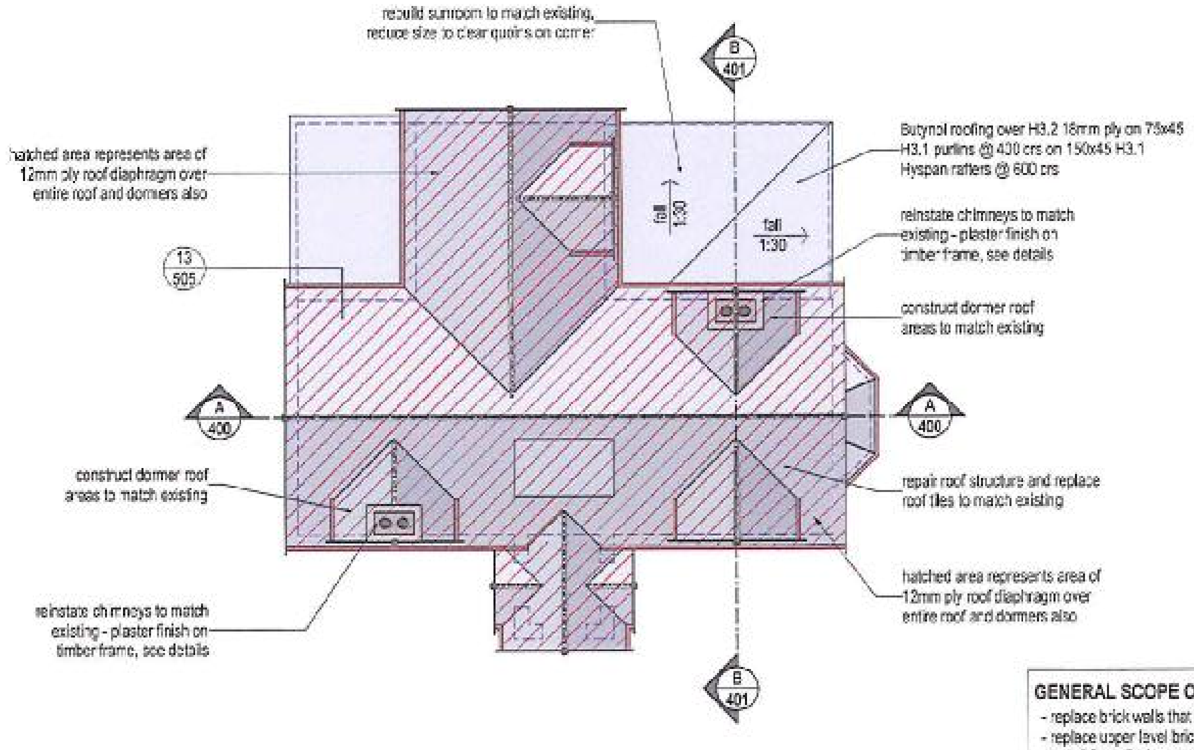
VW2012 A3 | DES - CJ | DRG TT/DJA

DATE 110512



PROPOSED ROOF PLAN
Scale 1:100 @ A3

GENERAL SCOPE OF WORKS RECONSTRUCTION:

- replace brick walls that have been removed with concrete walls.
- replace upper level brick walls with timber framed walls in locations as shown and detailed on the plans.
- install floor diaphragm over top of existing first floor flooring to all rooms. remove and make good part ceilings as required, as per details.
- install roof diaphragm to rafters as detailed. replace with Gib board over ceiling battens (install new battens if required)
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- ensure all doors and windows open and close properly. replace broken glass as required.
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REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

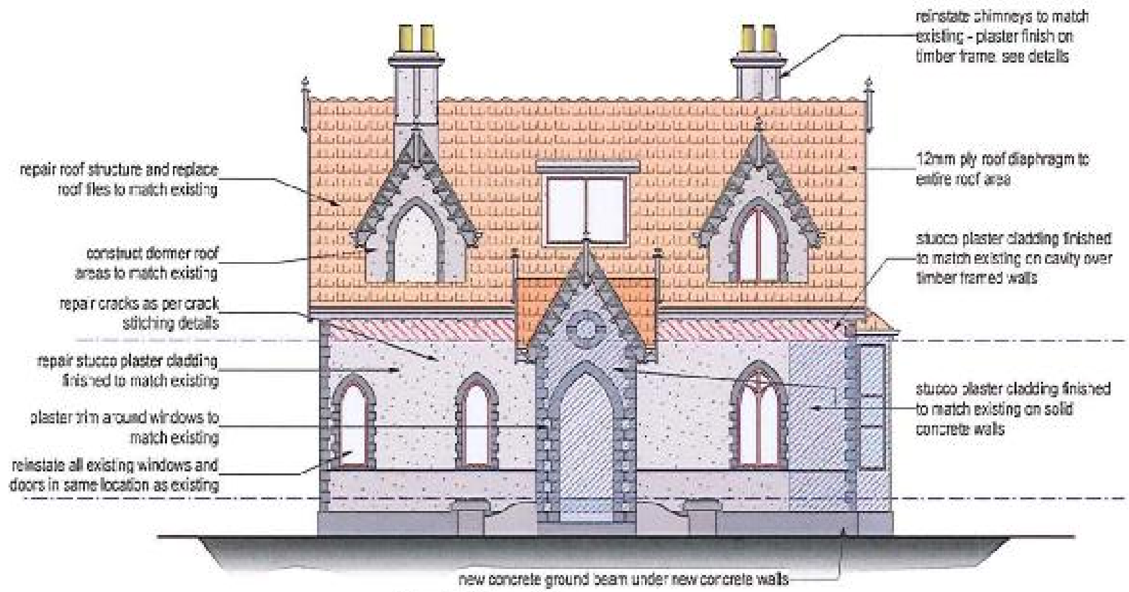
SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Proposed Roof Plan

emajineer
Structural Concepts

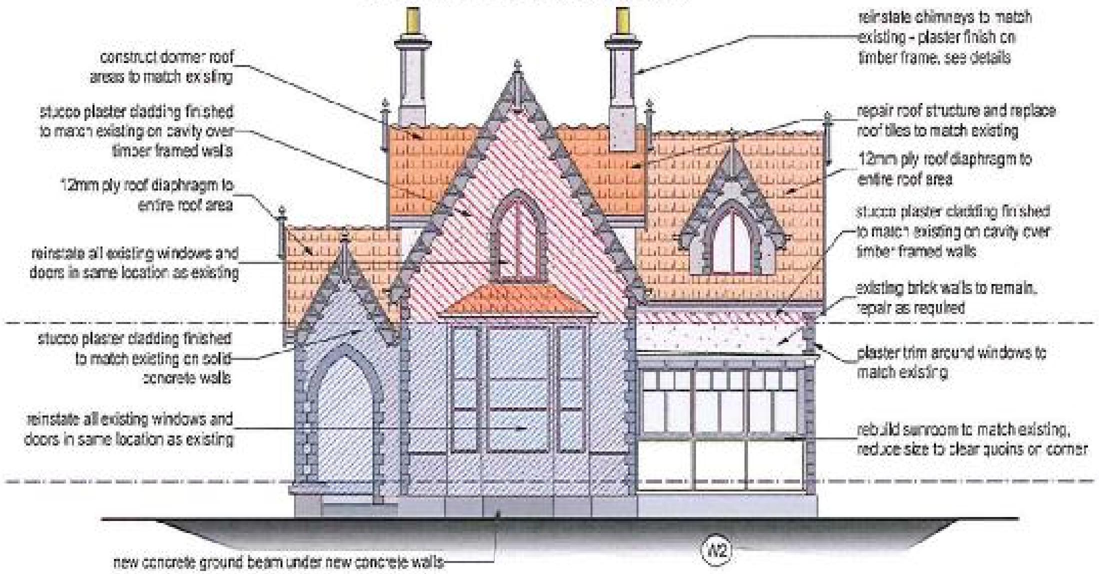
SCL NUMBER 1606
SHEET 202 REV 0

DATE 11/05/12 | V/2012 A3 | DES-GN | DRG TIVOA

| STRUCTURAL CONCEPTS | E info@structuralconcepts.co.nz | P: +64 6 8430113 | F: +64 6 8430113 | 55 OLD OP RD, PO BOX 3315, ONEKAWA, NAPIER 4142, NEW ZEALAND |



East Elevation Scale 1:100 @ A3



North Elevation Scale 1:100 @ A3

GENERAL SCOPE OF WORKS RECONSTRUCTION:

- replace brick walls that have been removed with concrete walls.
- replace upper level brick walls with timber framed walls in locations as shown and detailed on the plans.
- install floor diaphragm over top of existing first floor flooring to all rooms. remove and make good part ceilings as required, as per details.
- install roof diaphragm to rafters as detailed. replace with Gib board over ceiling battens (install new battens if required)
- generally repair all cracked plaster to timber walls. finish of all walls and ceilings to be confirmed with the Heritage Architect.
- replace existing chimney with timber frame as detailed, and install new roof tiles and roof structure to roof as required, make good, ensure roof is weather-tight.
- rebuild sun room with new structure as detailed.
- ensure all doors and windows open and close properly. replace broken glass as required.
- generally ensure all structure, finishes, plumbing, electrical and joinery items are repaired or replaced as required. contractor to determine extent of damage to all items on site. and confirm repair and replacement of all items with Heritage Architect.

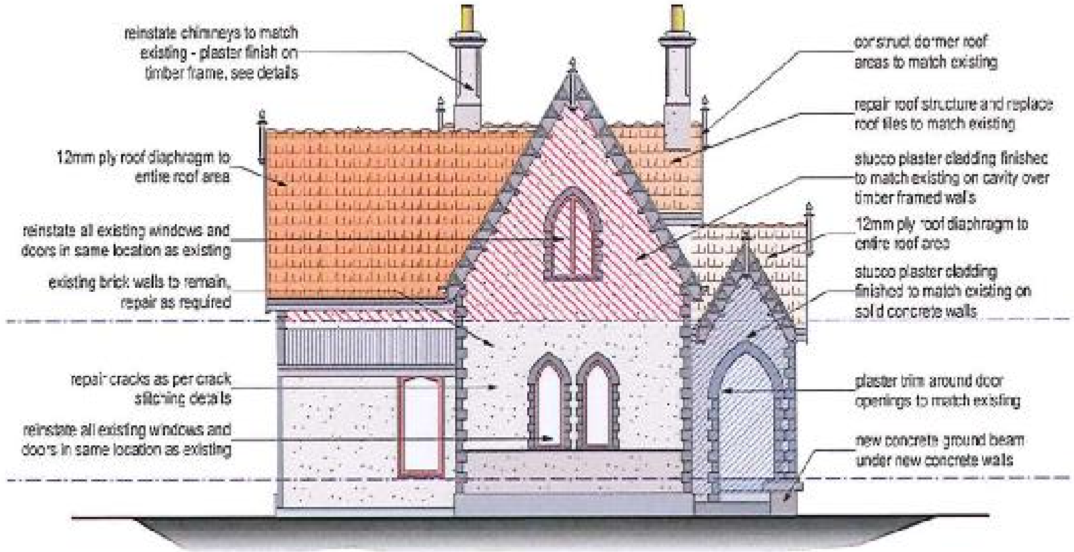
REV	DATE	DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

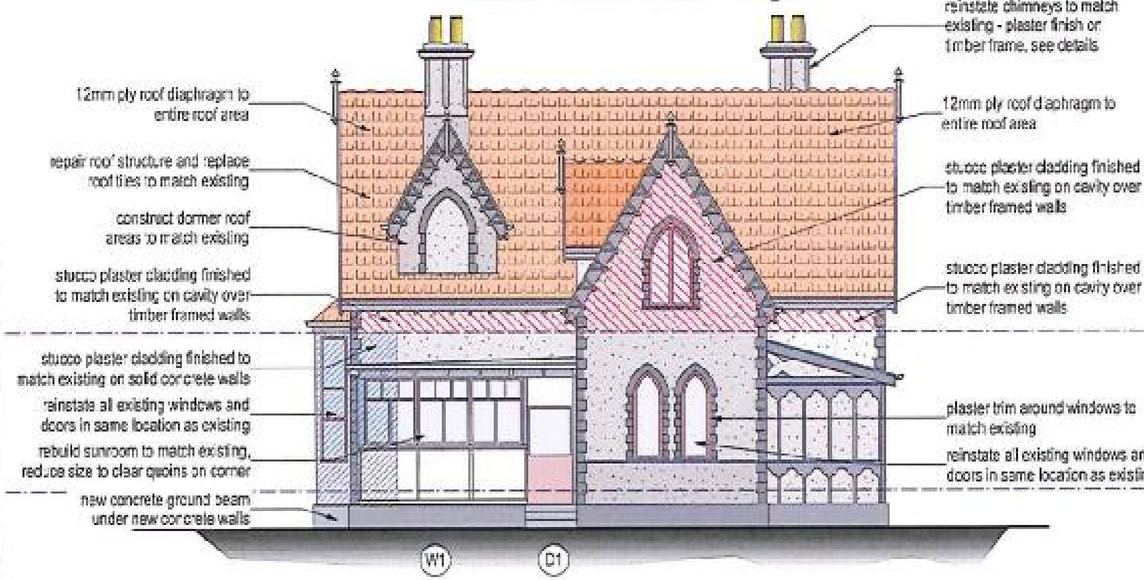
SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Proposed North and East Elevations

emajineer
Structural Concepts

SCL NUMBER 1606
SHEET 280 REV 0



South Elevation Scale 1:100 @ A3



West Elevation Scale 1:100 @ A3

GENERAL SCOPE OF WORKS RECONSTRUCTION:

- replace brick walls that have been removed with concrete walls.
- replace upper level brick walls with timber framed walls in locations as shown and detailed on the plans.
- install floor diaphragm over top of existing first floor flooring to all rooms, remove and make good part ceilings as required, as per details.
- install roof diaphragm to rafters as detailed, replace with Gib board over ceiling battens (install new battens if required)
- generally repair all cracked plaster to timber walls, finish of all walls and ceilings to be confirmed with the Heritage Architect.
- replace existing chimney with timber frame as detailed, and install new roof tiles and roof structure to roof as required, make good, ensure roof is weather-tight.
- rebuild sun room with new structure as detailed.
- ensure all doors and windows open and close properly, replace broken glass as required.
- generally ensure all structure, finishes, plumbing, electrical and joinery items are repaired or replaced as required, contractor to determine extent of damage to all items on site, and confirm repair and replacement of all items with Heritage Architect.

REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

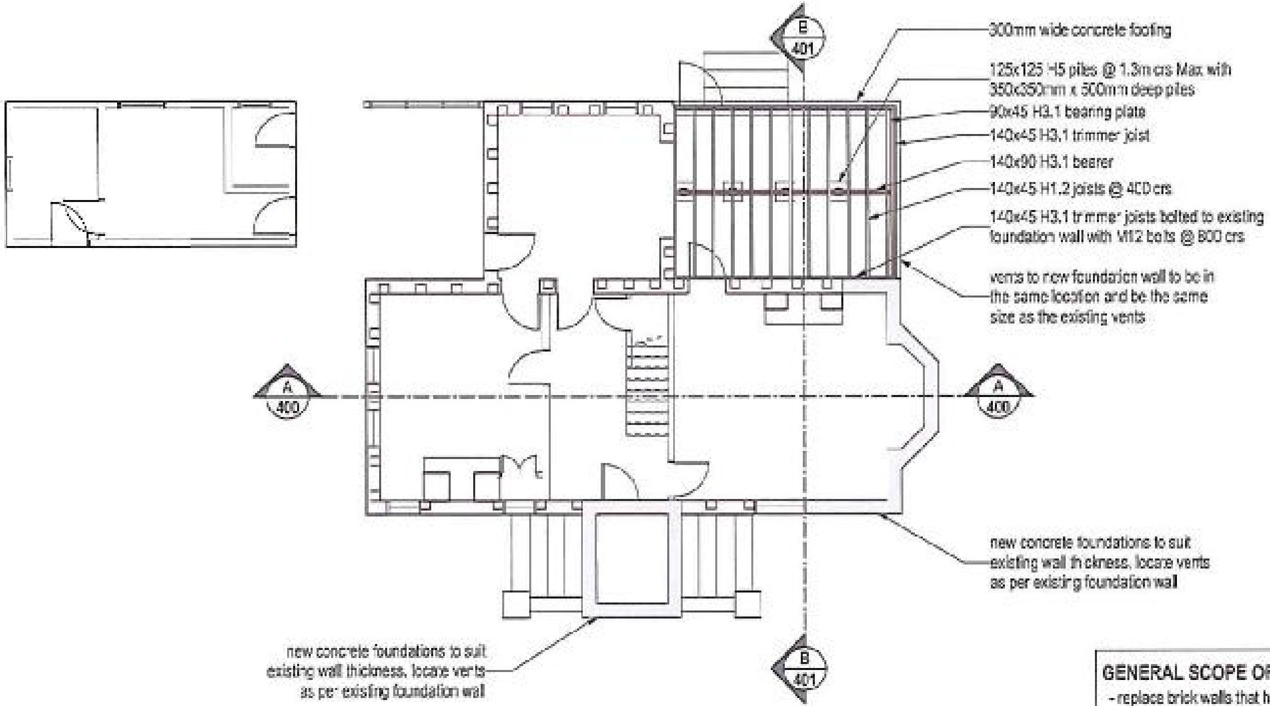
SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Proposed South and West Elevations

emajineer
Structural Concepts

SC. NUMBER 1606
SHEET 281 REV 0

DATE 11/09/12 W/2012 A3 | DES - GH | DRG TRDA

| STRUCTURAL CONCEPTS | E: info@structuralconcepts.co.nz | P: +64 6 8432111 | F: +64 6 8432113 | 55 DUNLOP RD, PO BOX 3315, ONEKAWA, NAPIER 4142, NEW ZEALAND |



GENERAL SCOPE OF WORKS RECONSTRUCTION:

- replace brick walls that have been removed with concrete walls.
- replace upper level brick walls with timber framed walls in locations as shown and detailed on the plans.
- install floor diaphragm over top of existing first floor flooring to all rooms. remove and make good part ceilings as required, as per details.
- install roof diaphragm to rafters as detailed. replace with Gib board over ceiling battens (install new battens if required)
- generally repair all cracked plaster to timber walls. finish of all walls and ceilings to be confirmed with the Heritage Architect.
- replace existing chimney with timber frame as detailed, and install new roof tiles and roof structure to roof as required. make good, ensure roof is weather-tight.
- rebuild sun room with new structure as detailed.
- ensure all doors and windows open and close properly. replace broken glass as required.
- generally ensure all structure, finishes, plumbing, electrical and joinery items are repaired or replaced as required. contractor to determine extent of damage to all items on site, and confirm repair and replacement of all items with Heritage Architect.

PROPOSED FOUNDATION PLAN

Scale 1:100 @ A3

REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

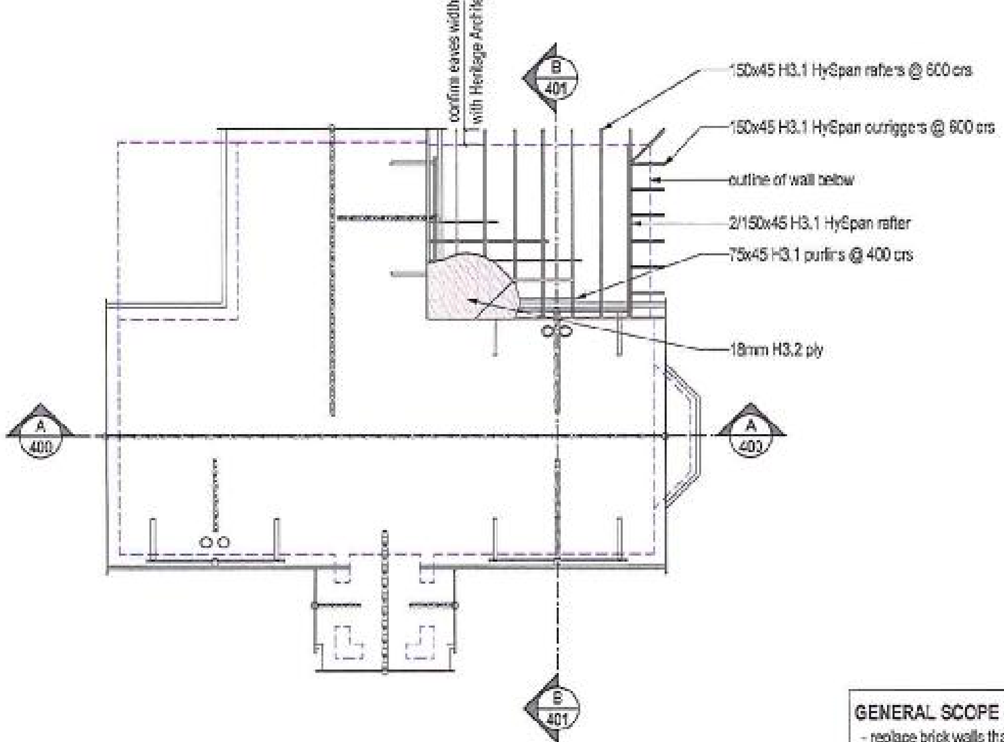
SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Proposed Foundation Plan

emajineer
Structural Concepts

SCL NUMBER 1606
SHEET 300 REV 0

DATE 11/09/12 W/2012 A3 | DCS-GV | DSG T/DA

| STRUCTURAL CONCEPTS | E: info@structuralconcepts.co.nz | P: +64 6 8420111 | F: +64 6 8420113 | 55 DUNLOP RD, PO BOX 3015, ONEKAWA, NAPIER 4112, NEW ZEALAND |



PROPOSED ROOF FRAMING PLAN

Scale 1:100 @ A3

GENERAL SCOPE OF WORKS RECONSTRUCTION:

- replace brick walls that have been removed with concrete walls.
- replace upper level brick walls with timber framed walls in locations as shown and detailed on the plans.
- install floor diaphragm over top of existing first floor flooring to all rooms. remove and make good part ceilings as required, as per details.
- install roof diaphragm to rafters as detailed. replace with Gib board over ceiling battens (install new battens if required)
- generally repair all cracked plaster to timber walls. finish of all walls and ceilings to be confirmed with the Heritage Architect.
- replace existing chimney with timber frame as detailed, and install new roof tiles and roof structure to roof as required, make good, ensure roof is weather-tight.
- rebuild sun room with new structure as detailed.
- ensure all doors and windows open and close properly. replace broken glass as required.
- generally ensure all structure, finishes, plumbing, electrical and joinery items are repaired or replaced as required. contractor to determine extent of damage to all items on site, and confirm repair and replacement of all items with Heritage Architect.

REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Proposed Roof Framing Plan

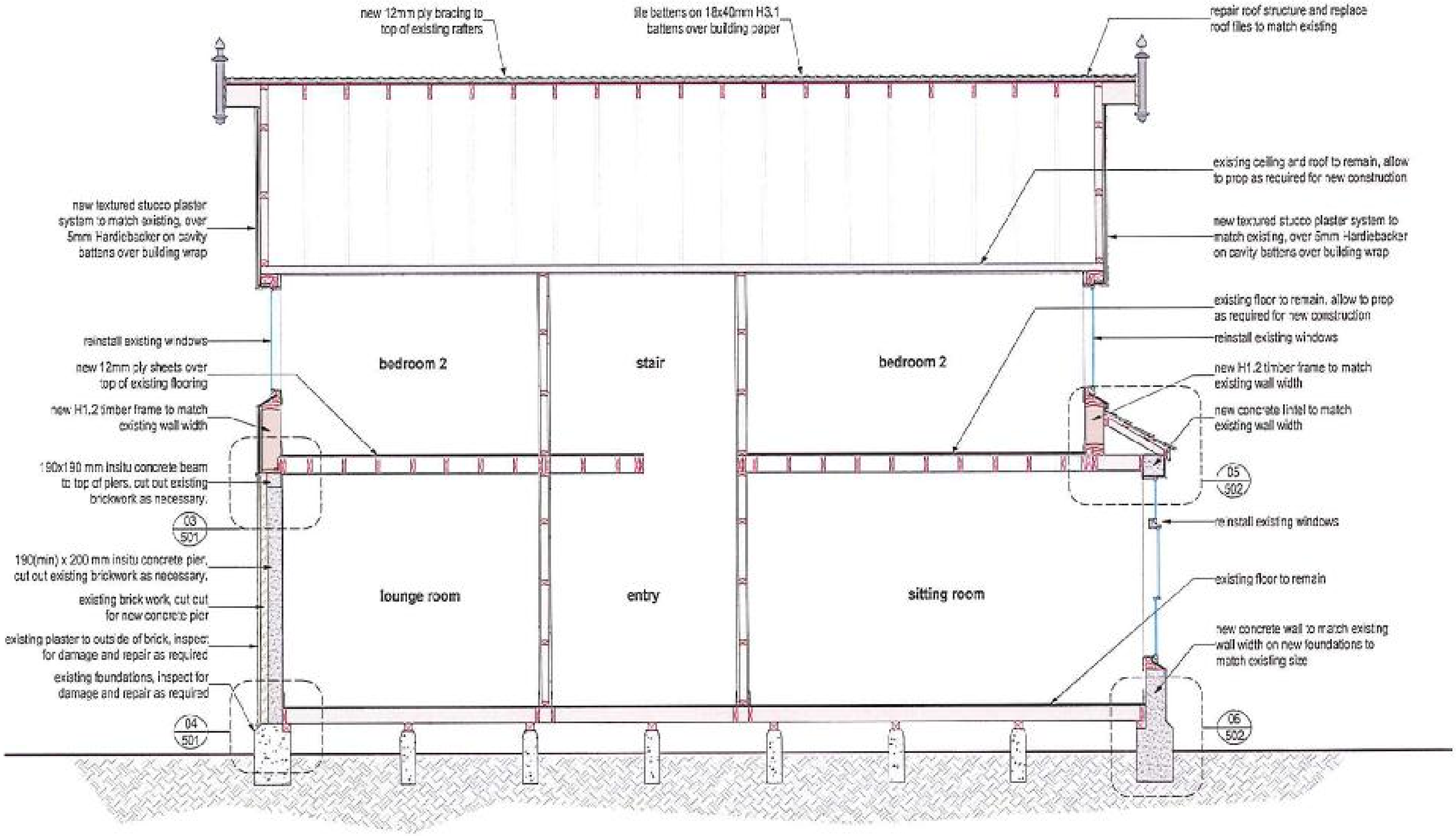
emajineer
Structural Concepts

SCL NUMBER 1606
SHEET 310 REV 0

DATE 11/02/12

VIl2012 A3 | DES-GN | DRG TT/OA

| STRUCTURAL CONCEPTS | E info@structuralconcepts.co.nz | P: +64 6 8430111 | F: +64 6 8430113 | 55 DUNLOP RD, PO BOX 3315, ONEKAWA, NAPIER 4142, NEW ZEALAND |



Section A-A Scale 1:50 @ A3

REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

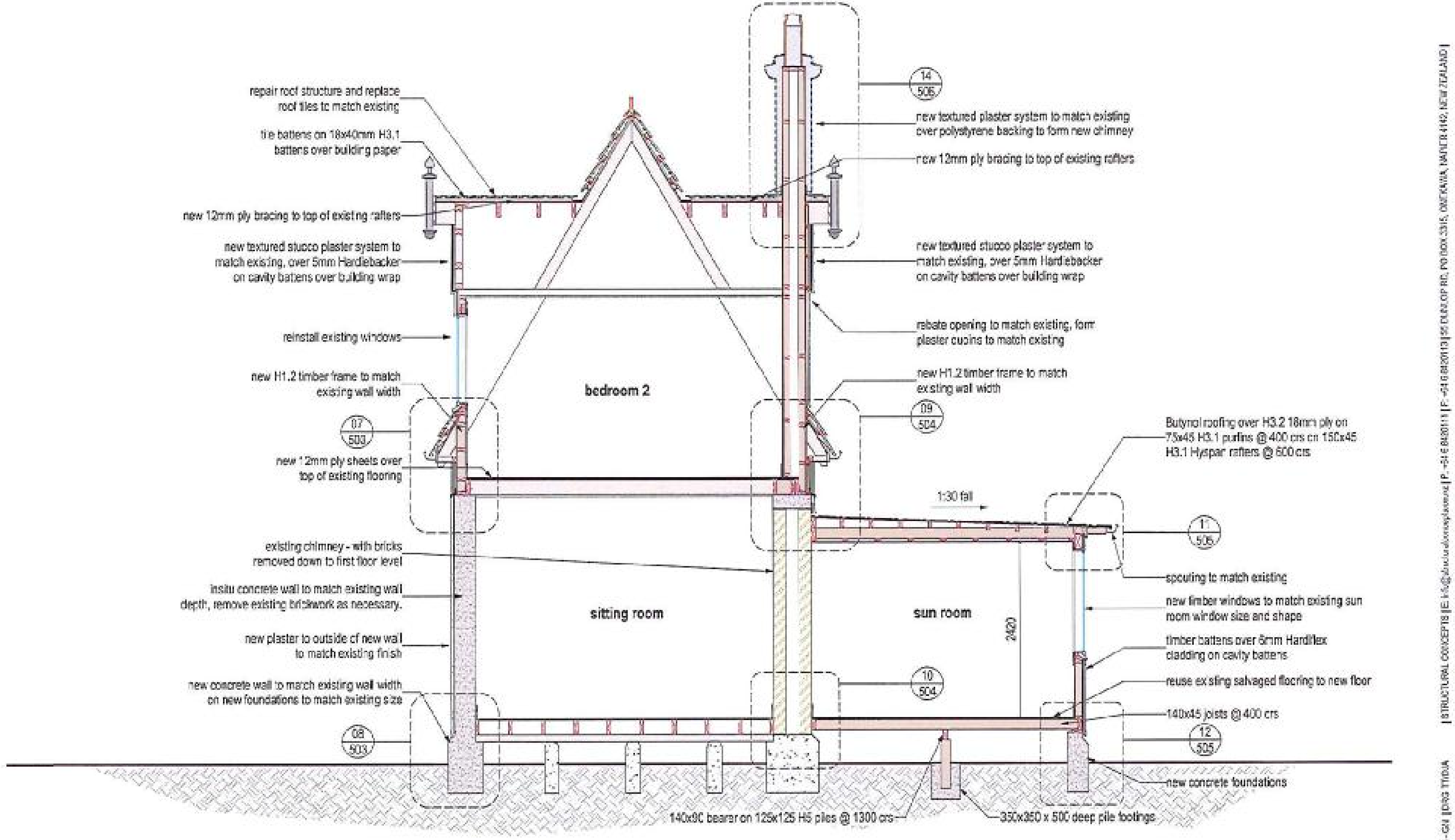
SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Section A-A

emajineer
Structural Concepts

SCL NUMBER 1606
SHEET 400 REV 0

DATE 11/06/12 W2012 A3 | DESIGN | DRG TITLE

| STRUCTURAL CONCEPTS | E info@structuralconcepts.co.nz | P: +64 6 8120111 | F: +64 6 8120113 | 55 DUNLOP RD, PO BOX 3315, ONEKAWA, NAPIER 4142, NEW ZEALAND |



Section B-B Scale 1:50 @ A3

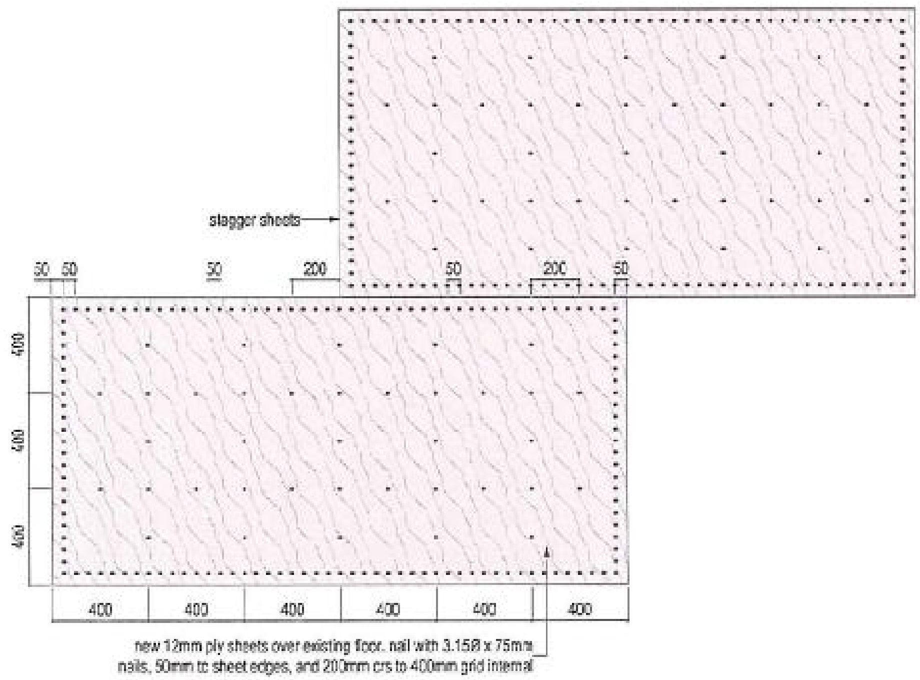
REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

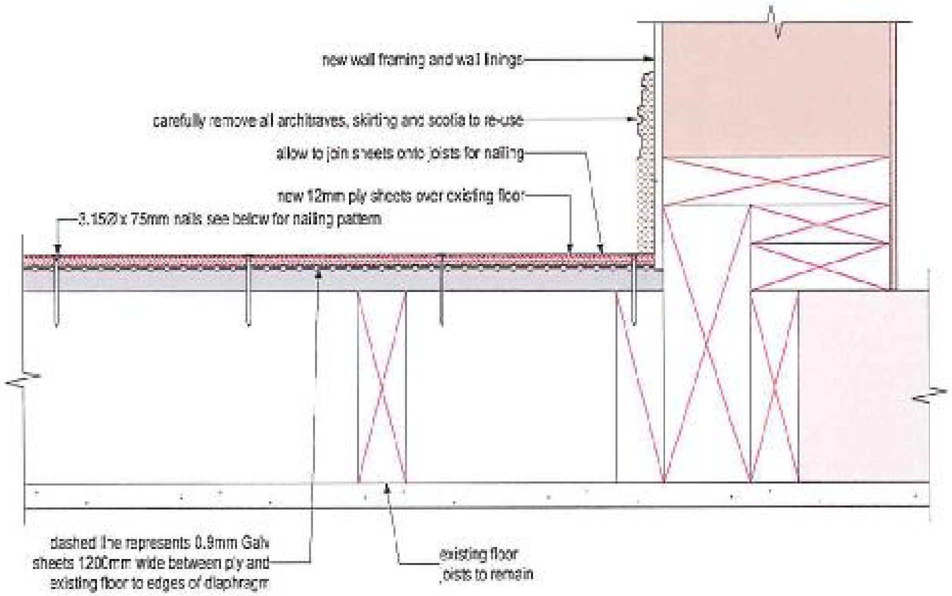
SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Section B-B

emajineer
Structural Concepts

SCL NUMBER 1606
SHEET 401 REV 0



01/201 FLOOR DIAPHRAGM NAIL LAYOUT
1:20 at A3



02/201 FLOOR DIAPHRAGM DETAILS
1:5 at A3

REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

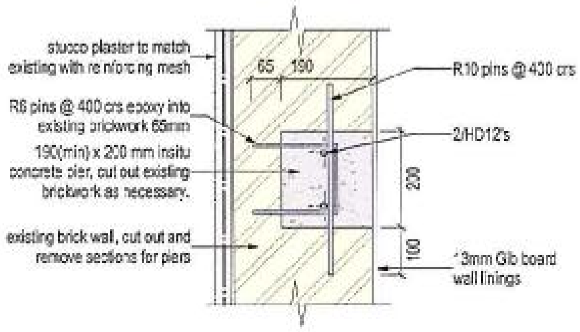
SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Structural Details

emajineer
Structural Concepts

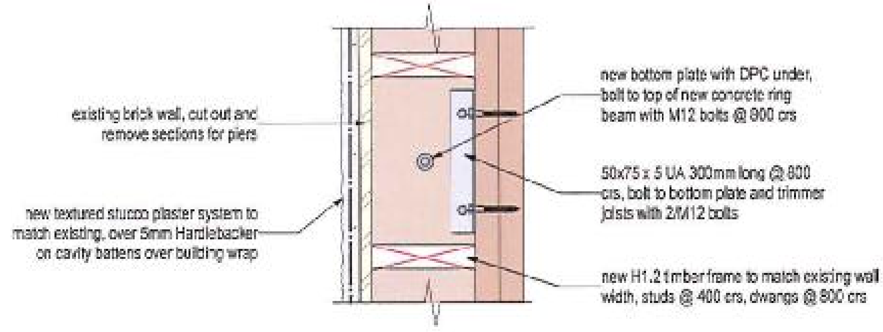
SCL NUMBER 1606
SHEET 500 REV 0

| STRUCTURAL CONCEPTS | E info@structuralconcepts.co.nz | P: +64 6 8120113 | F: +64 6 8120111 | 55 DUNLOP RD, PO BOX 3355, ONEKAWA, NAPIER 4142, NEW ZEALAND |

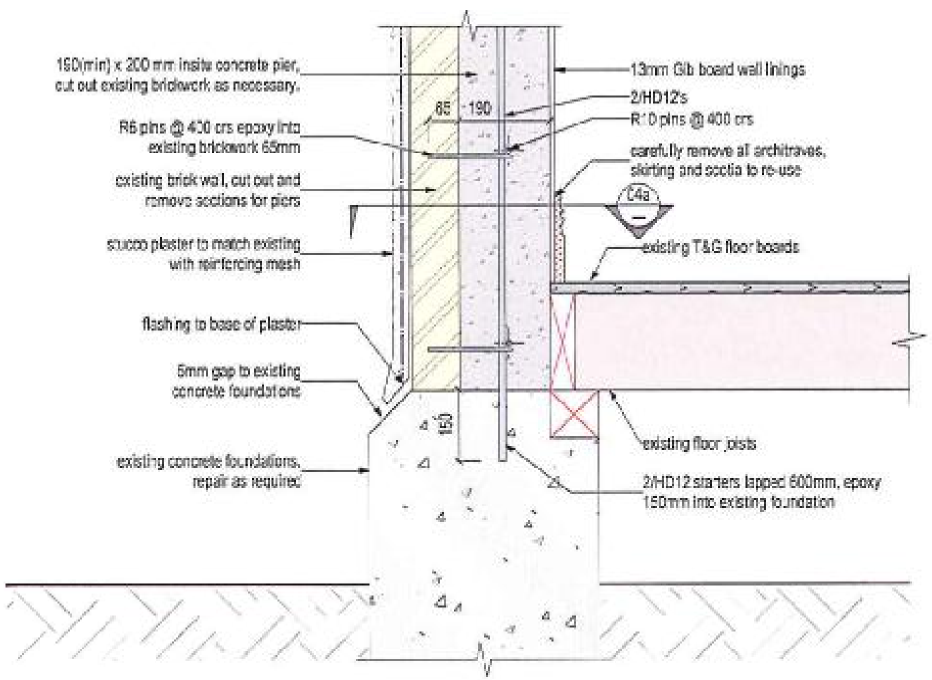
VW2012 A3 | DES-CN | DRG TT/GVA
DATE 11/09/12



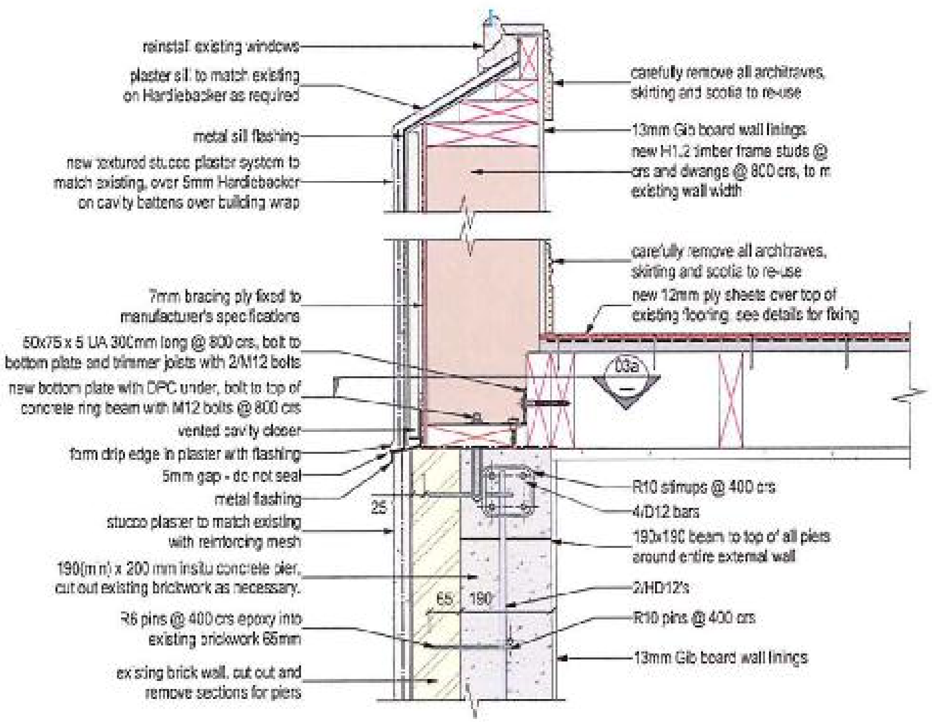
04a DETAIL
1:10 at A3



03a DETAIL
1:10 at A3



04 DETAIL
400 1:10 at A3



03 DETAIL
400 1:10 at A3

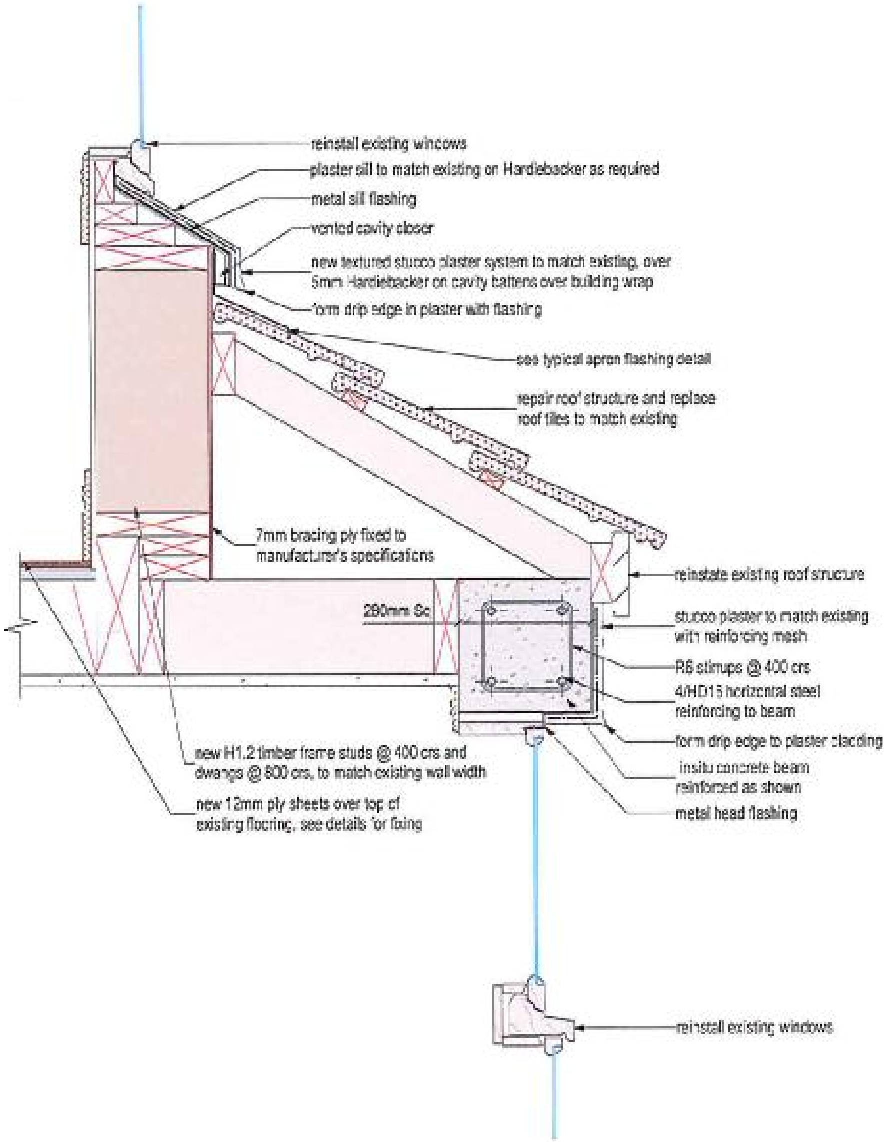
REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

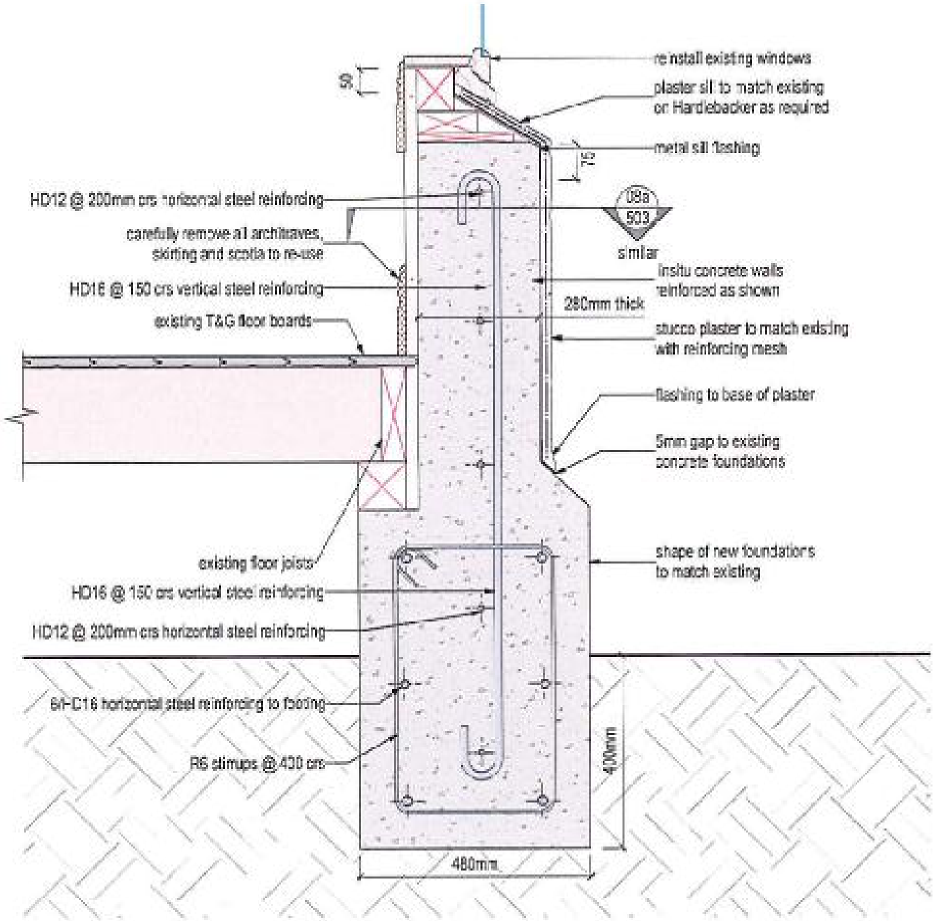
SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Structural Details

emajineer
Structural Concepts

SCL NUMBER 1606
SHEET 501 REV 0



05/400 **DETAIL**
1:10 at A3



06/400 **DETAIL**
1:10 at A3

REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

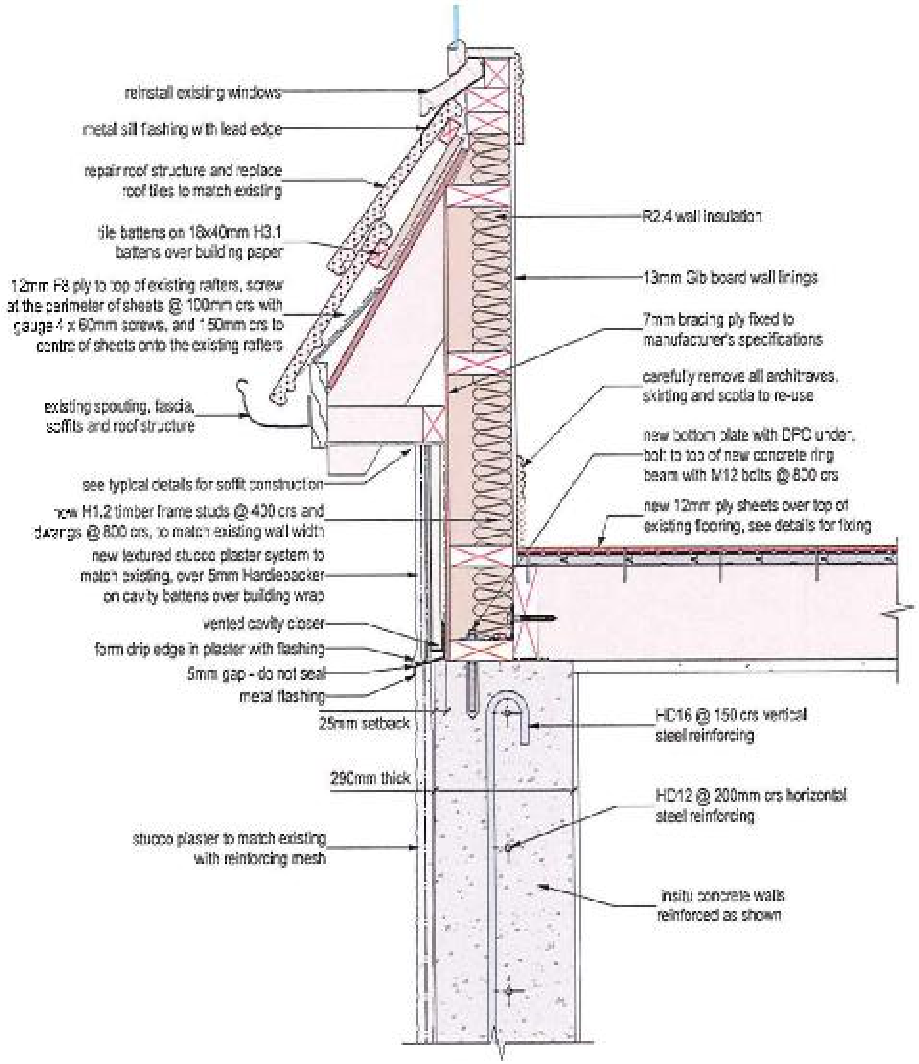
SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Structural Details

emajineer
Structural Concepts

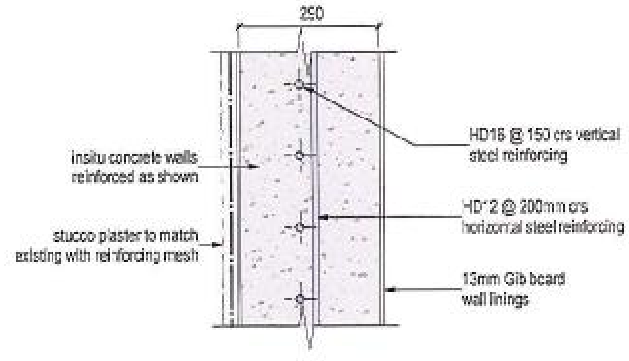
SCL NUMBER 1606
SHEET 502
REV 0

DATE 1/05/12 V4/2012 A3 | DCS-CH | DRG TTIDIA

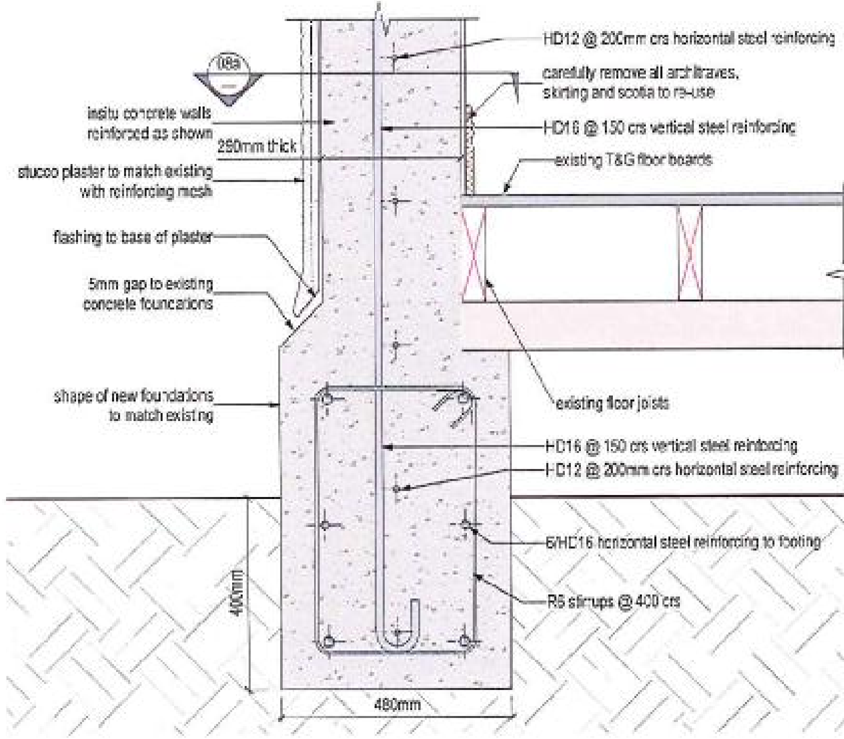
| STRUCTURAL CONCEPTS | E [illegible] | P: +64 6 8120111 | F: +64 6 8120113 | 56 DUNLOP RD, PO BOX 3315, ONEKAWA, [illegible] 4142, NEW ZEALAND |



07 DETAIL
401 1:10 at A3



08a DETAIL
— 1:10 at A3



08 DETAIL
401 1:10 at A3

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Structural Details

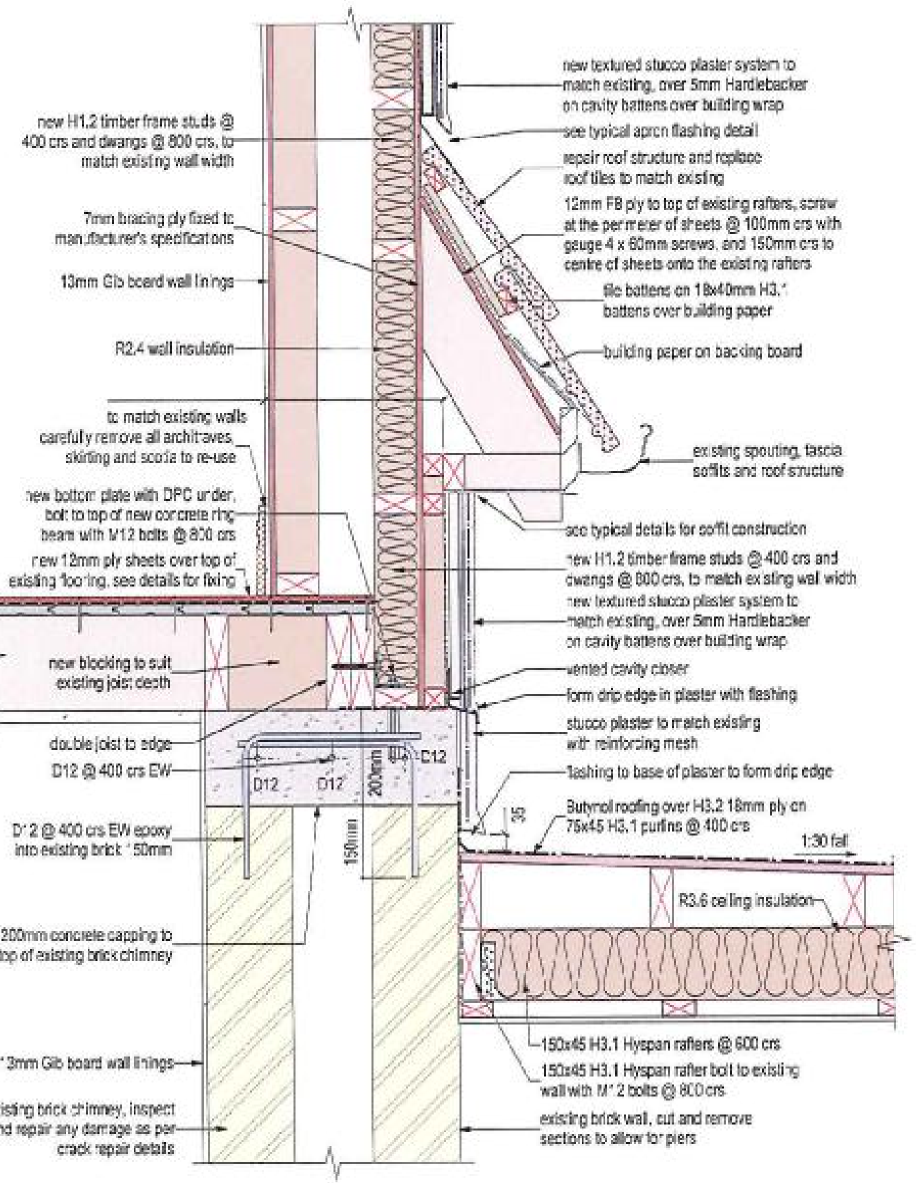
emajineer
Structural Concepts

SC. NUMBER 1606
SHEET 503 REV 0

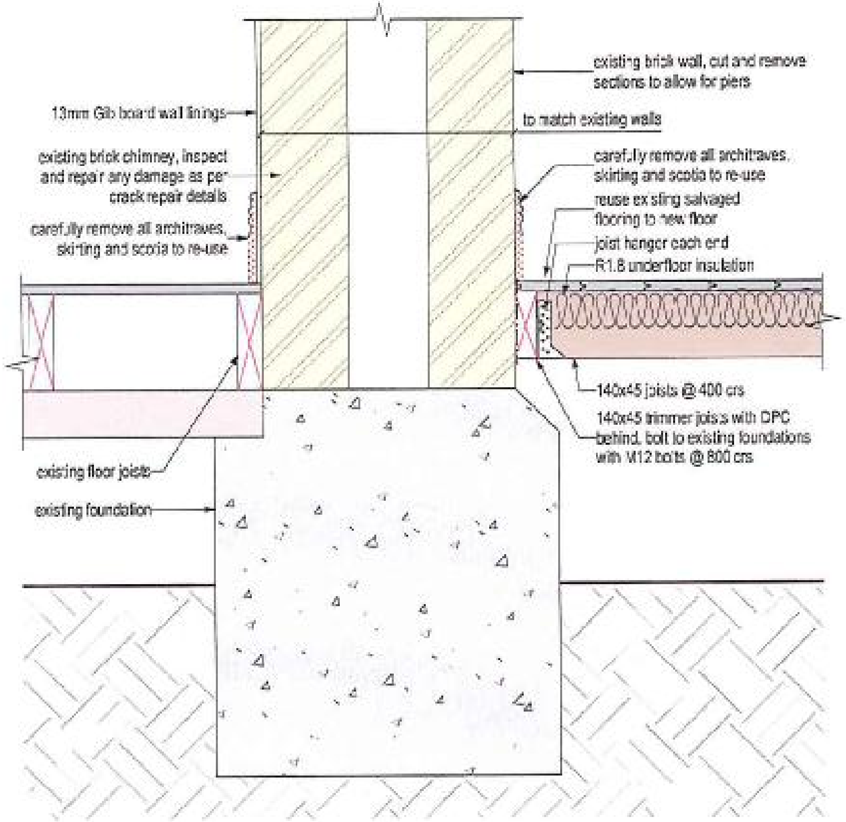
REV DATE DESCRIPTION

DATE 11/05/12 V1/2012 A3 | DES - GN | DRG TT/JA

| STRUCTURAL CONCEPTS | E info@structuralconcepts.co.nz | P. +64 6 8420113 | F. +64 6 8420111 | 55 DUNLOP RD, PO BOX 3315, ONEKAWA, NAPIER 4142, NEW ZEALAND |



39/401 **DETAIL** 1:10 at A3



10/401 **DETAIL** 1:10 at A3

REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Structural Details

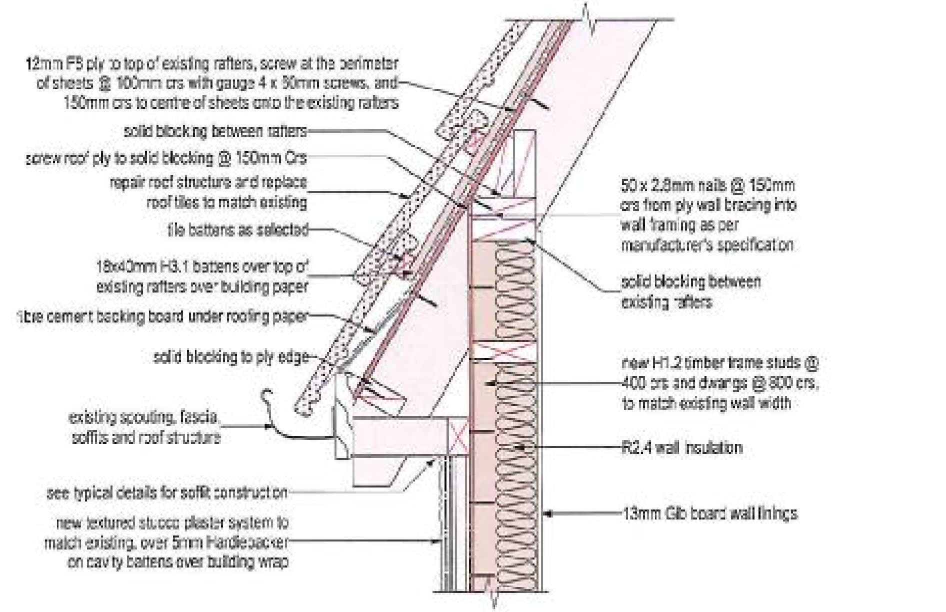
emajineer
Structural Concepts

SCL NUMBER 1606
SHEET 504 REV 0

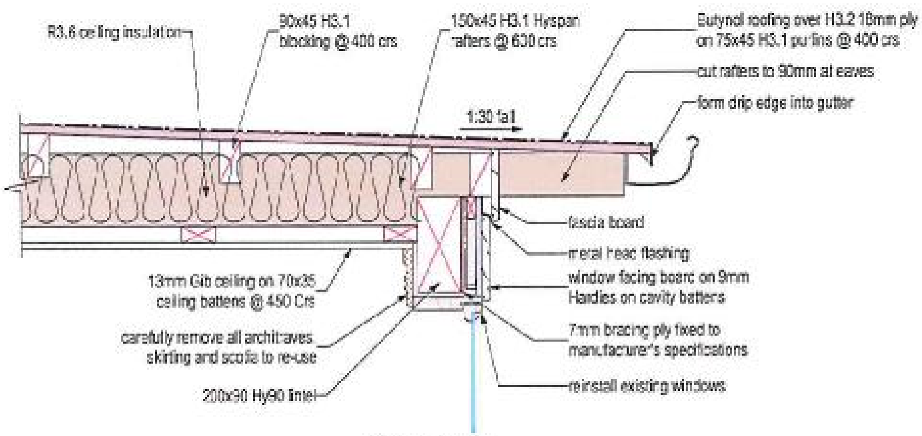
DATE 11/09/12

VW2012 A3 | DES - GV | DRG T.HMA

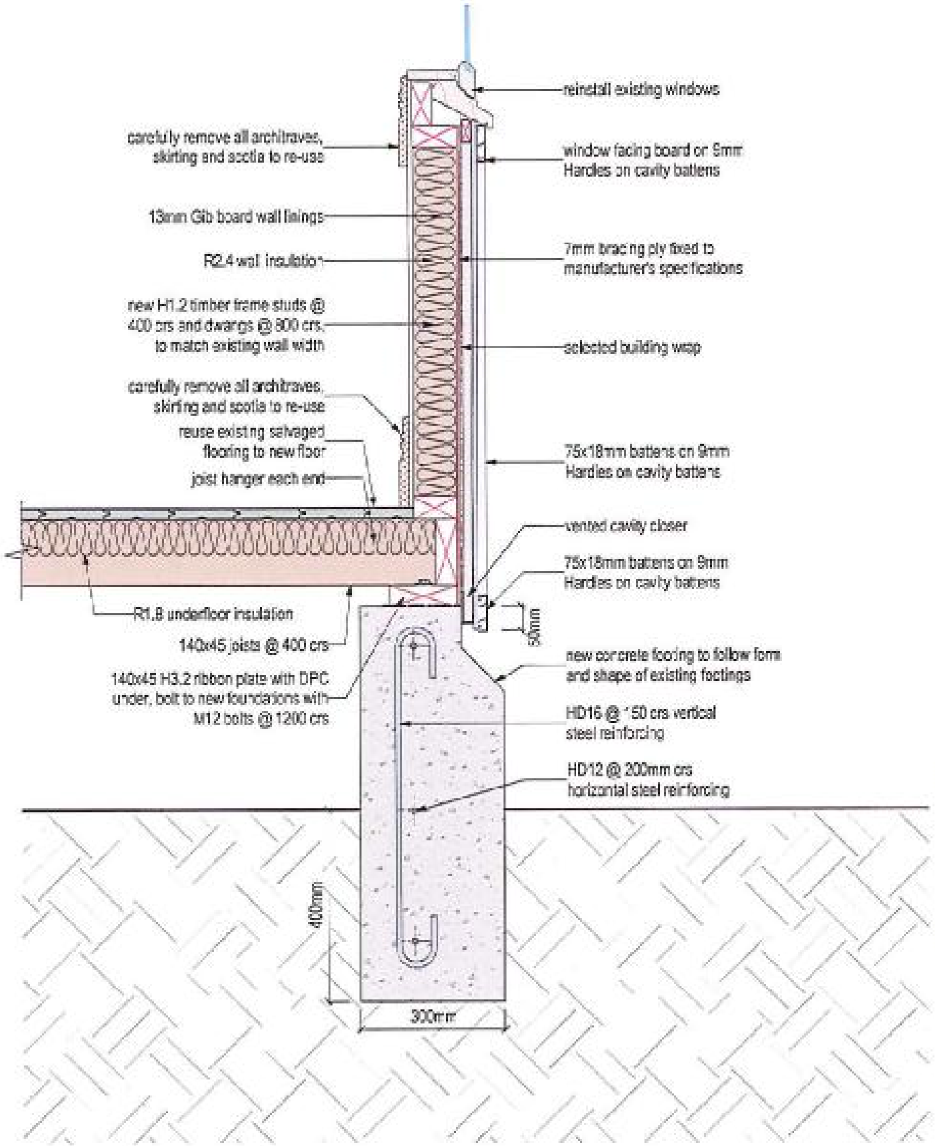
| STRUCTURAL CONCEPTS | E: info@structuralconcepts.co.nz | P: +64 6 8120113 | F: +64 6 8120111 | 55 DUNLOP RD, PO BOX 3315, ONEKAWA, NAPIER 4142, NEW ZEALAND |



13 DETAIL
202 1:10 at A3



11 DETAIL
401 1:10 at A3



12 DETAIL
401 1:10 at A3

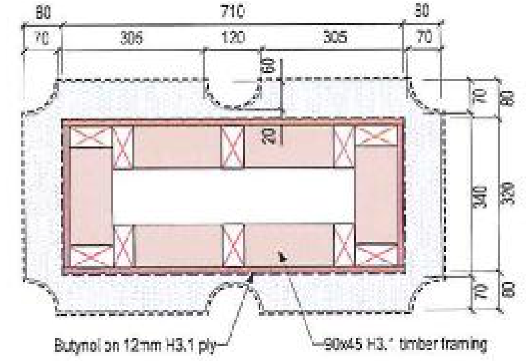
REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

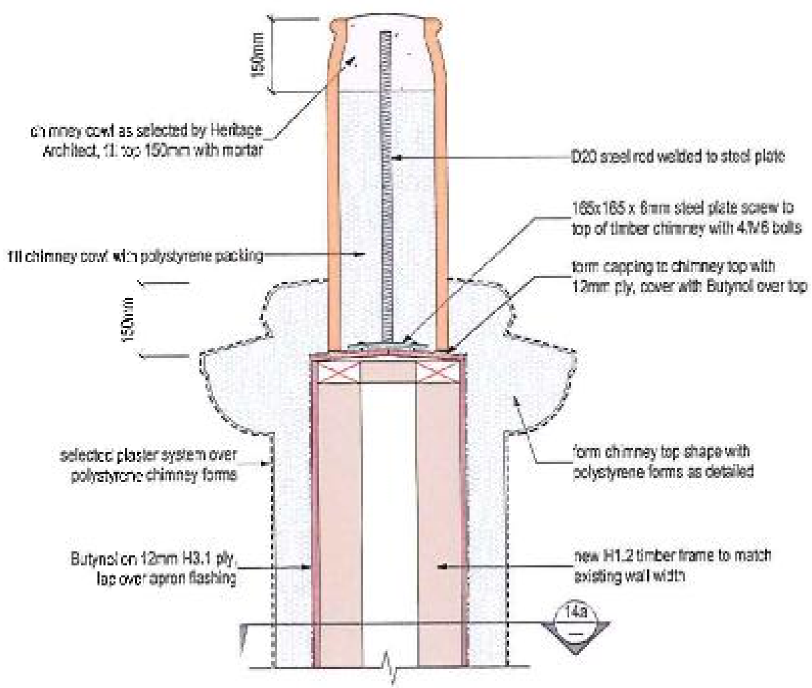
SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Structural Details

emajineer
Structural Concepts

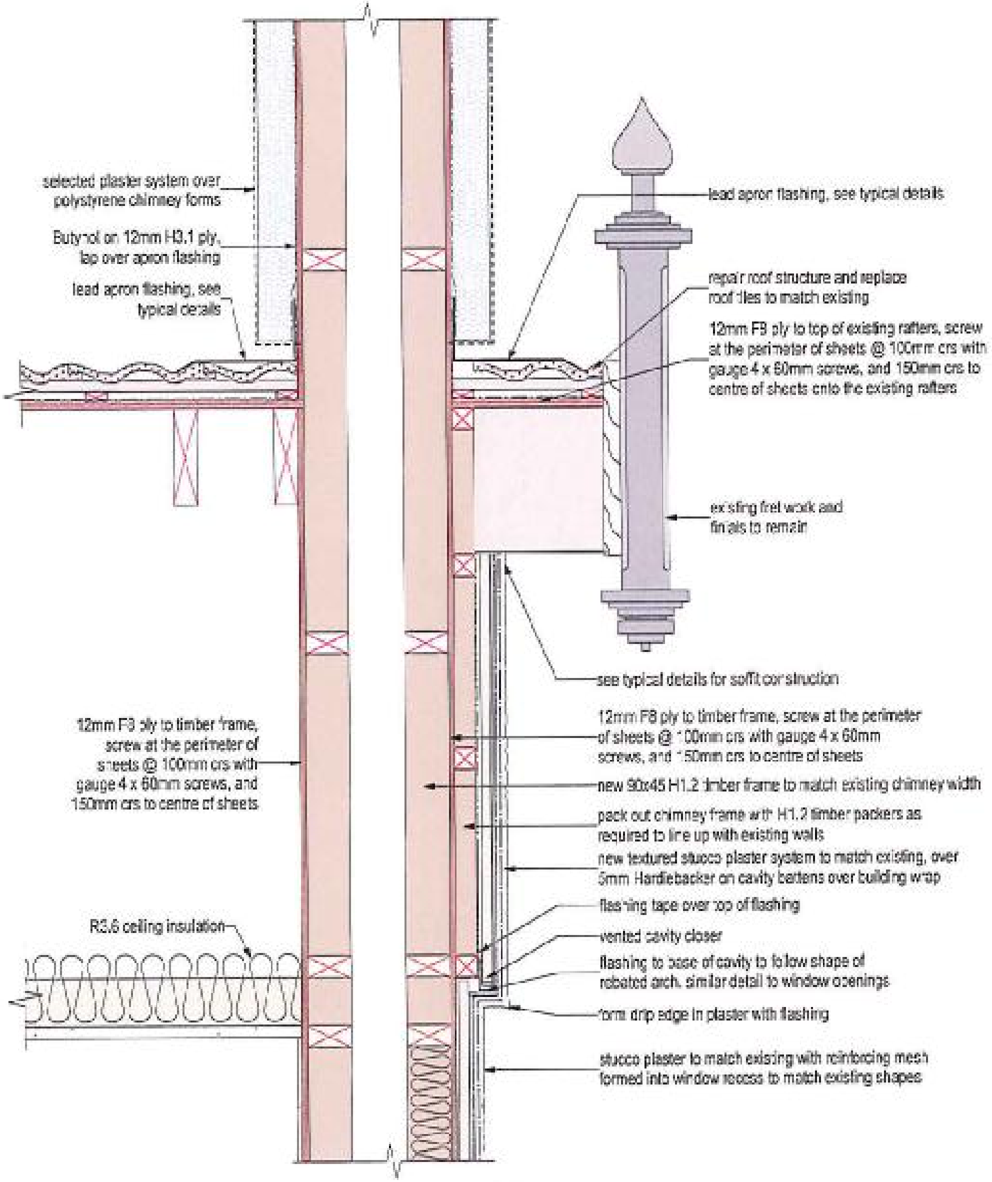
SCL NUMBER 1606
SHEET 505 REV 0



14a DETAIL
1:10 at A3



14/401 DETAIL
1:10 at A3



14/401 DETAIL
1:10 at A3

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF MONAVALE GATE HOUSE CHRISTCHURCH
Structural Details

emajineer
Structural Concepts

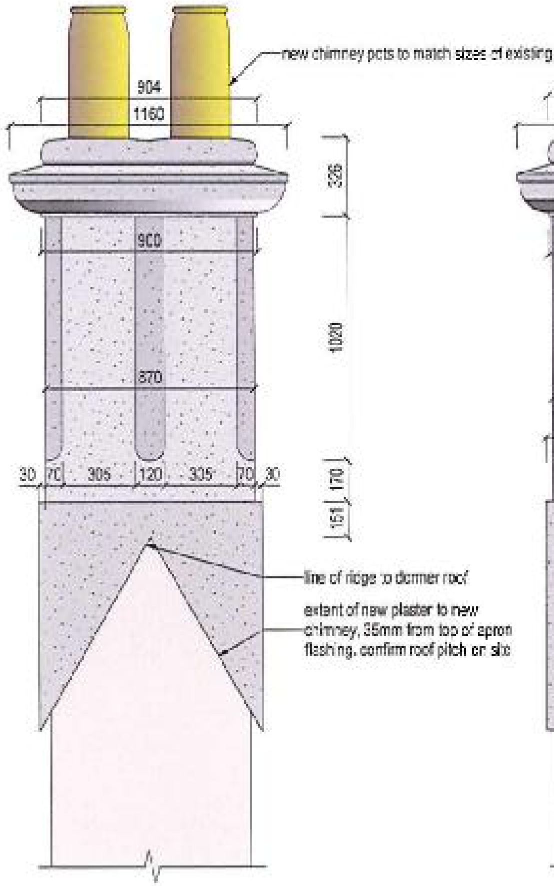
SC NUMBER	
1606	
SHEET	REV
506	0

REV DATE DESCRIPTION

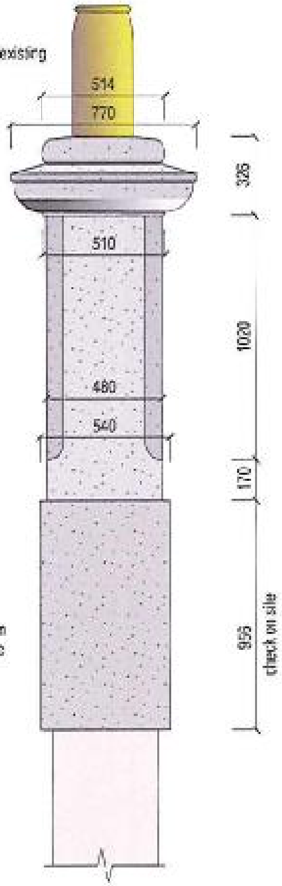
DATE 11/09/12

V9/2012 A3 | DES - GN | DRG TNDIA

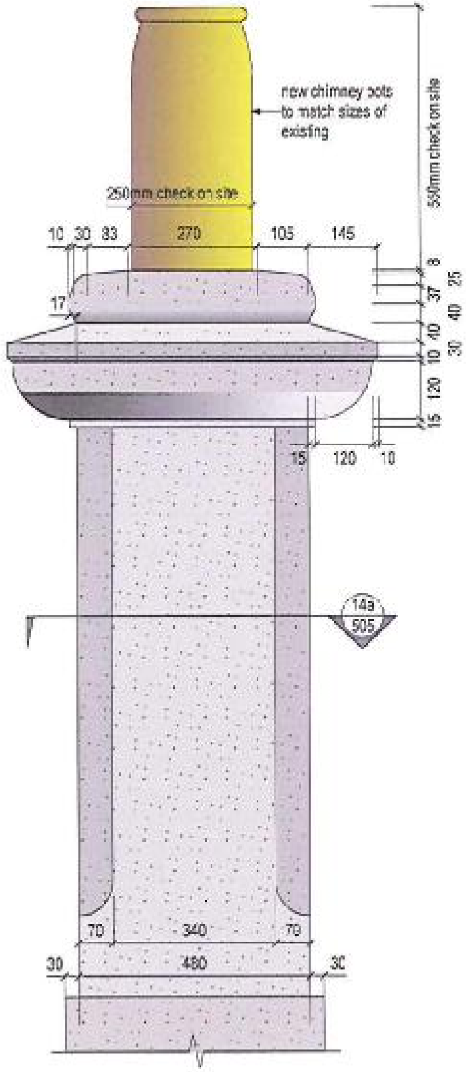
| STRUCTURAL CONCEPTS | E: info@structuralconcepts.co.nz | P: +64 6 8420111 | F: +64 6 8420110 | 55 DUNLOP RD, PO BOX 3315, ONEKAWA, NAPIER 4142, NEW ZEALAND |



Front Elevation Scale 1:20 @ A3



Side Elevation Scale 1:20 @ A3



Chimney Top Detail Scale 1:10 @ A3

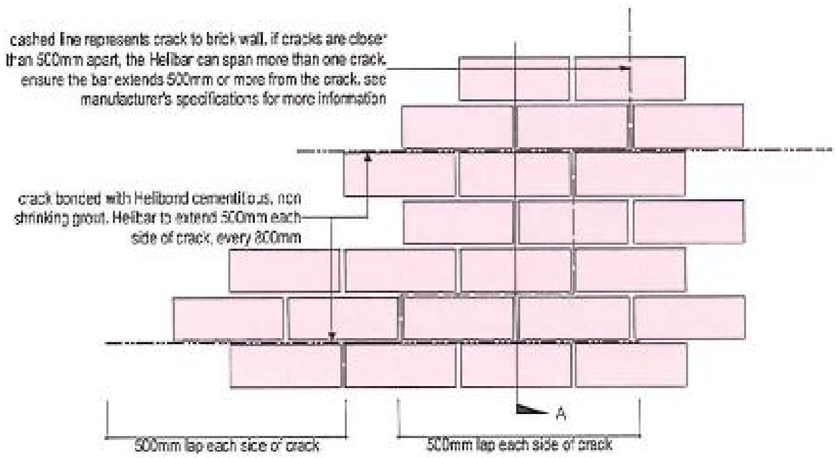
REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

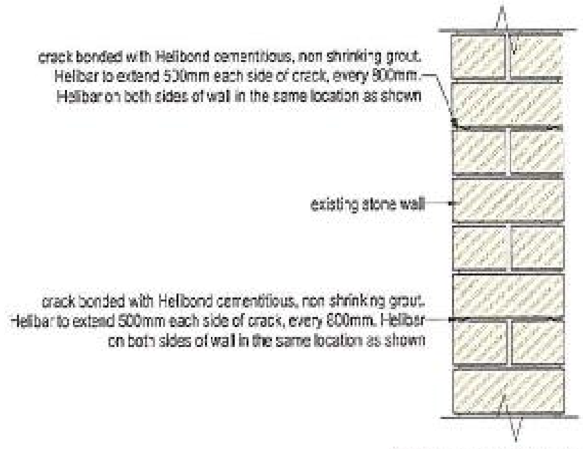
SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Chimney Elevations

emajineer
Structural Concepts

SCL NUMBER 1606
SHEET 510
REV 0

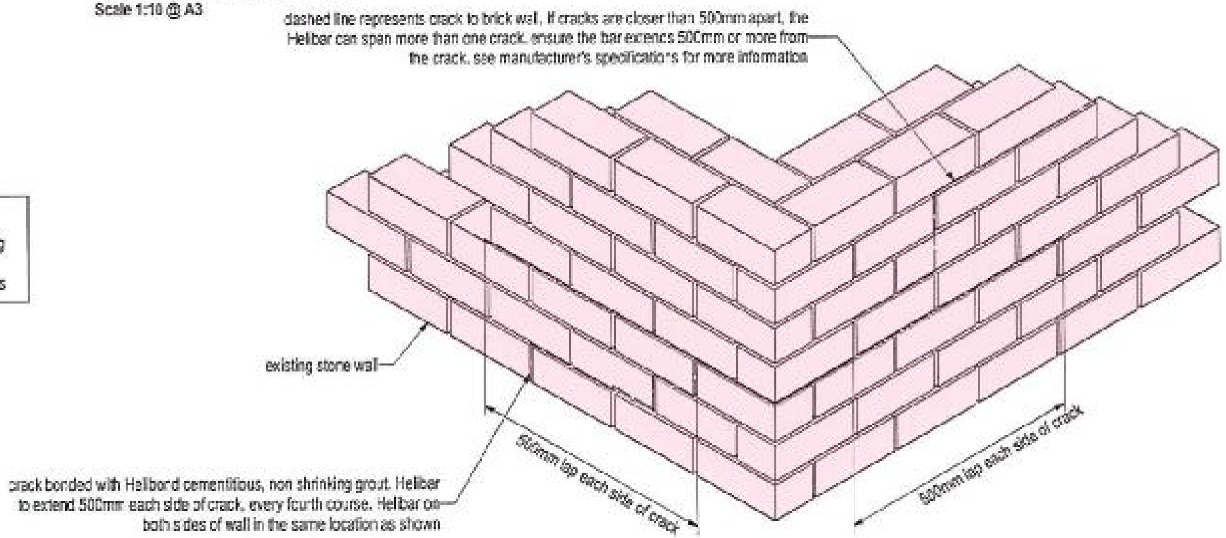


Elevation
Typical Crack Stitch Detail
Scale 1:10 @ A3



Section 'A' Through Wall

NOTES:
- exact locations of where crack stitching is to be used must be confirmed by the engineer on site before work commences



Crack Stitch Detail at Corners
Scale 1:10 @ A3

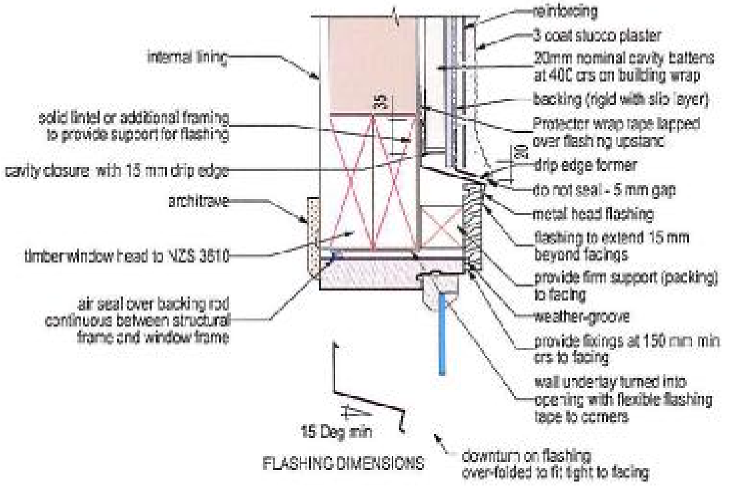
CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Crack Stiching Details

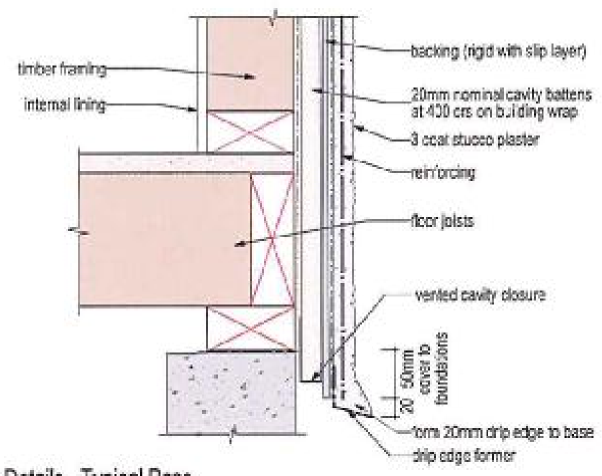
emajineer
Structural Concepts

SCL NUMBER 1606
SHEET 550 REV 0

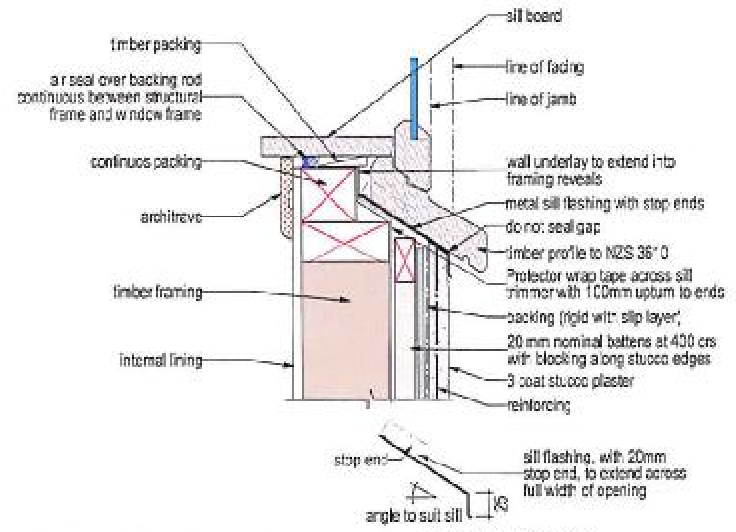
REV DATE DESCRIPTION



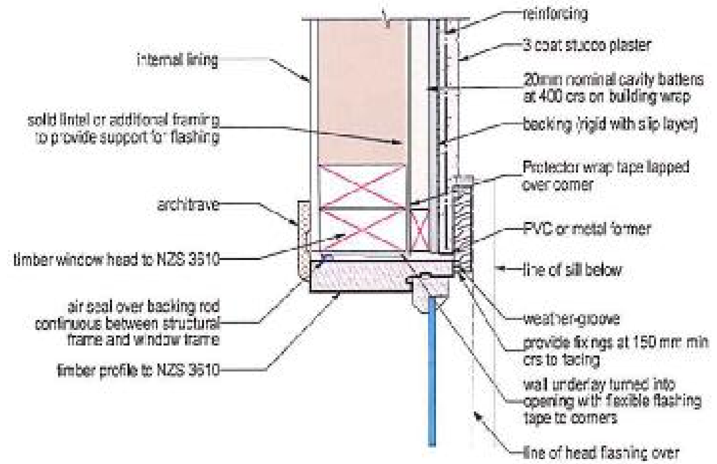
Stucco Cladding Details - Window Head
Scale 1:5 @ A3



Stucco Cladding Details - Typical Base
Scale 1:5 @ A3



Stucco Cladding Details - Window Sill
Scale 1:5 @ A3



Stucco Cladding Details - Window Jamb
Scale 1:5 @ A3

REV DATE DESCRIPTION

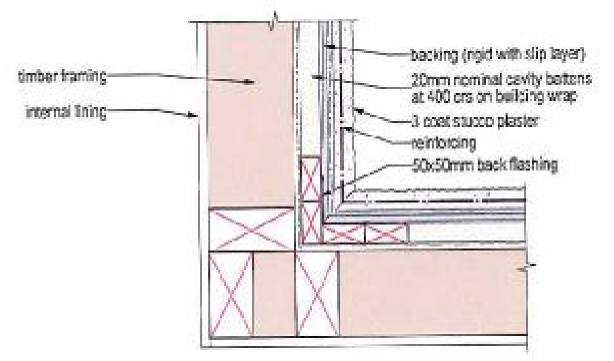
CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Cladding Details

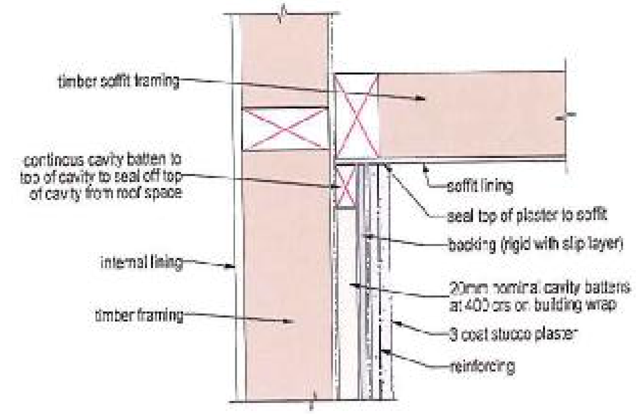
emajineer
Structural Concepts

SCL NUMBER 1606
SHEET 600 REV 0

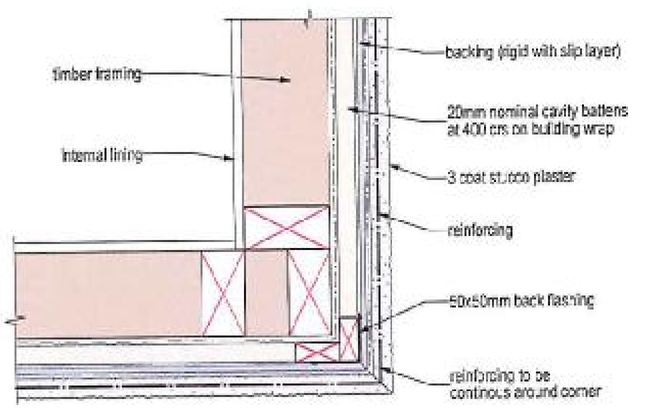
DATE 11/02/12



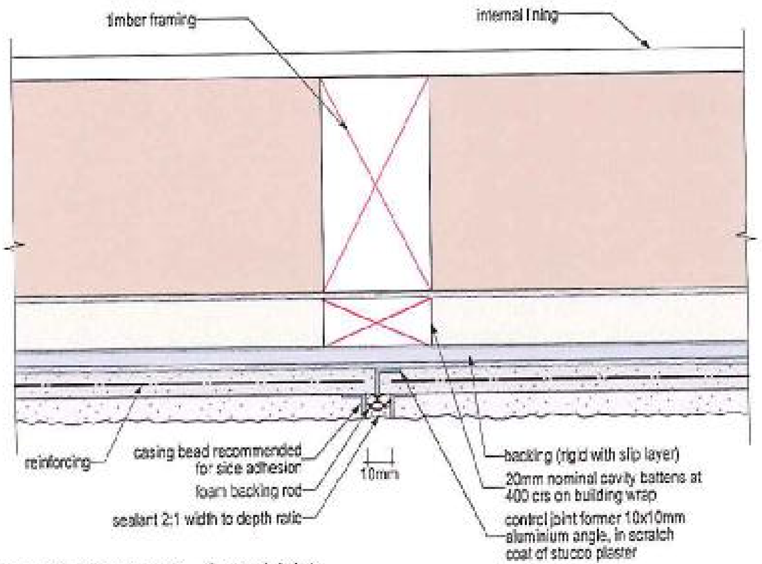
Stucco Cladding Details - Internal Corner
Scale 1:5 @ A3



Stucco Cladding Details - To Soffit
Scale 1:5 @ A3



Stucco Cladding Details - External Corner
Scale 1:5 @ A3



Stucco Cladding Details - Control Joint
Scale 1:2 @ A3

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Cladding Details

emajineer
Structural Concepts

SCL NUMBER 1606
SHEET 601 REV 0
DATE 11/2012

VW2012 A3 | DES - GV | DRG T.VDM

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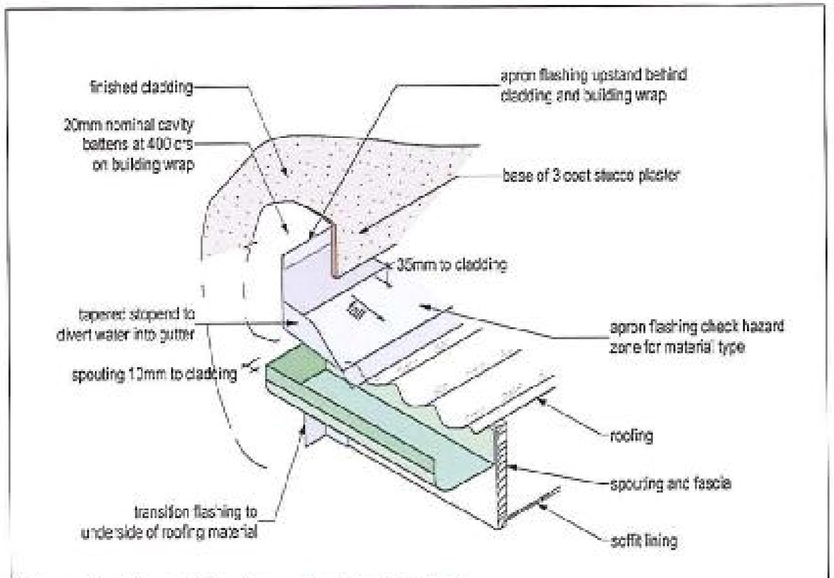
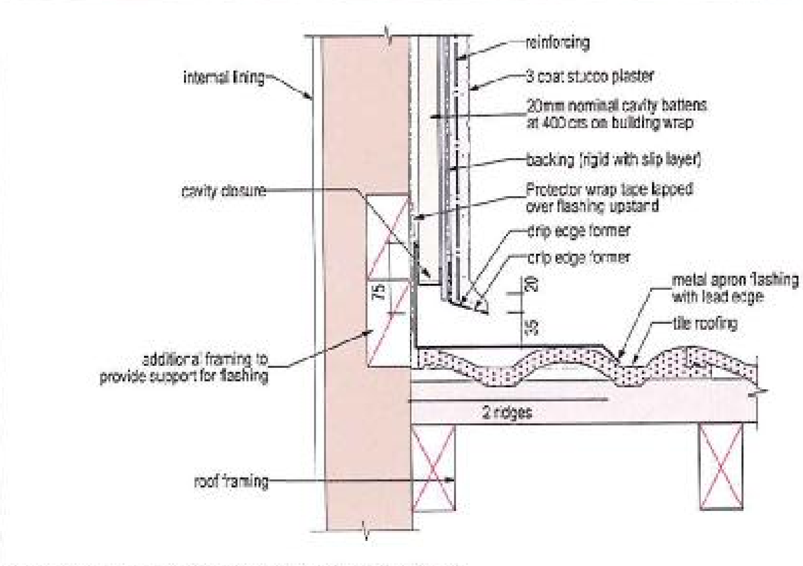
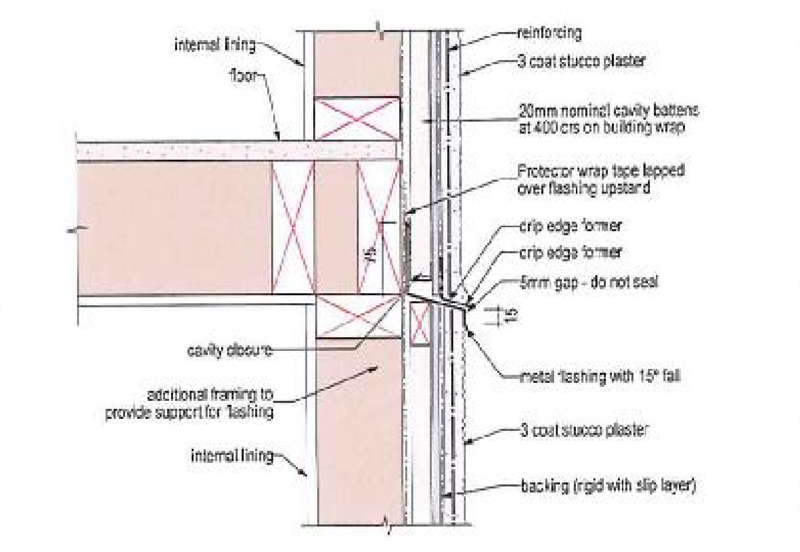
REV DATE DESCRIPTION



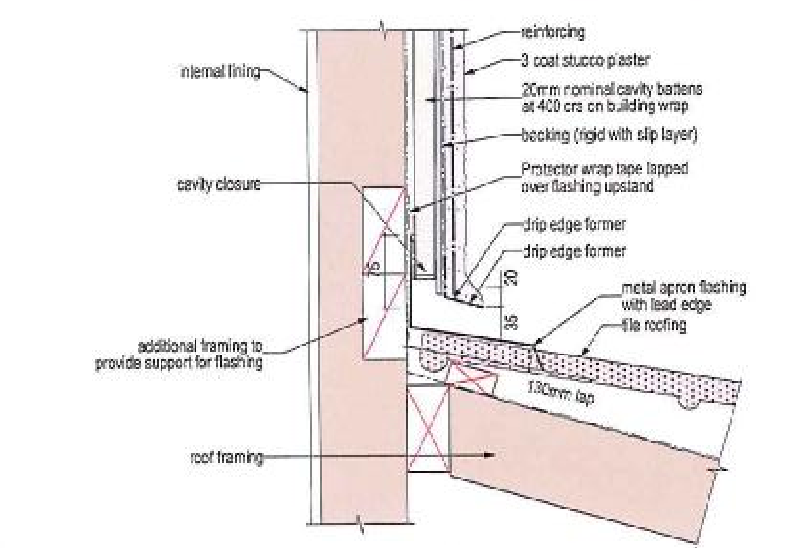
Stucco Cladding Details - Apron Flashing Stop End
Scale 1:5 @ A3



Stucco Cladding Details - Apron Flashing Tiled Roof
Scale 1:5 @ A3



Stucco Cladding Details - Horizontal Joint
Scale 1:5 @ A3



Stucco Cladding Details - Apron Flashing Tiled Roof
Scale 1:5 @ A3

REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Cladding Details

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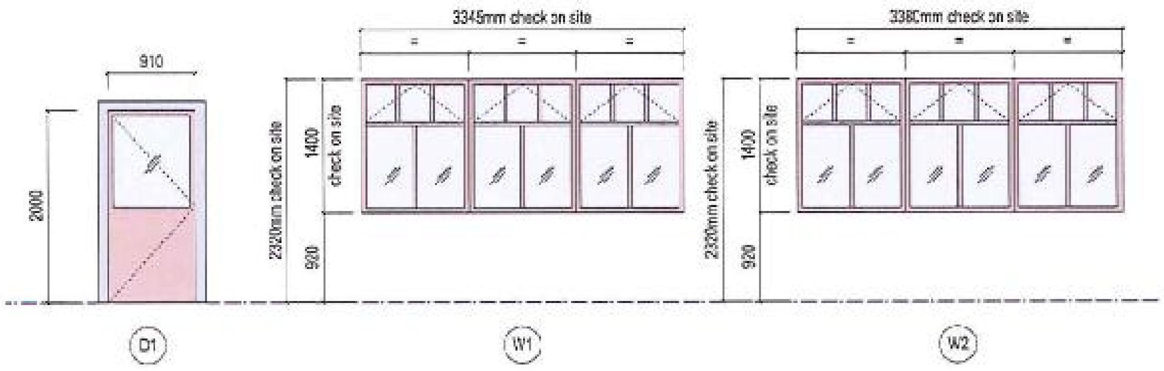
SCL NUMBER 1606
SHEET 602 REV 0

DATE 11/2012 VIN2012 A3 | DES - GN | DRG TT/DJA | STRUCTURAL CONCEPTS | E: info@structuralconcepts.co.nz | P: +64 6 8120111 | F: +64 6 8120113 | 55 DUNLOP RD, PO BOX 3315, ONEKAWA, NAPIER 4142, NEW ZEALAND

TABLE 7 E2/AS1	Metal flashings - general dimensions		
Type	Description	All	Low, Med & High wind, Roof Pitch >10°
Aprons: General	Transverse Flashing over roof		130mm - excluding any soft edging or down-turn
	Parallel Flashing over roof	Two crest of the roof profile, and finishing in the next trough	
Ridges / Hips	Transverse Flashing over roof		130mm - excluding any soft edging or down-turn
Barges	Overlap to barge boards		50mm - excluding drip edge to flashing
Membrane Roof & Deck	Laps under cladding above	115mm Min.	
Windows	Flange - Direct fixed, fibre cement & ply on cavity	5mm Min.	
	Cover to window/door jamb flange	10mm Min. excluding drip edge	
	Cover to window/door sill flange	8mm Min. excluding drip edge	
Sill Flashing	Sill flashing slope	10° for direct fixed joinery - flashing to extend past the condensation channel	
Head Flashings	Head flashing slope	15° Min.	
	Lap under cladding above	35mm Min. excluding drip edge	
	Anti-capillary gap to cladding above flashing	5mm Min.	
Corners	Corner Flashing	50 x 50mm mm Min.	
Inter-story cladding junctions	Junction Flashing: Slope	15° Min.	
	Lap over cladding below	35mm Min. excluding drip edge	
	Lap under cladding above	35mm Min	
	Clearance under cladding Total Upstand 40mm	5mm Min	

Window Notes:

- Confirm all measurements on site before fabrication of windows.
- Confirm style and location of opening sashes and window frame profile with Heritage Architect before fabrication.
- Windows as drawn are an indication of size and shape only.
- Reuse any windows and doors that may have been salvaged from the existing sunroom in the new construction.
- All new windows and doors to match the profile and look of the existing window, confirm with the Heritage Architect.



Window Schedule

Scale 1:50 @ A3

REV DATE DESCRIPTION

CLIENT
Christchurch City Council
PROJECT ADDRESS
63 Fendalton Road, Christchurch

SEISMIC STRENGTHENING OF
MONAVALE GATE HOUSE CHRISTCHURCH
Window Schedule

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SCL NUMBER 1606
SHEET 650 REV 0

DATE 11/2012 VM2012 A3 | DES - CN | DRG TT/DM

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APPENDIX D

MONAVALE GATEHOUSE
FENDALTON ROAD, CHRISTCHURCH

PRELIMINARY CALCULATIONS (extract only)

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Client: Christchurch City Council

Project: Mona Vale Gatehouse
63 Fendalton Road, Christchurch

Ref: 1606

Date: 23-Jun-13

CALCULATIONS

BY GARRY NEWTON
BE (Civil) , MIPENZ(Civil, Structural), CPEng, IntPE(NZ)

CONTENTS

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Client:	Christchurch City Council	Ref:	1606
Project:	Mona Vale Gatehouse	Date:	23/6/13
	63 Fendalton Road, Christchurch	BY:	GN
Subject:	Gravity Loads		

Sheet No.: 2

Loads

Roof

Clay tiles	0.670	
Timber 20.6	0.092	
Purlins 05 .4	0.034	
Battens 05 1.2	0.011	
Rockwool Insu.	0.002	
Gib Board 13	0.120	
Timber 15.6	0.069	
	0.998	kPa

External Walls

Portland Plaster	0.290	
Timber 15.4	0.103	
140. Nogs & plates	0.104	
Rockwool Insu.	0.002	
Gib Board 13	0.120	
	0.619	kPa

Timber floor

25mm Pine deck	0.138	
Timber 20.6	0.092	
90. Nogs & plates	0.067	
Battens 05 1.2	0.011	
Rockwool Insu.	0.002	
Gib Board 13	0.120	
	0.429	kPa

Partitions

Timber 15.4	0.103	
140. Nogs & plates	0.104	
Gib Board 13	0.120	
Gib Board 13	0.120	
	0.447	kPa

Exterior Brick Walls

100 Brick veneer	1.900	
215 Med Brick	4.600	
Battens 03 .4	0.021	
Fibrous plaster	0.090	
	6.611	kPa

Live loads

Domestic Floor	1.50	kPa
R2 Roofs	0.25	kPa

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Client: Christchurch City Council		Ref:	1606
Project: Mona Vale Gatehouse 63 Fendalton Road, Christchurch		Date:	23/6/13
		BY:	GN
Subject: Seismic loads to NZS1170			

Sheet No.: 3

Seismic Loads to NZS 1170.5

Ref: | **Design** | **Output**

Design working live — **50 Years**

Importance level — 2

Annual Probability of exceedance (inverse) Ultimate — 500

Annual Probability of exceedance (inverse) Service — 25

Element			Area/length	Load Kpa	Total kN
Roof			60.00	1.00	59.90
Partitions			20.00	0.45	8.94
Exterior Brick Walls			16.00	6.61	105.77
			0.00	0.00	0.00
			0.00	0.00	0.00
			0.00	0.00	0.00
	1.00	0.40	0.00	0.00	0.00
					174.61 kN

Element			Area/length	Load Kpa	Total kN
Timber floor			60.00	0.43	25.77
External Walls			12.00	0.62	7.43
Exterior Brick Walls			37.00	6.61	244.59
Roof			16.00	1.00	15.97
Interior Brick Walls			12.00	4.60	55.20
Partitions			30.00	0.45	13.41
Domestic Floor	0.69	0.30	60.00	1.50	90.00
	0.69	0.40	0.00	0.00	0.00
					380.93 kN

Live load reduction

Total floor area 60.0

$$.3 + \frac{3}{\sqrt{A}} = 0.687$$

But not less than .5

Total building weight
555.54 kN

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Client:	Christchurch City Council	Ref:	1606
Project:	Mona Vale Gatehouse	Date:	23/6/13
	63 Fendalton Road, Christchurch	BY:	GN
Subject:	Seismic loads to NZS1170		

Sheet No.: 4

Ref:	Design				Output
	Soil type				
	D. Deep or soft soil				
	Across the building				
	Period of building across the building		0.40		☑
	Does the seismic bracing have ductile capabilities but is designed as nominally ductile				
	Structural ductility factor (Ultimate)	μ =	1.00		
	Structural ductility factor (Service SLS1)	μ =	1.00		
	Hazard Factor Christchurch	Z =	0.3		
	Return period factor	Ru =	1.00		
	Return period factor	Rs =	0.25		
	Structural Performance factor (Ultimate)	Sp =	0.65		15% damping
	Structural Performance factor (Service)	Sp =	0.70		
	Spectral Shape Factor (across)	Ch(T) =	3.00		
	Near Fault factor	N(T,D) =	1.0	n/a	
	Elastic site spectra (Ultimate)	C(T) =	0.90		
	Elastic site spectra (Service)	C(T) =	0.23		
	Ultimate	kμ =	1.00		
	Service	kμ =	1.00		
	Ultimate				
	Horizontal design action coefficients (Across)	Cd(T1) =	0.59	But not less than 0.030Ru	
	Ultimate force across the building	Cd(T1) x Wi =	324.99	kN Total	
	Service				
	Horizontal design action coefficients (Across)	Cd(T1) =	0.16		
	Service force across the building	Cd(T1) x Wi =	87.50	kN Total	
	Along the building				
	Period of building along the building		0.40		
	Does the seismic bracing have ductile capabilities but is designed as nominally ductile				☑
	Structural ductility factor (Ultimate)	μ =	1.00		
	Structural ductility factor (Service SLS1)	μ =	1.00		
	Structural Performance factor (Ultimate)	Sp =	0.65		15% dampng
	Spectral Shape Factor (across)	Ch(T) =	3.00		
	Near Fault factor	N(T,D) =	1.0		
	Elastic site spectra (Ultimate)	C(T) =	0.90		
	Elastic site spectra (Service)	C(T) =	0.23		
	Ultimate	kμ =	1.00		
	Service	kμ =	1.00		
	Ultimate				
	Horizontal design action coefficients (Across)	Cd(T1) =	0.59	But not less than 0.030Ru	
	Ultimate force along the building	Cd(T1) x Wi =	324.99	kN Total	
	Service				
	Horizontal design action coefficients (Across)	Cd(T1) =	0.15		
	Service force across the building	Cd(T1) x Wi =	81.25	kN Total	

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Client:	Christchurch City Council	Ref:	1606
Project:	Mona Vale Gatehouse	Date:	23/6/13
	63 Fendalton Road, Christchurch	BY:	GN
Subject:	Seismic Forces		

Seismic Loads to NZS 1170.5 Sheet No.: 5

Ref:	Design				Output	
	Seismic weight at level i	Wi	174.61	kN		
	Height at level i	hi	5.0	m		
	Seismic weight at level I	Wi	380.93	kN		
	Height at level I	hi	3.0	m		
	Sum of Wihi		2015.8			
	Base shear ultimate		324.99	kN		
	Base shear service		87.50	kN		
	8% of base shear to be applied at top level		26.00	kN		
	8% of base shear to be applied at top level		7.00	kN		

$$Fi = .92V \frac{Wihi}{\sum(Wihi)}$$

Design	Output	
<u>Ultimate</u>		
Equivalent Lateral force at level i (Roof)	155.49	3110
Equivalent Lateral force at level i	169.50	
Equivalent Lateral force at level i	0.00	
Equivalent Lateral force at level i	0.00	
Equivalent Lateral force at level i	0.00	
Equivalent Lateral force at level i	0.00	
	324.99	kN base V
	6499.78	
<u>Service</u>		
Equivalent Lateral force at level i (Roof)	41.86	
Equivalent Lateral force at level i	45.63	
Equivalent Lateral force at level i	0.00	
Equivalent Lateral force at level i	0.00	
Equivalent Lateral force at level i	0.00	
Equivalent Lateral force at level i	0.00	
	87.50	kN base V

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Client:	Christchurch City Council	Ref:	1606
Project:	Mona Vale Gatehouse	Date:	23/6/13
	63 Fendalton Road, Christchurch	BY:	GN
Subject:	West Wall - Seismic loads to NZS1170		

Seismic Loads to NZS 1170.5

Sheet No.: 6

Ref:	Design	Output

Design working live — **50 Years**

Importance level — 2

Annual Probability of exceedance (inverse) Ultimate — 500

Annual Probability of exceedance (inverse) Service — 25

Element			Area/length	Load Kpa	Total kN
Roof			11.00	1.00	10.98
Partitions			0.00	0.45	0.00
Exterior Brick Walls			6.00	6.61	39.66
			0.00	0.00	0.00
			0.00	0.00	0.00
			0.00	0.00	0.00
	1.00	0.40	0.00	0.00	0.00
					50.64 kN

Element			Area/length	Load Kpa	Total kN
Timber floor			11.00	0.43	4.72
External Walls			0.00	0.62	0.00
Exterior Brick Walls			16.00	6.61	105.77
Roof			8.00	1.00	7.99
Interior Brick Walls			0.00	4.60	0.00
Partitions			0.00	0.45	0.00
Domestic Floor	1.00	0.30	11.00	1.50	16.50
	1.00	0.40	0.00	0.00	0.00
					123.43 kN

Live load reduction

Total floor area 0.0

$$.3 + \frac{3}{\sqrt{A}} = 1.000$$

But not less than .5

Total building weight
174.07 kN

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Client:	Christchurch City Council	Ref:	1606
Project:	Mona Vale Gatehouse	Date:	23/6/13
	63 Fendalton Road, Christchurch	BY:	GN
Subject:	West Wall - Seismic loads to NZS1170		

Sheet No.: 7

Ref:	Design				Output
	Soil type				
	D. Deep or soft soil				
	Across the building				
	Period of building across the building		0.40		☑
	Does the seismic bracing have ductile capabilities but is designed as nominally ductile				
	Structural ductility factor (Ultimate)	μ =	1.00		
	Structural ductility factor (Service SLS1)	μ =	1.00		
	Hazard Factor Christchurch	Z =	0.3		
	Return period factor	Ru =	1.00		
	Return period factor	Rs =	0.25		
	Structural Performance factor (Ultimate)	Sp =	0.65		15% damping
	Structural Performance factor (Service)	Sp =	0.70		
	Spectral Shape Factor (across)	Ch(T) =	3.00		
	Near Fault factor	N(T,D) =	1.0	n/a	
	Elastic site spectra (Ultimate)	C(T) =	0.90		
	Elastic site spectra (Service)	C(T) =	0.23		
	Ultimate	kμ =	1.00		
	Service	kμ =	1.00		
	Ultimate				
	Horizontal design action coefficients (Across)	Cd(T1) =	0.59	But not less than 0.030Ru	
	Ultimate force across the building	Cd(T1) x Wi =	101.83	kN Total	
	Service				
	Horizontal design action coefficients (Across)	Cd(T1) =	0.16		
	Service force across the building	Cd(T1) x Wi =	27.42	kN Total	
	Along the building				
	Period of building along the building		0.40		
	Does the seismic bracing have ductile capabilities but is designed as nominally ductile				☑
	Structural ductility factor (Ultimate)	μ =	1.00		
	Structural ductility factor (Service SLS1)	μ =	1.00		
	Structural Performance factor (Ultimate)	Sp =	0.65		15% dampng
	Spectral Shape Factor (across)	Ch(T) =	3.00		
	Near Fault factor	N(T,D) =	1.0		
	Elastic site spectra (Ultimate)	C(T) =	0.90		
	Elastic site spectra (Service)	C(T) =	0.23		
	Ultimate	kμ =	1.00		
	Service	kμ =	1.00		
	Ultimate				
	Horizontal design action coefficients (Across)	Cd(T1) =	0.59	But not less than 0.030Ru	
	Ultimate force along the building	Cd(T1) x Wi =	101.83	kN Total	
	Service				
	Horizontal design action coefficients (Across)	Cd(T1) =	0.15		
	Service force across the building	Cd(T1) x Wi =	25.46	kN Total	

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Client:	Christchurch City Council	Ref:	1606
Project:	Mona Vale Gatehouse	Date:	23/6/13
	63 Fendalton Road, Christchurch	BY:	GN
Subject:	West Wall - Seismic Forces		

Seismic Loads to NZS 1170.5 — Sheet No.: 8

Ref:	Design			Output	
	Seismic weight at level i	Wi	50.64 kN		
	Height at level i	hi	5.0 m		
	Seismic weight at level I	Wi	123.43 kN		
	Height at level I	hi	3.0 m		
	Sum of Wihi		623.5		
	Base shear ultimate		101.83 kN		
	Base shear service		27.42 kN		
	8% of base shear to be applied at top level		8.15 kN		
	8% of base shear to be applied at top level		2.19 kN		

$$Fi = .92V \frac{Wihi}{\sum(Wihi)}$$

Design	Output	
<u>Ultimate</u>		
Equivalent Lateral force at level i (Roof)	46.20	924
Equivalent Lateral force at level i	55.64	
Equivalent Lateral force at level i	0.00	
Equivalent Lateral force at level i	0.00	
Equivalent Lateral force at level i	0.00	
Equivalent Lateral force at level i	0.00	
	101.83	kN base V
	50.92	
<u>Service</u>		
Equivalent Lateral force at level i (Roof)	12.44	
Equivalent Lateral force at level i	14.98	
Equivalent Lateral force at level i	0.00	
Equivalent Lateral force at level i	0.00	
Equivalent Lateral force at level i	0.00	
Equivalent Lateral force at level i	0.00	
	27.42	kN base V

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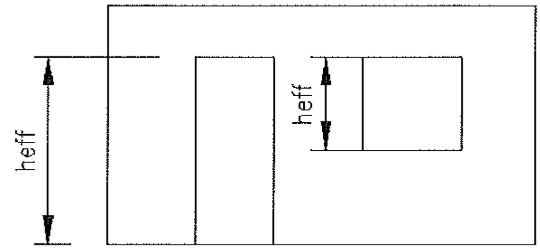
Client:	**Christchurch City Council**	Ref:	**1606**
Project:	**Mona Vale Gatehouse**	Date:	**23/6/13**
	63 Fendalton Road, Christchurch	BY:	**GN**
Subject:	**West Wall URM Pier in-plane**		

In-Plane strength of walls and piers to FEMA URM seismic guidelines — Sheet No.: **9**

Ref:	Design				Output
	The following calculation follows the FEMA 273 guild lines for seismic rehabilitation of existing unreinforced masonry buildings (URM). This calculation is for piers or walls between window and door openings. Typically these piers are limited by diagonal tension in the panel or toe compressive stress, but bed-joint sliding shear or expected rocking strength can also limit the capacity.				



Effective height and pier geometry may vary in the same wall assembly

Ref	Design			
	Expected axial gravity force on pier	P_{CE}	27	kN
	Pier dimentions			
	Effective height of pier	heff	2.00	m
	Pier length (net mortared length)	L	0.90	m
	Pier thickness (net mortared width)	T_m	325	mm
	Net mortared area		292500	mm²
	Average bed-joint shear strength	V_{te}	1.00	Mpa
(7-1)	Expected shear strength			
	$\frac{0.75\left(0.75v_{te}+\frac{P_{ce}}{A_n}\right)}{1.5}$ =	V_{me}	0.421	Mpa
	Expected lateral strength is the lesser of:-			
(7-3)	Bed-joint shear strength $V_{me} \times A_n$ =	Q_{CE}	123.2	kN
	α = 0.5 for cantilever or 1.0 for fixed pier	α	1.0	
(7-4)	Expected rocking strength $.9\alpha P_{ce}\left(\frac{L}{h_{eff}}\right)$ =	Q_{CE}	10.9	kN
	Masonry compressive strength	f_m	4.0	Mpa
	Diagonal tension strength			
	V_{me} = f_{dt} in eq. (7-5) only	f_{dt}	0.421	Mpa
	Vertical axial compressive stress	f_a	0.092	Mpa
	Aspect ratio	(L / heff) =	0.45	

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Client:	**Christchurch City Council**	Ref:	**1606**
Project:	**Mona Vale Gatehouse**	Date:	**23/6/13**
	63 Fendalton Road, Christchurch	BY:	**GN**
Subject:	**West Wall URM Pier in-plane**		

In-Plane strength of walls and piers continued — Sheet No.: **10**

Ref:	Design				Output
	Expected lateral strength of pier is lesser of:-				
(7-5)	Diagonal tenson stress				
	$Vdt = fdt.An\left(\frac{L}{heff}\right)\sqrt{1+\frac{fa}{fdt}}$ =	QCL	61.2	kN	
(7-6)	Toe compressive stress				
	$Vtc = \alpha Pcl\left(\frac{L}{heff}\right)\left(1-\frac{fa}{0.7fm}\right)$ =	QCL	11.7	kN	
	The govening lateral force for this pier is		10.9	kN	
	Actural force on pier is		51.0	kN	
	% of NBS, proportion of NZS1170.5	%NBS	21	%	
			<u>Not acceptable</u>		

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APPENDIX E

MONAVALE GATEHOUSE
FENDALTON ROAD, CHRISTCHURCH

LDE GEOTECHNICAL REPORT

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LAND DEVELOPMENT & EXPLORATION LTD.

CHRISTCHURCH CITY COUNCIL

MONA VALE GATE HOUSE, 73 FENDALTON ROAD, FENDALTON

DETAILED GEOTECHNICAL INVESTIGATION REPORT

Project Reference: 10048
12 September 2011

1 INTRODUCTION

Land Development & Exploration Ltd was engaged by Insight Unlimited on behalf of Christchurch City Council to undertake a detailed geotechnical investigation of the ground beneath buildings and land at Mona Vale Gate House, 73 Fendalton Road, Fendalton. The buildings and land were damaged by earthquake shaking, particularly from the 22 February 2011 earthquake event.

The purpose of the investigation was to assess the stratigraphy and strength distribution of the materials beneath the property to assist with the foundation design to remediate the building on it and to reduce the potential for damage that may result from future earthquake events. This included an assessment of the potential for future liquefaction and lateral spreading arising from earthquake shaking.

This work follows on from a preliminary assessment of the property in July 2011.

2 SITUATION

2.1 Location

The Gate House comprises a relatively small, predominantly two storey masonry building adjacent to Fendalton Road and the Avon River (Figure 1 and 2). LiDAR data indicates that the ground surface is about 9m above sea level.

Figure 1: View of Gate House. Main tension crack from lateral spreading in foreground (arrowed).

2.2 Building Foundations

The building foundations appear to comprise largely strip footings under load bearing walls, with suspended internal timber floors on pile foundations.

Figure 2: Aerial view of property. Fendalton Road passes along the northern side of the property and the Avon River to the right. Main tension cracks from lateral spreading shown in red.

2.3 Earthquake Damage

Much of the damage to the house appears to have been the result of extensive earthquake shaking.

However, minor to moderate settlement of the building has occurred as a result of liquefaction of the underlying ground and the subsequent loss of bearing support.

Localised lateral spreading has also occurred within the area between the house and the stream resulting in the formation of a meandering tension crack up to some 150mm wide passing along within 4m of the full length of the house (Figure 1). Minor lateral spreading has also occurred beneath the house resulting in the formation of a crack <10mm wide in the footing adjacent to Fendalton Road. A hairline crack along which sand has ejected also exists adjacent to the southwestern corner of the building.

In our opinion there is a moderate potential for the regression of the main zone of lateral spreading beneath the house from future large earthquake events.

2.4 Geotechnical Recommendations for Property

Based on the visual assessment undertaken the following recommendations were made with respect to the geotechnical issues affecting the property:

1. Repair of the footings and re-level floors as required.
2. Install a palisade wall down to the gravel layer along the river side of the building to minimise the potential for regression of lateral spreading.

3 Detailed Investigations

The detailed investigation of the site included the following work;

- A desk top study of published and unpublished information of the site.
- A walkover assessment of the site and surrounding area to assess its geomorphology and any features which may potentially influence the long term behaviour of the site.
- Two electronic cone penetrometer tests (CPTs) put down to refusal (2.5m to 2.8m depth) using a specialist rig.
- Three 50mm handaugered boreholes put down to refusal ranging between 1.2m and 1.7m depth. Measurements of the undrained shear strength were taken at 200mm intervals within cohesive soils encountered down through the boreholes using a calibrated shear vane. The soils encountered were generally logged to NZ Geotechnical Society Logging Guidelines for the field classification of soil and rock for engineering purposes.
- One dynamic penetrometer test put down to refusal (1.9m depth). The penetrometer tests were measured in 50mm increments to better identify lower strength zones beneath the surface.
- Observations and measurements of the soil moisture content and levels of groundwater encountered down through the boreholes. The possible seasonal variation of these levels was noted and compared to the regional groundwater table expected for the area and the timing of the investigation.

The locations of the subsurface investigations are shown in the Geotechnical Investigation Plan appended. Logs of the boreholes and penetrometer tests are also appended.

The field work was completed in winter.

All work was completed by qualified geological-geotechnical specialists.

4 ENGINEERING GEOLOGY

4.1 General

The engineering geology of the site is summarised below and in the appended cross section (Appendix B). It is based on an integration of published and unpublished data, the geomorphology of the site, and subsurface investigations carried out at discrete locations. The nature of the ground between the investigation points is inferred and may vary from that described. For details of the materials encountered and measurements of their respective strengths please review the appended investigation logs.

4.2 Subsurface Conditions

The investigations show that the building is generally underlain by generally low strength soils overlying very dense sand and gravel present from 1.7m depth,

More specifically, stiff to very stiff silty clay, clayey silt and silt generally underlie the site down to about 0.8m depth.

These low strength layers overlie loose to medium dense sand and gravel down to 1.7m depth beneath the western side and central building areas and firm silty clay down to 1.7m depth beneath the road (Cross Section).

Very dense sand and gravel is present below 1.7m depth and was not able to be penetrated by the boreholes and penetrometer tests. However regional investigations undertaken by the Earthquake Commission indicate it is some 2.5m thick and extends down to 6.5mRL. Loose silt, firm clayey silt and loose to medium dense sand some 3m thick are indicated to underlie the gravel down to some 4m RL, and to overlie a thick layer of dense gravelly sand.

Non-engineered fill up to 1.2m thick is present beneath the eastern side of the building and possibly extends out towards the river bank to the east. Fill was also encountered to 0.3m depth along the northern side. Fill was absent at the rear of the property. The fill includes brick and concrete, and is variable in strength ranging between 50kPa and 160kPa (average 120kPa).

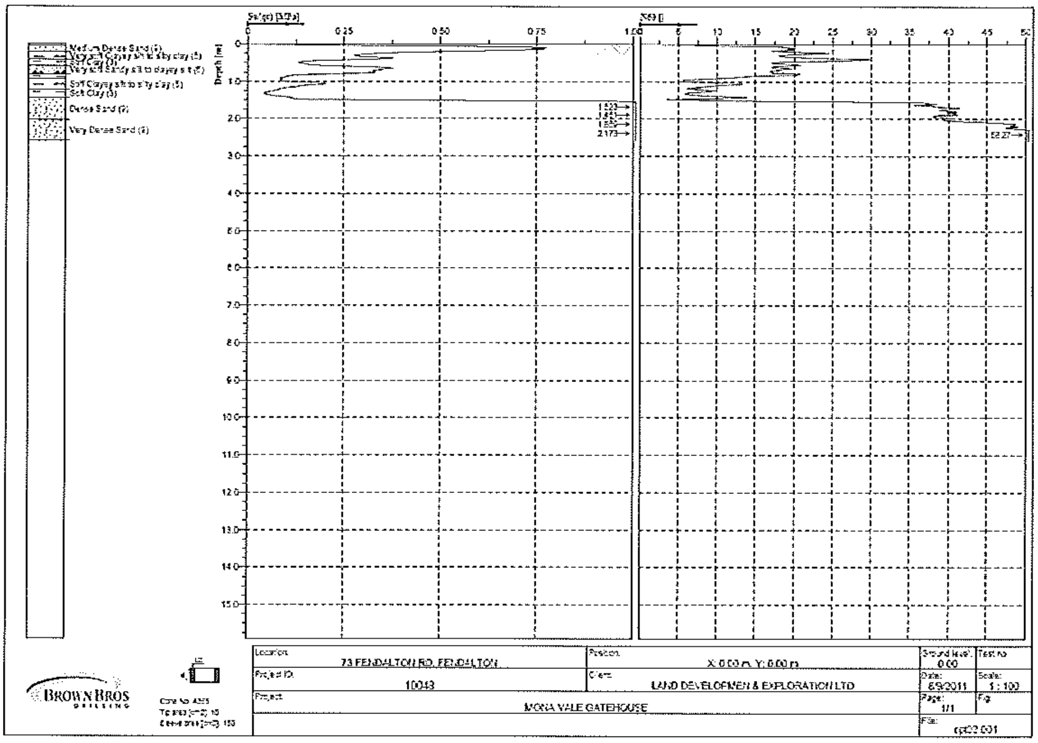

Figure 3: CPT 2 put down to the east of building showing typical ground profile beneath property

4.3 Soil Moisture Profile and Groundwater Conditions

Groundwater was encountered at 1.0m to 1.2m depth in the boreholes, which is consistent with the level of the Avon River. However, wet to saturated soils were encountered from 0.5m depth.

4.4 Site Subsoil Category

We consider that the site is a Class D deep soil site as defined by NZS 1170.5 (2004) "Structural Design Actions: Part 5: Earthquake actions – New Zealand".

Assuming a building importance level of 2, the following peak ground accelerations are considered appropriate for seismic analyses and design:

Ultimate Limit State event: 0.34g
Serviceability Limit State: 0.11g

Note that the SLS value has been calculated using a risk factor (R_s) of 0.33.

The following earthquake magnitudes are estimated[1] from the peak ground accelerations assuming rupture on a fault line beneath the Port Hills, some 10km to the southeast of the site.

Ultimate Limit State event:	M 6.6
Serviceability Limit State:	M 5.1

5 Ground Deformation Potential

5.1 Liquefaction Potential and Resultant Deformations

Analyses have been carried out using specialist software to determine what material layers beneath the site are likely to be prone to liquefaction under ULS and SLS design conditions, the resultant potential settlement at the surface due to consolidation of the liquefied sand layers, possible dry settlement due to shaking, building settlement due to the potential loss of ground bearing capacity as a result of the liquefaction of the near surface soils, and the potential for sand boil development at the surface. A review of the layers that are likely to have liquefied during the 22 February and 13 June 2011 earthquake events was also carried out using measured peak ground acceleration data.

5.1.1 Layers Subject to Liquefaction

SLS Conditions

No layers are predicted to liquefy during a SLS seismic event.

ULS Conditions

The analyses show that the saturated sandy layer at 1.4m to 1.6m beneath the surface building is likely to be prone to liquefaction during an ULS seismic event (see Figure 5). The underlying very dense layer is not shown to have the potential to liquefy.

We expect that the silt and sand layers within the 3m of fine alluvium below the gravel layer are also likely to be prone to liquefaction under ULS seismic loads.

22 February M6.3 earthquake

The analyses show that the medium dense to dense layers beneath the site at depth are likely to have liquefied during the February 22 M6.3 earthquake event (see Figure 6). Despite this, the dense sand from 3.8m to 6.4m depth is unlikely to have liquefied and is therefore expected to be a suitable bearing layer.

[1] Estimation using chart in Youd, Leslie, and Bartlett (2002) "Revised Multilinear Regression Equations for Prediction of Lateral Spread Displacement"

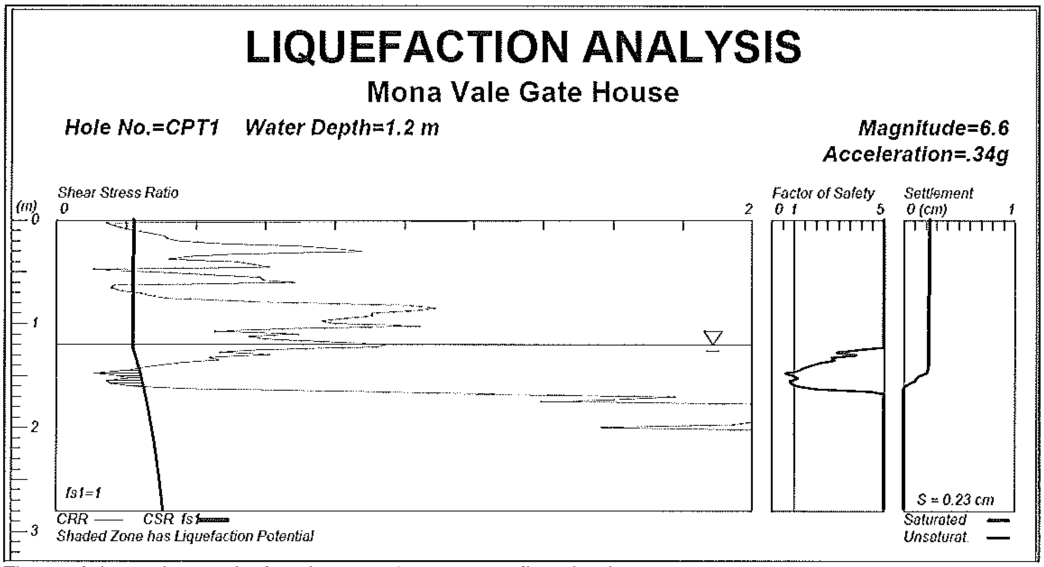

Figure 4: Layer beneath site shown to be prone to liquefaction.

5.1.2 Surface Settlement due to Liquefaction and Dry Settlement

The predicted surface settlement for each test location is presented below in Table 1.

Table 1: Potential surface settlements due to liquefaction*

CPT	Settlement (mm) for Serviceability Limit State Event	Settlement (mm) for Ultimate Limit State Event
CPT1	0mm	2mm
CPT2	0mm	1mm

* surface settlement potential may be greater due to liquefaction potential of layers below gravel layer.

Serviceability Limit State Conditions

In summary, no settlement is predicted to occur as result of a SLS earthquake event.

Ultimate Limit State Conditions

The potential surface settlement beneath the building under ULS conditions is shown to be negligible. The magnitude of surface settlement may be higher due to the potential for liquefaction of the fine alluvium beneath the gravel layer. However, we expect that the total settlement would be less than 25mm. We also expect that the very dense gravel layer would inhibit adverse surface deformation due to settlement of the layers at depth.

Negligible differential settlement is expected from future ULS seismic events.

5.1.3 Building Settlement due to Loss of Bearing Capacity

The potential for punching failure or settlement of the building foundations due to liquefaction of the ground at 1.4m to 1.6m depth beneath the building has been assessed for each seismic condition. A footing width of 0.3m has been assumed, as has an undrained shear strength of the liquefied layer of 5kPa estimated using the Seed and Harder (1990) methedology.

SLS conditions

Building settlement due to a loss of ground strength beneath the foundations or punching shear failure is not expected under SLS seismic conditions.

ULS Conditions

The analyses indicate that the bearing capacity of the near surface soils is likely to be reduced under ULS seismic conditions due to the loss of strength of the liquefied layer below the groundwater table. Assuming 0.4m deep foundations are used analyses show that settlement of the building foundations could occur under ULS seismic conditions (estimated up to 75mm), which is consistent with the observed foundation settlement of parts of the building following the 22 February 2011 earthquake event.

Accordingly, to avoid adverse settlements following a future ULS seismic event we recommend that the replacement strip footings be limited to depths less than 0.4m, unless supported on piled foundations taken to the dense sand and gravel from 1.6m depth.

5.1.4 Sand Boil Potential

No sand boiling is expected for a SLS earthquake event, however given the potential for liquefaction within the near surface soils below the groundwater table there is some potential for the development of sand boils and fissures at the surface as a result of a ULS seismic event. However, as the near surface soil layer is thin the volume of sand ejecta is not expected to be great. This is consistent with the limited extent of sand ejecta adjacent to the building following the 22 February and 13th June earthquake events.

5.2 Lateral Spreading Potential

A tension crack up to 150mm wide passes along the eastern side of the building. The size of the crack is consistent with the magnitude of lateral spreading calculated for the liquefied layer at 1.4m depth.

Lateral spreading through the alluvium beneath the gravel may have occurred from the February event although the effects of this are not evident. We expect that deformations from future event will be restricted to the upper 1.6m of soils.

For a future ULS event 150mm is predicted to occur 10m from the river, while 80mm may occur at the rear of the site 30m from the river. Some 70mm of extension may occur across the site from future ULS events, which should be taken into account with the design of any replacement foundations.

5.3 Compressible Ground and Consolidation Settlement

While the 1.1m to 1.2m thick layer of fill encountered beneath the southern end of the site appears to be non-engineered, it was found to be stiff to very stiff in strength with an estimated allowable bearing capacity of 70kPa. Limiting the foundation pressures to this is recommended.

5.4 Ground Shrinkage and Swelling Potential

The near surface soils appear to be slightly expansive to non-expanse soils with a liquid limit below 50% based on their physical characteristics determined during testing. We consider that the effects of soil shrinkage and swelling on the foundations due to seasonal changes in soil moisture is not likely to adversely affect the building.

6 ENGINEERING RECOMMENDATIONS

6.1 Strip and Pad Footings

Should replacement strip or pad footings be required for the reconstruction of the house we make the following recommendations.

Depth

For design we recommend strip footings and any pad footings be taken to a depth of 0.4m depth.

Bearing Capacity

At that depth a geotechnical ultimate, factored (ULS, Φ=0.5) and allowable (FoS=3) bearing capacity of 210kPa, 140kPa and 70kPa is recommended.

6.2 Piles

Purpose

Piles taken into the dense sand and gravel layer present from 1.7m depth are recommended along the eastern side of the property to provide shear resistance against lateral spreading through the overlying low strength sediments immediately above that depth, and also to provide resistance for regression of tension cracking beneath the eastern wing of the building.

Pile Depth

A minimum pile depth of 2.0m is recommended.

Lateral Load Considerations

Potential lateral movement of 100mm towards the river of the soils to 1.6m depth can be assumed.

Fixity can be assumed to exist at 1.7m depth.

End Bearing Capacity

Should the piles be used for bearing, at 2m depth geotechnical ultimate, factored (ULS, Φ=0.5) and allowable (FoS=3) end bearing capacities of 5400kPa, 2700kPa, and 1800kPa respectively can be used for bored and cast insitu piles.

Skin Friction

A geotechnical ultimate, factored (ULS, Φ=0.5) and allowable (FoS=3) skin friction of 50kPa, 25kPa, and 17kPa can be assumed for static load conditions. This should be reduced by 25% for ULS seismic conditions.

Construction Issues

The excavations for bored piles may be subject to collapse below the groundwater table, although the cohesive nature of some of the alluvial layers may limit this to a certain degree.

Driven piles are unlikely to be able to be driven into the dense sand and gravel and excessive shaking could damage the building as a result.

6.3 Verification Checks

Verification testing of the ground by a Christchurch City Council Building Inspector or Suitably Qualified Professional is recommended to ensure that the ground conditions at the base of the foundation excavations are as described in this report, and that all unsuitable and loose materials have been removed. We should be contacted immediately if these conditions vary from that described in this report. A modification to the recommendations or design may be required.

7 Other Considerations

This report has been prepared exclusively for Insight Unlimited on behalf of the Christchurch City Council with respect to the particular brief given to us. Information, opinions and recommendations contained in it can not be used for any other purpose or by any other entity without our review and written consent. Land Development & Exploration Ltd accepts no liability or responsibility whatsoever for or in respect of any use or reliance upon this report by any third party.

Opinions given in this report are based on visual methods, and subsurface investigations at discrete locations. The nature and continuity of the subsurface materials between these locations are inferred and it must be appreciated that actual conditions could vary from that described herein. We should be contacted immediately if the conditions are found to differ from that described in this report.

Yours faithfully
LAND DEVELOPMENT & EXPLORATION LTD

Georg Winkler
Geological & Geotechnical Engineer
MIPENZ, CPEng
Managing Director

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APPENDIX A

GEOTECHNICAL INVESTIGATION PLAN

APPENDIX F

MONAVALE GATEHOUSE
FENDALTON ROAD, CHRISTCHURCH

LEVEL SURVEY

55 Dunlop Road, Onekawa, Napier
PO Box 3315, Napier, 4142, New Zealand
P (06) 842 0111 F (06) 842 0113
E info@structuralconcepts.co.nz

www.structuralconcepts.co.nz

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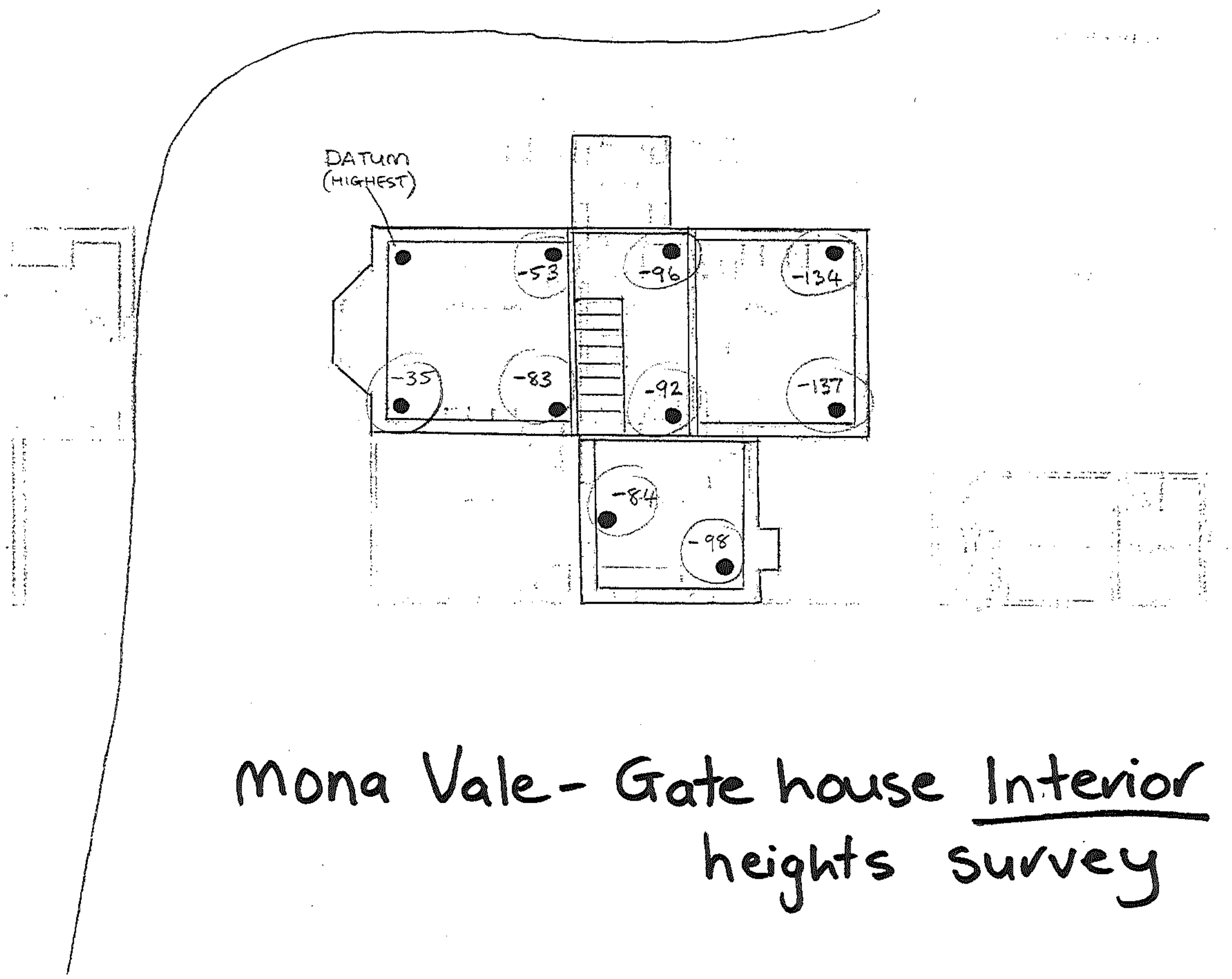
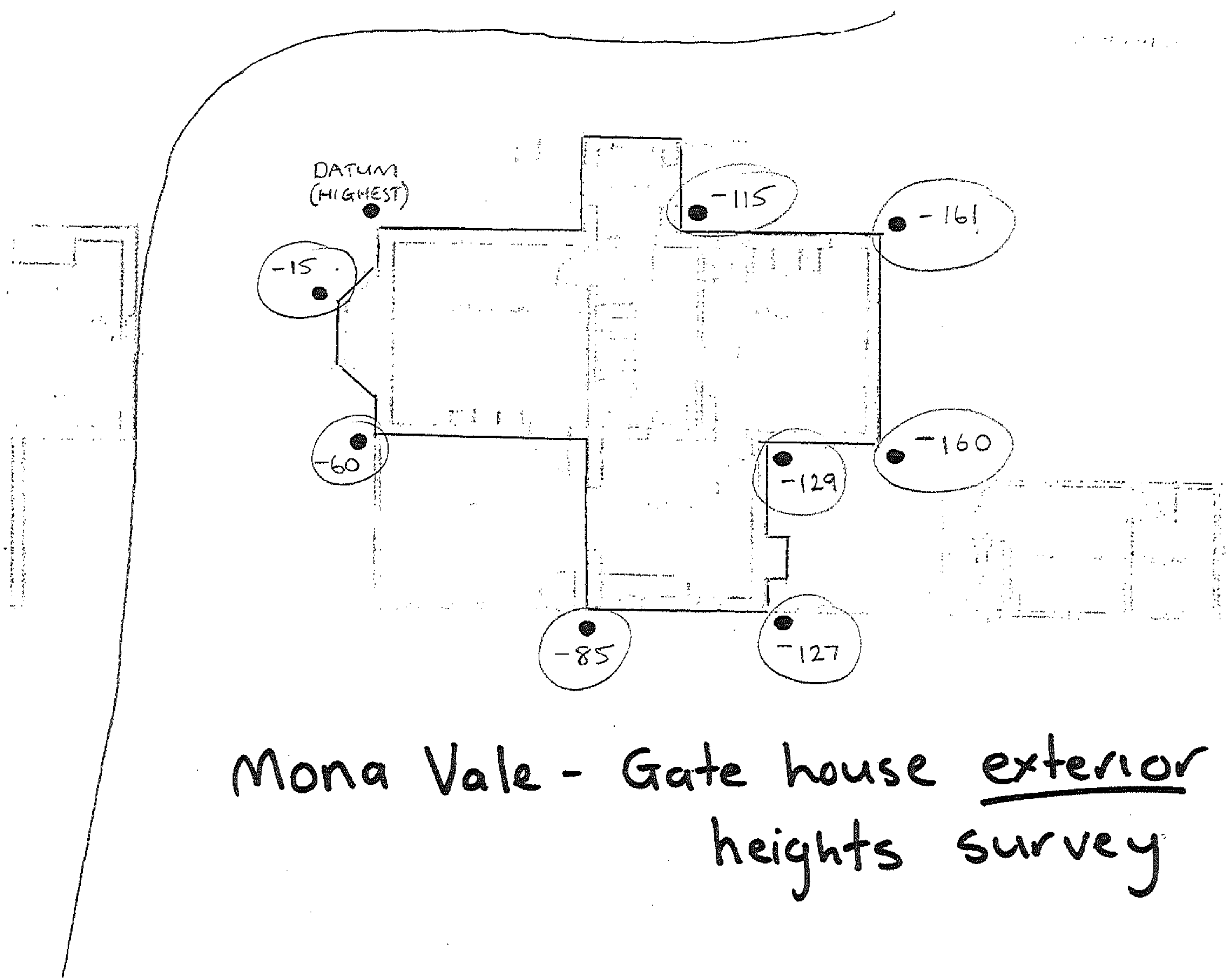


Mona Vale - Gate house Interior heights survey



Mona Vale - Gate house <u>exterior</u> heights survey

emajineer
Structural Concepts

APPENDIX G

MONAVALE GATEHOUSE
FENDALTON ROAD, CHRISTCHURCH

CERA BUILDING EVALUATION FORM

55 Dunlop Road, Onekawa, Napier
PO Box 3315, Napier, 4142, New Zealand
P (06) 842 0111 F (06) 842 0113
E info@structuralconcepts.co.nz

www.structuralconcepts.co.nz

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Monavale Gatehouse	Reviewer:	Garry Newton
Unit / No: / Street	63 Fendalton Road	CPEng No:	65305
Building Address:		Company:	Structural Concepts Ltd
Legal Description:		Company project number:	1605
		Company phone number:	06 8420111
GPS south: (Degrees / Min / Sec)		Date of submission:	30/08/2013
GPS east:		Inspection Date:	5-Aug
		Revision:	
Building Unique Identifier (CCC):		Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	0
Soil type:	silty sand	Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
Proximity to waterway (m, if <100m):	50	If Ground improvement on site, describe:	settlement locally
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	6.00

Building

No. of storeys above ground:	2	single storey = 1 / Ground floor elevation (Absolute) (m):	6.60
Ground floor split?	no	Ground floor elevation above ground (m):	0.60
Storeys below ground	0		
Foundation type:	strip footings	if Foundation type is other, describe:	
Building height (m):	7.00	height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	60		
Age of Building (years):	103	Date of design:	Pre 1935
Strengthening present?	no	If so, when (year)?	
		And what load level (%g)?	
		Brief strengthening description:	
Use (ground floor):	other (specify)		
Use (upper floors):	public		
Use notes (if required):	Residential		
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber framed	rafter type, purlin type and cladding	timber/timber/clay tiles on sarking
Floors:	timber	joist depth and spacing (mm)	300/450
Beams:	timber	type	timber
Columns:	brick masonry	typical dimensions (mm x mm)	300x100
Walls:	load bearing brick	#N/A	

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	other (note)		describe system	URM shear walls
Ductility assumed, μ:	1.00			
Period along:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):	30		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	10		estimate or calculation?	estimated
Lateral system across:	other (note)		describe system	URM shear walls
Ductility assumed, μ:	1.00			
Period across:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):	30		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	10		estimate or calculation?	estimated

Separations:

leave blank if not relevant

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

Non-structural elements

Stairs:	timber	describe supports	walls
Wall cladding:	other heavy	describe	stone
Roof Cladding:	Heavy tiles	describe	concrete tiles
Glazing:	timber frames		
Ceilings:	fibrous plaster, fixed		
Services(list):	lights		

Available documentation

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

Damage

Site: (refer DEE Table 4-2)

Site performance:	average	Describe damage:	some lateral spreading away from the main building not i
Settlement:	25-100m	notes (if applicable):	settlement to one corner
Differential settlement:	1:350-1:250	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:	moderate to substantial (1 in 5)	notes (if applicable):	

Building:

Current Placard Status: red

Along	Damage ratio:	43%	Describe how damage ratio arrived at:	assumed level of cracking and loss of chimneys assesse
	Describe (summary):	cracking to walls and ceilings. Collapse of chimneys. Collapse of some URM		
Across	Damage ratio:	67%		
	Describe (summary):	cracking to walls and ceilings. Collapse of chimneys. Collapse of some URM		

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

Diaphragms	Damage?:	yes	Describe:	cracking to lath and plaster
CSWs:	Damage?:	yes	Describe:	diaphragm connection
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	yes	Describe:	cracks to walls and ceilings

Recommendations

Level of repair/strengthening required:	significant structural	Describe:	cracking to walls and replacing of URM
Building Consent required:	yes	Describe:	loss of chimneys
Interim occupancy recommendations:	do not occupy	Describe:	

Along	Assessed %NBS before:	21%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology: static analysis and spreadsheet calculation
	Assessed %NBS after:	12%		
Across	Assessed %NBS before:	21%	##### %NBS from IEP below	
	Assessed %NBS after:	7%		