

DOCUMENT TRANSFER FIRE SERVICES



PROJECT: Clip n Climb EQ Strengthening and Extension
FILE No: 16175CC
DATE: 04 November 2016
SHEET: 1 of 1

Day	04	08				
Month	11	11				
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Drawing	Sheet	Description	Revision			
16175CC	SK01	Fire Safety Sketch	A	B		

Other Documents Enclosed	Issue			
Fire Strategy Report	A	B		

Distribution	Attention	No of Copies Distributed			
Clip n Climb	John Targett	pdf	pdf		
Structex Harvard	Julius Long	pdf	pdf		

Reason for Issue							
P	Preliminary	R	Revision				
N	Consent	I	Information	I	N		
Q	As Requested	C	Construction				
T	Tender	S	Schedule				

For fire guidance notes, please
refer to Building Consent
Construction Documentation
and Advice Notes (B-411).



CLIP'N CLIMB FACTORY
C/- SPAGHETTI JUNCTION LTD

Proposed EQ Strengthening and Office Extension 80 Byron St Fire Strategy Report

Issue B: Consent
November 2016
Reference: 16175CC

Summary – Clip’n Climb Factory

This report reviews compliance of the Fire Safety provisions of the NZ Building Code for Clip’n Climb factory at 80 Byron St. This is to be an alteration to an existing building involving earthquake strengthening and office extension. Below is an overview of the fire safety features proposed for NZ Building Code compliance:

Fire Safety System	Type Ref.	Comments
60 minute FRR	Life Rating	Not required due to the building forming a single firecell
120 minute FRR	Property Rating	Required to the western external wall of the new extension
Manual alarm system	2	Not required due to limited occupancy (<50 people) in a single level building
Fire hydrant system	18	Not required due to short hose run distance (<75m)

Building Act 2004 - NZFS DRU Involvement?	Yes	No
Evacuation Scheme Required, or would be required if no sprinklers are installed?	✓	
NZ Fire Service Engineering Unit Review Required?	✓	

This report is based on the meetings and documents as described in Section 1.3.

Please refer to the following documentation for detailed design information.

- Structural Engineering documentation for details of structural fire rating.
- Electrical Engineering documentation for details of the emergency lighting & illuminated exit signage in accordance with NZBC F6 & F8
- Architectural documentation for surface finishes & specific details of door schedule, door hardware, fire rating details.

This report is specific to this project and any material contained herein cannot be used for any other project.

Document Control

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Report ClipnClimb EQ Repair and Alterations dated
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A	3/11/2016	Draft	NC	DJ
B	7/11/2016	Consent	NC	BC

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1. INTRODUCTION

This report is written for the Building Control Authority as required by the NZ Building Act 2004 to enable a review of the minimum performance requirements of NZ Building Code Part C "Protection From Fire". This report is not a contract document for the project but is to form part of the documentation used for a Building Consent application and used as guidance for the contract works only.

Note: This Fire Strategy Report addresses minimum fire safety requirements only, as determined by the NZ Building Code. It does not consider loss control for the building and contents, unless specifically referenced. Refer to the Appendices for further advice in this regard.

1.1 PROJECT DESCRIPTION

This report covers the proposed earthquake strengthening and office extension for Clip'n Climb factory at 80 Byron St, Christchurch. The proposed work does not change the building fabric except for the proposed extension at north-western corner (facing Byron St) and removing of the existing mezzanine floors. This single level extension contains offices, meeting room, staff room, stores and toilets. The western external wall of the extension is to be constructed from 150 series masonry blocks to achieve the required 120 minute FRR – refer Structural Engineer's documentation for design details. The existing building is predominantly constructed from concrete walls with steel portal frames and metal roofing. The entire building (including the extension) has a footprint of 770m² with an apex height of 5m. The storage height within the building is to be limited to <3m for the life of the building (50 years). Signage is to be installed throughout the storage area to recognise this 3m limit in accordance with NZBC Part F8, and is proposed to be included as part of the Compliance Schedule. The building is not undergoing a "Change of Use" and will continue to be used as workshop and office with limited storage.

The existing building sits on a single site title with street frontage to the North (Byron St) and property boundaries to the remaining external walls. The building will continued to be used as a workshop/office with limited storage up to 3 m high.

1.2 COMPLIANCE REQUIREMENT

Due to the proposed extension, the building is required to comply with the NZ Building Act **S112 "Alterations to Existing Buildings"** for Means of Escape from Fire from the existing section and Spread of Fire and Means of Escape from Fire for the new extension. The criterion used for assessing compliance is the NZ Building Code Acceptable Solutions C/AS5 2012 (with Amendment 3, 2014).

1.3 STAKEHOLDER CONSULTATION

The following documents were referred to in preparation of this report:

- i) Architectural drawings, "Proposed Additions – 80 Byron St", File Ref 5996, Sheets A1 – A12, Issue B, dated November 2016, Issued by Architectural Design Group.

The following meetings were held with stakeholders groups:

- i) Site visit (including meeting with John Targett), 26/10/2016, key aspects reviewed including existing construction of the building, boundary exposures, storage height, mezzanine floor and means of escape.

2. OCCUPANCY

The following table summarises the design occupancy for this building using the values given in Table 1.2 of C/AS5 (2014) of the NZ Building Code.

Level	Description	Risk Group	Floor Area (m ²)	Occupant Density (m ² /user)	Occupant Load	
					Design	Actual
G	Workshop	WB	680	100	7	7
G	New offices	WB	27	10	3	3
G	New meeting room	WB	16	2.5	6	6
G	New store, staff and toilets	WB	52	-	-	- ¹
Total					16	16

Notes: ¹ Spaces occupied intermittently are not included in the occupant load calculation as allowed under paragraph 1.4.3 of C/AS5 (2014)

3. FIRE SAFETY PRECAUTIONS

3.1 BUILDING CLASSIFICATION

Offices, workshop with storage of less than 3 m height are listed in Table 1.1 of C/AS5 (2014) as being WB Risk Group.

C/AS5/Table 1.1

3.2 FIRE SAFETY PRECAUTIONS

C/AS5 specifies the required fire safety precautions for a WB Risk Group building with <100 people, <3m storage height and <4m escape height as:

C/AS5/2.2.1 &
C/AS5/2.3.1

- Life safety rating = 60 minutes. This applies to fire rating requirements in Part 3: Means of escape and Part 4: Control of internal fire and smoke spread.
- Property rating = 120 minutes. This applies to fire rating requirements in Part 5: Control of external fire spread.
- Type 2 manual alarm system. A direct connection to the Fire Service is not required where a phone is available at all times for 111 calls. This system is not required where the escape routes serve no more than 50 people and the building is a single level building with less than 3m storage.
- Type 18 building fire hydrant system required unless the Fire Service hose run distance to Fire Service vehicular access to any point on any floor is less than 75 m.

3.3 EXISTING FIRE SAFETY PRECAUTIONS

Fire Alarm System:

There is no active fire alarm system in the existing building.

Door Hardware & Exits:

The existing final exit in the northern external wall has sufficient exit width but a key lock on the inside.

Mezzanine and Stairs:

All existing mezzanine floors and stairs are to be removed as part of the proposed work.

Extinguishers:

The building is equipped throughout with fire extinguishers.

Emergency Lighting:

There is no emergency lighting coverage in the existing building.

Exit Signs:

A limited number of non-illuminated exit signs are provided in some areas.

Surface Finishes:

The existing wall lining is concrete and MDF in the workshop, and painted plasterboard in offices. The existing ceiling lining is timber sarking in the workshop and painted plasterboard in offices. The floor covering is a mixture of concrete, carpet and vinyl throughout.

3.4 PROPOSED FIRE PROTECTION

3.4.1 Alarm Systems

No active fire alarm system is required due to limited storage (<3m) in a single level building serving less than 50 people.

3.4.2 Hand-held Fire Fighting Equipment

Existing fire extinguishers are to be retained and the coverage is expected to meet the requirements of NZS 4503:2005.

3.4.3 Ancillary Devices

Since fire hose runs from the point of NZFS vehicular access will not exceed 75 m, a fire hydrant within the building is not required.

3.4.4 Emergency Lighting

Compliance Document F6, NZ Building Code requires the installation of emergency lighting in the following areas:

F6/AS1/1.2

- a) in an escape route from the point where the initial open path travel distance exceeds 20 m,

Refer to Appendix D for guidance on the extent of coverage. The emergency lighting is to last for a minimum duration of 30 minutes and be installed in accordance with AS/NZS 2293 Part 1 and 3 as amended by Appendix B NZBC F6 and NZBC G9. Refer to the Electrical Engineer's documentation for details of the emergency lighting.

3.5 NZ FIRE SERVICE REQUIREMENTS

The NZ Fire Service has specific requirements with respect to the Fire Safety and Evacuation of Buildings Regulations. This building requires a registered evacuation scheme. The proposed fire protection systems are expected to meet the requirements of the Fire Service.

4. MEANS OF ESCAPE

4.1 EGRESS METHODOLOGY

With reference to the Architect's plans, the egress of the occupants is as follows (refer to Appendix D):

- Existing workshop egress – exit via existing final exit at the north-eastern corner or via new fire exit through the new office extension.
- New office extension egress – exit directly to outside via main entrance.

4.2 WIDTH OF ESCAPE ROUTES

The following table compares the allowable and actual exit widths from each area.

C/AS5/3.3.2

Description	Total exit width less one largest exit (mm)		C/AS5 (2014) Compliance?
	Required	Actual	
Workshop	700	1000	Yes
Individual door	600	700	Yes

Note: a = based on occupant load
b = based on minimum width

The minimum allowable widths do not account for disabled access requirements. Refer to NZBC Part D1.

The above table shows that all escape widths meet the requirements of C/AS5 (2014).

4.3 HEIGHT OF ESCAPE ROUTES

Within escape routes, the clear height is required to be no less than 2100 mm across the full width. Isolated ceiling fittings not exceeding 200 mm in diameter may project downwards to reduce this clearance by no more than 100 mm.

C/AS5/3.3.1

Doors on escape routes are required to have a clear height of no less than 1955 mm for the required width of the opening. The dimension of the escape routes meet with these requirements.

4.4 PATH LENGTHS

The following table compares the allowable versus actual travel distances.

C/AS5/Table 3.2

Level	Description	Risk Group	Path Lengths				OK?
			Allowable		Actual		
			DOP	TOP	DOP	TOP	
G	Workshop	WB	25	60	16	58	Yes
G	New extension	WB	25	60	7	52	Yes

Note: DOP = Dead end open path length (m)
TOP = Total open path length (m)

The open path travel distances and exit door locations allow for diversion of open paths to a distance of 8m apart, as acceptable under C/AS5 (2014).

C/AS5/3.6.2

The table shows that all escape route travel distances are within the requirements of C/AS5 (2014).

4.5 SINGLE ESCAPE ROUTE

A single escape route is allowed for the new extension as it will contain less than 50 people and the travel distance meets the minimum code requirements.

C/AS5/3.13

4.6 DOORS

Given the low occupancy, the egress doors can open in either direction.

C/AS5/3.15.3

Egress doors are to have locks that can be easily opened from the inside in an emergency without the use of a key. The existing key lock in the final exit at north-eastern corner is to be replaced with a snib lock.

C/AS5/3.15.2

4.7 SIGNAGE

Illuminated fire exit signage is to be provided throughout the building in compliance with NZBC Part F8. Refer to the Electrical Engineer's documentation for details of the emergency lighting.

F8/AS1

5. SPREAD OF FIRE

5.1 PROPERTY RATING

The western external wall of the new extension is to be constructed from 150 series masonry block. The wall is required to be designed to achieve a 120 minute FRR, and detailed to meet with the post-fire structural stability requirements of NZBC Part B1. **Refer design documentation prepared by the Structural Engineer for detailed information.**

As per comment of C/AS5 Clause 1.3, only parts 1, 2, 3 and 4 of the Acceptable Solution need to be used for an assessment of the means of escape from fire of an existing building that is being altered, to meet the requirements of Section 112 of the Building Act. Furthermore, Section 112.1 of the Building Act requires that the building must continue to comply with other provisions of the Building Code to at least the same

extent as before the alterations.

The external facade of the existing building is not being altered (except for the street facing northern facade where the extension occurs) and the storage height within the building will be limited to 3m by signage throughout the workshop. The signage is to be installed in accordance with NZBC Clause F8, and is proposed to be included as part of the Compliance Schedule. Therefore, the existing external wall does not need to be addressed for spread of fire.

5.2 FOAMED PLASTICS

The use of foamed plastic / EPS panels requires compliance with paragraph 4.17.2 of C/AS5 (2014). This means that the complete system has to achieve a Group Number as specified in Section 5.4 and the foamed plastic has to meet the flame propagation criteria as specified in AS 1366.

C/AS5/4.17.2

Any penetrations through these foamed plastic / EPS panels shall be protected as per manufacturer's instruction to meet the NZBC flame propagation and surface finish requirements. There cannot be any exposed foamed plastic / EPS. This also applies to building insulations.

5.3 SERVICE PENETRATIONS

Where services pass through fire separations or are installed in fire separations, the continuity and effectiveness of the fire separation shall be maintained as required by NZBC C/AS5/4.4 (this will include services through walls and floors as applicable). Fire resistant materials are to be approved as per NZS/AS 1530 Part 4.

5.4 SURFACE FINISHES

Wall sections that are less than 1m from the boundary need to meet specific surface finish requirements of the NZ Building Code. This applies to the western external wall of the extension. Paragraph 5.8.1 of C/AS5 (2014) requires the wall cladding system to meet the following requirements,

C/AS5/5.8.1

- Peak Heat Release Rate of 100kW/m² and
- Total Heat Release Rate less than 25MJ/m².

The proposed masonry block is non-combustible and meets this requirement.

C/AS5 Table 4.1 requires the following surface finish properties in the listed area:

Building Elements	Maximum Permitted Group Number	Flammability Index
All occupied spaces wall and ceiling linings	3	
Flooring (All other occupied spaces)	Non combustible, or when tested to ISO 9239-1 have a critical radiation of not less than 1.2 kW/m ²	
Ducts for HVAC systems: internal surfaces	1S	-

Ducts for HVAC systems: external surfaces	3	-
Underlay to roofing or external cladding when exposed to view	-	not > 5
All occupied spaces including exitways: Suspended flexible fabrics	-	not > 12

These surface finish requirements are to apply throughout the building and should apply to other existing areas during future refurbishments.

The existing wall lining is concrete and MDF in the workshop, and painted plasterboard in offices. The existing ceiling lining is timber sarking in the workshop and painted plasterboard in offices. Painted plasterboard achieves a Group Number of at least 2S. MDF and solid wood product ($\geq 9\text{mm}$ thick and $\geq 400 \text{ kg/m}^3$) is deemed acceptable in achieving a Group Number of 3. The floor covering is a mixture concrete, carpet and vinyl throughout. Existing carpet and vinyl is considered acceptable in meeting the required Critical Radiant Flux as per BRANZ Study Report No.181 [2007] – refer Appendix G for detailed information.

The proposed office extension is to have painted plasterboard to walls and ceiling, and carpet ($\geq 1.2 \text{ kW/m}^2$) on the floor.

6. FIRE FIGHTING

6.1 FIRE SERVICE VEHICULAR ACCESS

Where buildings are located remote from the street boundaries of a property, pavements situated on the property and likely to be used for vehicular access by fire appliances shall:

C/AS5/6.1

- a) Be able to withstand a laden weight of up to 25 tonnes with an axle load of 8 tonnes or, have a load bearing capacity of no less than the public roadway serving the property, whichever is the lower,
- b) Be trafficable in all weathers,
- c) Have a minimum width of 4.0 m,
- d) Provide a clear passageway of no less than 3.5 m in width and 4.0 m in height at site entrances, internal entrances and between buildings,
- e) Provide access to a hard-standing within 20m of
 - i) An entrance to the building, and
 - ii) Any inlets to fire sprinkler or building fire hydrant systems

Since the building is readily accessible from Byron St, the fire service vehicular access is expected to comply.

7. FIRE REPORT CONCLUSIONS

For the building to comply with the NZBC Fire Safety objectives, the following fire safety features will be required:

1. Emergency lighting (to AS/NZS 2293 Part 1 and 3 as amended by Appendix B NZBC Clause F6 and NZBC G9) is to be installed in those parts of egress routes that exceed the initial 20 meters of

travel. They are to last for a minimum duration of 30 minutes. Refer Appendix D for guidance on the extent of coverage.

2. All egress doors are to have locks that can be easily opened from the inside without the use of a key. The existing key lock in the final exit at north-eastern corner is to be replaced with a snib lock.
3. Illuminated exit signage is to be provided throughout the building in compliance with NZBC Clause F8. Refer to the Electrical Engineer's documentation for details of the emergency lighting.
4. The western external wall of the new extension is to be designed to achieve a 120 minute FRR, and detailed to meet with the post-fire structural stability requirements of NZBC Part B1. **Refer design documentation prepared by the Structural Engineer for detailed information.**
5. The storage height within the building will be limited to 3m by signage throughout the workshop. The signage is to be installed in accordance with NZBC Clause F8, and is proposed to be included as part of the Compliance Schedule.
6. The use of foamed plastic / EPS panels requires compliance with Table 4.1 of C/AS5 (2014). This means that the foamed plastic / EPS in-fill has to meet the flame propagation criteria as specified in AS 1366. Any penetrations through these foamed plastic / EPS panels shall be protected as per manufacturer's instruction to meet the NZBC flame propagation and flame barrier requirements. There cannot be any exposed foamed plastic / EPS panels. This also applies to building insulations.
7. Where services pass through fire separations or are installed in fire separations, the continuity and effectiveness of the fire separation shall be maintained as required by NZBC (this will include services through walls and floors as applicable). Fire resistant materials are to be approved as per AS 1530 Part 4.
8. The Code requires the following surface finish properties in the listed areas:

Building Elements	Maximum Permitted Group Number	Flammability Index
All occupied spaces wall and ceiling linings	3	
Flooring (All other occupied spaces)	Non combustible, or when tested to ISO 9239-1 have a critical radiation of not less than 1.2 kW/m ²	
Ducts for HVAC systems: internal surfaces	1S	-
Ducts for HVAC systems: external surfaces	3	-
Underlay to roofing or external cladding when exposed to view	-	not > 5
All occupied spaces including exitways: Suspended flexible fabrics	-	not > 12

These surface finish requirements are to apply throughout the building and should apply to other existing areas during future

refurbishments. The proposed office extension is to have painted plasterboard to walls and ceiling, and carpet ($\geq 1.2 \text{ kW/m}^2$) on the floor.

Given that the above features are included, the proposed earthquake strengthening and office extension for the Clip'n Climb factory is considered adequate to meet the requirements of the NZBC C/AS5 (2014) part 1 - part 5, F6-F8.

APPENDIX A: GUIDANCE NOTES FOR ACHIEVING A CODE COMPLIANCE CERTIFICATE FOR FIRE SAFETY SYSTEMS

The emergency lighting installer shall provide written confirmation that the emergency lights meet minimum illumination levels to the required areas and the minimum duration time as required by the Building Code. The contractor may be asked to demonstrate the emergency lighting system with a mains failure simulation. Also required is the test and commissioning certificates for the emergency lighting, including test results.

Where services pass through fire and smoke separations or are installed in fire and smoke separations, the continuity and effectiveness of the separation shall be maintained as required by NZBC C/AS5 2014/4.4 (this will include services through walls and floors as applicable). Certification is required from the installer(s) that all penetrations through fire and smoke separations have been installed in full accordance with manufacturer's requirements.

Door locks to comply with NZBC C/AS5 2014/3.15.2

Signs to comply with NZBC C/AS5 2014/3.16.1

APPENDIX B: SUMMARY OF PRECAUTIONS REQUIRED FOR SERVICE PENETRATIONS

Abstract: Attached is a summary sheet for fire rating of service penetrations. The following listed items should be adhered to during construction for achieving appropriate fire rating integrity of services penetrations:

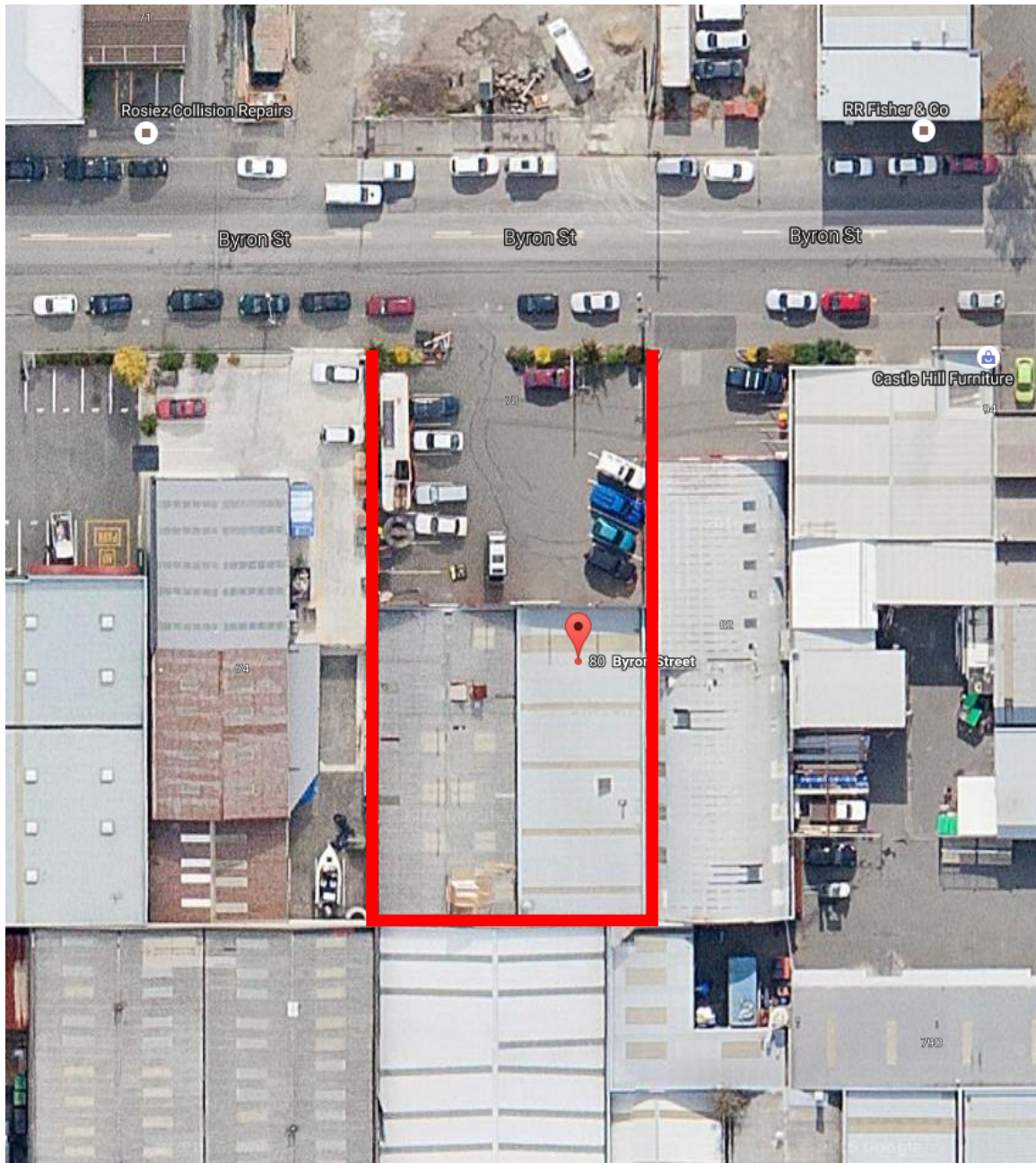
1. Test certificates are required for all service penetration fire rating products used. Non-certified products will be deemed non-compliant.
2. Fire rating products must be installed in strict compliance with the manufacturer's requirements for the application and for the specified tested / assessed system.
3. Service penetrations shall be made available for inspection to competent qualified persons (i.e. council inspector, consultant engineer, or Licensed Building Practitioner) to sample selections of penetrations.
4. It is recommended that components of fire-stopping systems not be 'mixed and matched' from different manufacturers.
5. Proposal of all fire stopping systems should be provided for the fire engineer's approval prior to commencement of installation.
6. Fire stopping systems are required to be installed by competent trained persons.

FIRE RATING OF SERVICE PENETRATIONS – SUMMARY SHEET

SERVICE	CONCRETE SEPARATION	DRY WALL SEPARATION
Plastic Pipe	Fix fire collar against masonry surface and around pipe. Ensure any gaps between pipe and concrete are fitted with fire rated mastic sealant. <i>Firepro B310FG Fyre Collars</i> are suitable. For sprinkled buildings fire collars are to be fitted for pipes equal to or greater than 25mm, fire rated mastic sealant is to be located around pipes less than 25mm.	Fixed block of laminated Gib® Fyreline, solid timber or similar in wall cavity through which the pipe passes. Install fire collar around pipe and against block surface. <i>Promat Promaseal Fire Collar</i> kits are suitable products. Ensure gaps between fire collar and adjoining surfaces are filled with fire rated mastic sealant. For sprinkled buildings fire collars are to be fitted for pipes equal to or greater than 25mm, fire rated mastic sealant is to be located around pipes less than 25mm.
Metal Pipe	Ensure full grout or fire retardant compound between metal pipe and concrete surface. Fill any cavities with fire rated mastic sealant or mortar seal. For insulated pipe, replace insulation with <i>Kaowool</i> or <i>Fyrefibre</i> for a set distance as described in <i>Winstones Gib®</i> catalogue 'Penetrations in GIB Fire Rated Systems', August 2012 (suitable up to 60 min. FRR).	Wrap fire strip seal, such as <i>Firepro IBS</i> , around pipe across dry wall thickness, and encase strip seal sleeve, such as <i>Firepro B340</i> steel sleeve. Seal gaps with fire rated mastic sealant (i.e. <i>Flamex</i>). For insulated pipe, replace insulation with <i>Superwool</i> or <i>Fyrefibre</i> for a set distance as described in <i>Winstones Gib®</i> catalogue 'Penetrations in GIB Fire Rated Systems', August 2012 (suitable up to 60 min. FRR).
Ductwork	Fit proprietary fire damper into opening, including a suitable sleeve or frame to allow fixing to the wall structure as per suppliers instructions. Connecting ducting is to be slip fixed only to damper to ensure that the damper is not physically damaged through failure of the connecting ductwork. Any cavities filled with fire mortar or similar. Small gaps filled with fire rated mastic sealant. Allow for access panel and test latches. <i>Holyoakes</i> or <i>Halton</i> damper units are suitable	
Electrical Services	Install bulkhead and coating system for cable tray penetrations, such as the <i>Promat Promaseal</i> system. Otherwise, use suitable fire rated mastic sealant around singular penetrations. Where ladders or trays pass through fire rated elements, terminate the ladders or trays at both sides of the openings and provide holes for the cables only. All holes are to be fire stopped with a proprietary product that is equal to or greater than the fire resistance of the materials being filled and is installed to the manufacture's specifications.	
Recessed Fittings: Lights, Cabinets, Flush Boxes	Usually not applicable for lights. Ensure full grout or fire mortar seal around recessed features.	<i>Lights & Cabinets:</i> Form fire rated recess constructed from same thickness wall lining (i.e. <i>Gib®</i>) as per the ceiling or wall, except extra layer for top section of recess. Refer <i>Winstones Gib®</i> Catalogue 'Penetrations in GIB Fire Rated Systems', October 2012. <i>Flush Boxes:</i> Install proprietary intumescent blocks into flush boxes. Apply fire rated mastic sealant around outer edges/gaps.

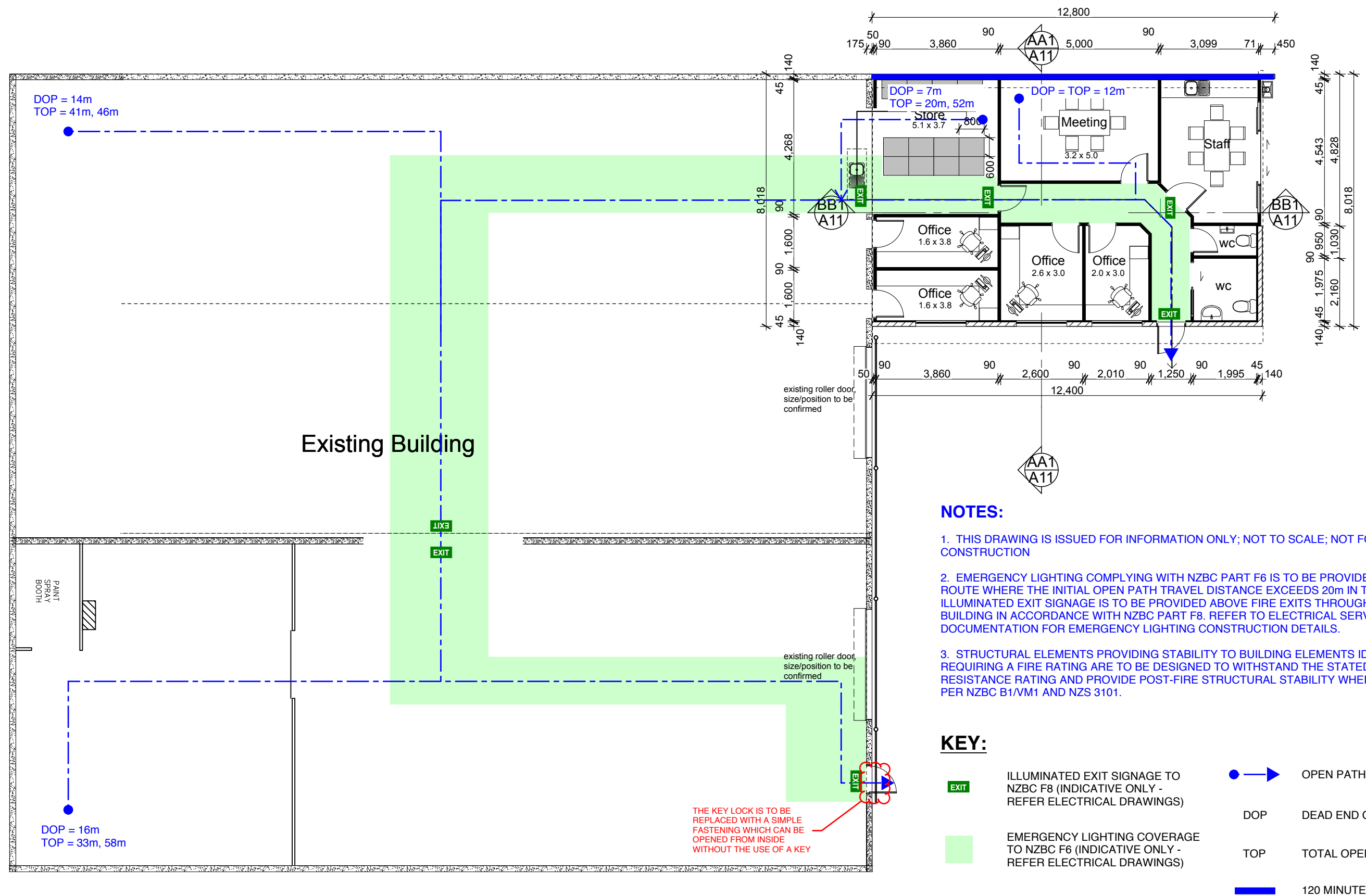
APPENDIX C: SITE PLAN

Abstract: Attached is a copy of the site plan for the Clip'n Climb factory, showing the general layout of the existing building and extension.



APPENDIX D: KEY FIRE SAFETY REQUIREMENTS

Abstract: Attached are copies of the floor plans showing the required fire safety features that are to be incorporated into the building design.



NOTES:

1. THIS DRAWING IS ISSUED FOR INFORMATION ONLY; NOT TO SCALE; NOT FOR CONSTRUCTION
2. EMERGENCY LIGHTING COMPLYING WITH NZBC PART F6 IS TO BE PROVIDED IN AN ESCAPE ROUTE WHERE THE INITIAL OPEN PATH TRAVEL DISTANCE EXCEEDS 20m IN THE BUILDING. ILLUMINATED EXIT SIGNAGE IS TO BE PROVIDED ABOVE FIRE EXITS THROUGHOUT THE BUILDING IN ACCORDANCE WITH NZBC PART F8. REFER TO ELECTRICAL SERVICES DOCUMENTATION FOR EMERGENCY LIGHTING CONSTRUCTION DETAILS.
3. STRUCTURAL ELEMENTS PROVIDING STABILITY TO BUILDING ELEMENTS IDENTIFIED AS REQUIRING A FIRE RATING ARE TO BE DESIGNED TO WITHSTAND THE STATED FIRE RESISTANCE RATING AND PROVIDE POST-FIRE STRUCTURAL STABILITY WHERE REQUIRED AS PER NZBC B1/VM1 AND NZS 3101.

KEY:

- | | | | |
|--|--|-----|---------------------------|
| | ILLUMINATED EXIT SIGNAGE TO NZBC F8 (INDICATIVE ONLY - REFER ELECTRICAL DRAWINGS) | | OPEN PATH TRAVEL ROUTES |
| | EMERGENCY LIGHTING COVERAGE TO NZBC F6 (INDICATIVE ONLY - REFER ELECTRICAL DRAWINGS) | DOP | DEAD END OPEN PATH LENGTH |
| | | TOP | TOTAL OPEN PATH LENGTH |
| | | | 120 MINUTE FRR |

CHECK ALL INFORMATION ON SITE PRIOR TO COMMENCING WORK. READ IN CONJUNCTION WITH THE SPECIFICATION AND OTHER RELEVANT DRAWINGS AND DOCUMENTS			 PO Box 842 Christchurch, New Zealand. Ph. (03) 377 8600 Email: admin@cosgroves.com	PROJECT: CLIP N CLIMB FACTORY 80 BYRON ST CHRISTCHURCH	SHEET TITLE: KEY FIRE SAFETY PROVISIONS	BUILDING CONSENT		
						DESIGNED: NC	DATE: 07/11/16	ISSUE: B
						DRAWN: NC	SCALE: NTS	
B	BUILDING CONSENT	07/11/16				SHEET No: 16175CC-SK01		
A	DRAFT	04/11/16						
ISSUE	AMENDMENT	DATE						

APPENDIX E: COMPLIANCE SCHEDULE

	Specified System <i>Description: Location:</i>	Maintenance Procedure / Performance Standards	Frequency of Inspections	Maintained By	Specified System Modified By
4	Emergency Lighting System Systems from 1995 <i>Location: As per Electrical Design Documentation</i>	AS/NZS 2293 Part 2:1995	As specified by the Standard	Independent Qualified Person	New
15/2	Final Exit Doors and Other Exit Doors <i>Location: As per Fire Report</i>	Visual inspection to ensure all the means of escape are in good repair and in accordance with Compliance document C/AS5 or NZS 1900 for buildings built and as altered prior to the introduction of the Building Act.	Monthly (other occupancies) Annually	Owner Independent Qualified Person	New Existing
15/4	Signs for communicating information intended to Facilitate Evacuation <i>Location: As per Electrical Design Documentation</i>	All signs are to be clearly visible and unobstructed. Signs shall be refurbished before they become illegible, and shall be replaced immediately should they be missing. Defects in illuminated signs shall be replaced immediately they are apparent. And in accordance with Compliance document F8/AS1.	Monthly Annually	Owner Independent Qualified Person	New
-	Signs for limiting the storage height to 3m <i>Location: Throughout the workshop/storage area</i>	All signs are to be clearly visible and unobstructed. Signs shall be refurbished before they become illegible, and shall be replaced immediately should they be missing. Defects in illuminated signs shall be replaced immediately they are apparent. And in accordance with Compliance document F8/AS1.	Monthly Annually	Owner Independent Qualified Person	New

APPENDIX F: INSPECTION SCHEDULE FIRE SAFETY SYSTEMS

PROJECT: Clip'n Climb

LEVEL OF CONSTRUCTION MONITORING: CM2 (refer IPENZ Guidance Note)

CM2	<i>"Review, preferably at the earliest opportunity, a sample of <u>each</u> important work procedure, material of construction and component for compliance with the requirements of the plans and specifications and review a representative sample of <u>each</u> important completed work prior to enclosure or completion as appropriate. Be available to provide the constructor with technical interpretation of the plans and specification."</i>
-----	--

ITEM #	ELEMENT	INSPECTION REQUIREMENT
1.	Fire Rated Construction <i>[Structural Engineer to inspect + verify structural performance]</i> <i>[PS3 to be provided by Contractor for all work aligned to fire ratings, including Trade penetration]</i>	Western external wall for the new extension.
2.	Means of Escape <i>[Electrical Engineer to inspect + verify the emergency lighting and exit signage system – this will be covered by the Contractor's PS3 and Electrical Engineer's PS4]</i>	The following systems need to be inspected: • Egress paths – unobstructed, door opening direction, hardware, widths • Emergency Lighting – as per Electrical Design (PS3 & PS4 by others), visual inspection by Cosgroves • Doors – fail safe unlock mechanism and door opening forces

The Contractor is to advise our office when the installation of each of these systems is advanced to a level to enable inspection. Any technical enquiries or notification for inspections can be directed to Nick Chen, Fire Engineer, Cosgroves (Ph 377 8600)

APPENDIX G: EXCERPT OF BRANZ STUDY REPORT NO.181



STUDY REPORT

No. 181 (2007)

Fire Properties of Floor Coverings: New Fire Test Methods and Acceptable Solutions

PCR Collier



The work reported here was jointly funded by Building Research Levy whose logo is shown above.

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ISSN: 0113-3675

3. EXPERIMENTAL TRIALS AND ANALYSIS

The approach of this study is to compare the results obtained in the CC, FRPT and HMN test apparatus of a selection of typical New Zealand available flooring products. Table 3 lists the physical properties of the tested flooring products and Figure 23 and Figure 24 (in the Appendices) show photographs of the samples. The materials were selected based on covering the range from low to high hazard. Materials obviously at the extreme low hazard end of the scale were omitted, as it was considered that the evidence gathered would be of limited use in demonstrating that the test methods are capable of discriminating levels of performance when there is obviously no hazard. The types of materials omitted were ceramic and stone flooring tiles as they are essentially non-combustible.

Table 3: Selection of flooring types and testing

#	Flooring product type	Thickness, mm (nominal including backing)	Density, kg/m ²	Cone	FRP	HMN
A	Flooring laminate (0.25 mm) on MDF	7 mm	879	x	x	x
B	Carpet tile (polyester)	4 mm	347	x	x	x
C	Cork tile	6 mm	460	x	x	x
D	Flooring laminate (0.25 mm) (formica) on HDF	12 mm	978	x	x	x
E	Flooring laminate 0.25 mm (formica) on HDF	8 mm	896	x	-	-
F	Vinyl tiles	1.5 mm	898	x	x	x
G	Polyester, overlay	12 mm	148	x	x	x
H	Plywood flooring	20 mm	511	x	x	x
I	Rubber floor covering	2.4 mm	2073	x	x	x
J	Polypropylene carpet with latex backing	6 mm	142	x	*	*
K	Polypropylene carpet bonded to polyolefin backing	6.2 mm	337	x	*	*

x tested for this project

*Data supplied by manufacturer

3.1 Test results

3.1.1 Flooring Radiant Panel Test

The results from the FRPT ISO 9239-1:2002 (2002) for the CRF and smoke measurements are shown in Table 4. The results are derived from the average of three samples.

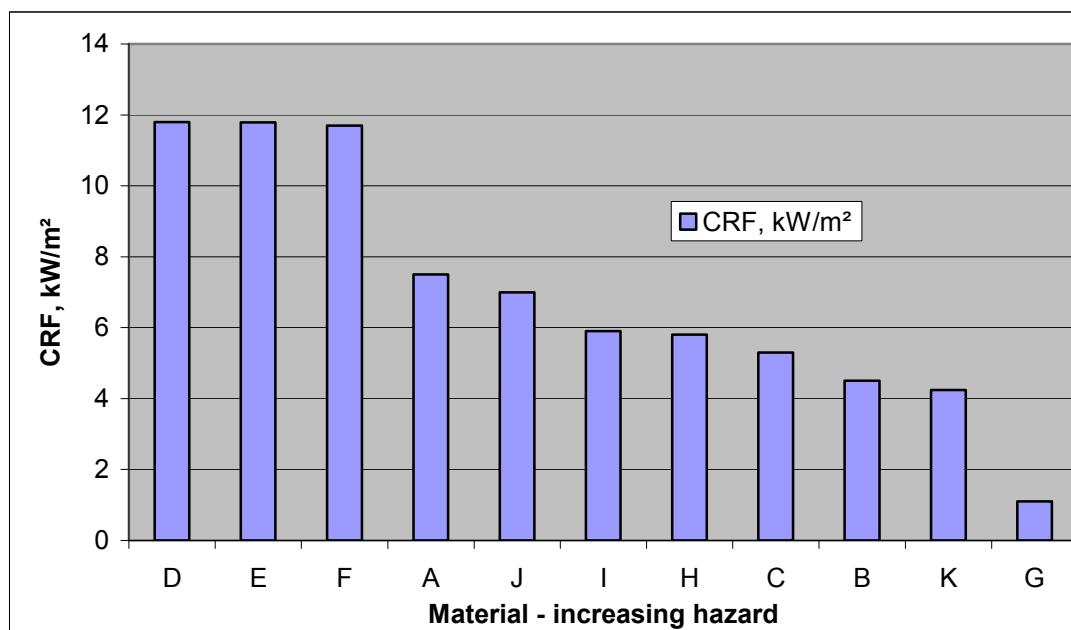
Table 4: Summary of FRP results (heat and smoke)

#	Flooring product type	CRF, kW/m ²	Smoke, %.min
A	Flooring laminate on MDF, 7 mm	7.5	131
B	Carpet tile (Autex)	4.6	542
C	Cork tile, 6 mm	5.3	106
D	Flooring laminate (formica), 12 mm	11.8	234
E	Flooring laminate (formica), 8 mm	11.8*	234*
F	Vinyl tiles, 1.5 mm	11.7	158
G	Polyester, overlay	<1.1	629
H	Plywood flooring	5.8	185
I	Rubber floor covering	5.9	813
J	Polypropylene on latex	7.0	124
K	Polypropylene on polyolefin backing	4.24	660

*Not tested – estimated from material D

The materials A to K are ranked in order of reducing CRF and plotted in Figure 2. Subsequent analysis using bar charts has retained the same order to determine whether the trend of increasing hazard is maintained for the different assessment parameters of the other test methods.

While the measurement of CRF may not be truly representative of the actual hazard, which is the ability of floor coverings to aid transport of fire/flame from one area/compartment to another, it is the test method adopted in Australia, Europe and USA in conjunction with the smoke measurement in Figure 3 from the same test.

**Figure 2: FRP – CRF, kW/m² results to ISO 9239-1:2002(E)**

APPENDIX H: PROPERTY PROTECTION MEASURES

Abstract: The following describes additional property protection measures that the building owner may wish to consider incorporating into the building design.

Property Protection Measures

As has already been mentioned, the Fire Report has been written for the purposes of complying with minimum Code requirements. No property protection measures have specifically been addressed. However, there are various property protection measures the building owner may wish to consider, which may serve to mitigate the loss of stock, property, or continued business in the event of a fire, and additionally offer incentives for reduced insurance premiums.

There are various options of passive and active fire protection available, and further combinations of these can be derived to assess the most cost effective solution. The three general options are described as follows are for guideline purposes only to assist the building owners in their assessment of property protection measures.

Further evaluation of the feasibility and cost benefits of each of the options would need to be undertaken by the building owner.

Automatic Heat and/or Smoke Detection

The installation of an automatic heat or smoke detection system, to NZS4512, would activate an alarm and can be direct connected to the Fire Service for a prompt response to a fire situation. This can provide a level of Fire Service intervention even when the building is unoccupied. In an occupied situation, the alarm system will notify occupants, of whom a suitably qualified occupant may be in a position to extinguish any fire in its' early stage of development. Hence, an automatic detection system can provide a level of property protection.

Sprinkler Protection

Installation of a sprinkler system to NZS4541 will provide both detection and suppression in the early stages fire and is recognised as the most effective fire protection measure, when used within buildings. A NZS4541 compliant sprinkler system will call the Fire Service out on sprinkler activation and commence suppression of the fire. Suppression by the NZS4541 sprinkler system would be expected to be to an extent whereby, if the fire is not actually extinguished by the time of NZFS arrival, the fire size would be expected to be controlled within the small area of sprinkler operation. The small controlled fire size would be expected to be easily extinguished by the Fire Service.

Installation of a sprinkler system also offers construction savings by allowing reductions in fire rating requirements of the Code. As an example, the Property Rating requirement is halved.

Multiple Firecells

Subdivision of the building into firecells offers property protection by limiting the extent of fire damage to within the confines of the firecell of fire origin. Additional firecell separation will be expected to reduce both loss of stock (due to fire or smoke damage) and business operations (after the fire event).

The firecell separation between the two firecells could vary between the full Property Rating separation, which would protect against a full burn out, down to a lesser extent (say 30 minutes FRR) which may be adequate to ensure that Fire Service intervention would prevent further spread of fire to another firecell. The smaller (or more numerous) the firecells, the easier it will be for the NZFS to contain and suppress a fire within that firecell.

Various practicalities of achieving the firecell separation and the associated costs will have to be weighed up against the expected benefits (from insurance premium reduction, or business continuance estimates etc.) of the extent of firecell protection. Firecell separations, in conjunction with a fire alarm system, and/or sprinkler system offer a high level of property protection.

From: Nick Chen nick.chen@cosgroves.com
Subject: RE: 80 Byron Street Christchurch Clip N Climb
Date: 16 June 2017 4:24 pm
To: Adrian adrian@architecturaldesigngroup.co.nz

Hi Adrian,

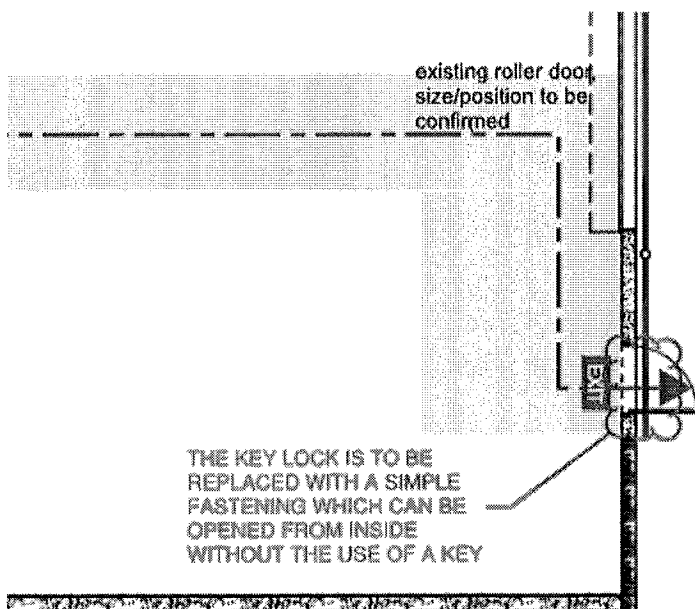
Apologies for not getting back to you sooner. I was trying to clear the backlog in the past month after my annual leave but still found myself snowed under. Anyway, I have gone through the RFIs and suggested a few words for you to reply to the BCO and some questions for you to answer.

FIR005 – My understanding is that the building is not protected with a sprinkler system at all and the proposed extension is for office and meeting rooms only. I don't believe the proposed extension constitutes a "Change of Use".

FIR010 – Awaits response from NZFS

FIR025 – The workshop is used to assemble indoor climbing equipment and majority of the floor area is occupied by the storage on a single wood pallet. Also, the occupant number 7 calculated based on 100m²/person number of employees is a more accurate representation for the space.

FIR031 – Please provide a door schedule to show the below door lock to be changed.



FIR037 – Is plywood really necessary? Can we not go for the plasterboard ceiling? Council will look for test datasheet for the plywood achieving a Group Number of 3.

FIR044 – The fire report called up for installation of emergency lighting and exit signage. Has this been designed by an electrical engineer? We can provide that service in-house. Please advise.

FIR046 – We can also provide necessary inspections on a time basis. Is the client willing to engage us to provide that service? Please advise.

Kind Regards

Nick Chen | Senior Fire Engineer BE(Hons), ME(Fire), CPEng, MIPENZ
Cosgroves Ltd | Level 3, ASB House, 518 Colombo Street | PO Box 842, Christchurch 8140
T +64 3 377 8600 | W www.cosgroves.com



PRODUCER STATEMENT – PS1 – DESIGN

(Guidance on use of Producer Statements (formerly page 2) is available at www.ipenz.nz)

ISSUED BY: Structex Harvard Ltd.
(Design Firm)

TO: Clip 'n' Climb
(Owner/Developer)

TO BE SUPPLIED TO: Christchurch City Council
(Building Consent Authority)

IN RESPECT OF: Proposed New Office Addition
(Description of Building Work)

AT: 80 Bryon Street
(Address)

Town/City: Christchurch LOT 1 DP 449853 SO
(Address)

We have been engaged by the owner/developer referred to above to provide:
structural engineering design

(Extent of Engagement)

services in respect of the requirements of Clause(s) B1 (structure) of the Building Code for:
☒ All or ☐ Part only (as specified in the attachment to this statement), of the proposed building work.

The design carried out by us has been prepared in accordance with:

☒ Compliance Documents issued by the Ministry of Business, Innovation & Employment B1/VM1 (NZS1170 set) or
(verification method/acceptable solution)

☐ Alternative solution as per the attached schedule NZS3404:1997, NZS4230:2004, NZS3101:2006, NZS3603:1993

The proposed building work covered by this producer statement is described on the drawings titled:

Proposed Additions, 80 Byron St, Christchurch and numbered A9, A12 - A15, A17-A18;
together with the specification, and other documents set out in the schedule attached to this statement.

On behalf of the Design Firm, and subject to:

- (i) Site verification of the following design assumptions - safe bearing pressure of 50kPa or more
- (ii) All proprietary products meeting their performance specification requirements;

I believe on reasonable grounds that a) the building, if constructed in accordance with the drawings, specifications, and other documents provided or listed in the attached schedule, will comply with the relevant provisions of the Building Code and that b), the persons who have undertaken the design have the necessary competency to do so. I also recommend the following level of construction monitoring/observation:

☐ CM1 ☐ CM2 ☒ CM3 ☐ CM4 ☐ CM5 (Engineering Categories) or ☐ as per agreement with owner/developer (Architectural)

I, William Julius Long am: ☒ CPEng 231242 # ☐ Reg Arch #
(Name of Design Professional)

I am a Member of: ☒ IPENZ ☐ NZIA and hold the following qualifications: B.E.(Hons) (Civil)

The Design Firm issuing this statement holds a current policy of Professional Indemnity Insurance no less than \$200,000*.

The Design Firm is a member of ACENZ: ☒

SIGNED BY: William Julius Long (Signature) Julius Long
(Name of Design Professional)

ON BEHALF OF Structex Harvard Ltd. Date: 01/02/17
(Design Firm)

Note: This statement shall only be relied upon by the Building Consent Authority named above. Liability under this statement accrues to the Design Firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the Building Consent Authority in relation to this building work, whether in contract, tort or otherwise (including negligence), is limited to the sum of \$200,000*.

This form is to accompany **Form 2 of the Building (Forms) Regulations 2004** for the application of a Building Consent.
THIS FORM AND ITS CONDITIONS ARE COPYRIGHT TO ACENZ, IPENZ AND NZIA

GUIDANCE ON USE OF PRODUCER STATEMENTS

Producer statements were first introduced with the Building Act 1991. The producer statements were developed by a combined task committee consisting of members of the New Zealand Institute of Architects, Institution of Professional engineers New Zealand, Association of Consulting Engineers New Zealand in consultation with the Building Officials Institute of New Zealand. The original suit of producer statements has been revised at the date of this form as a result of enactment of the Building Act (2004) by these organisations to ensure standard use within the industry.

The producer statement system is intended to provide Building Consent Authorities (BCAs) with reasonable grounds for the issue of a Building Consent or a Code Compliance Certificate, without having to duplicate design or construction checking undertaken by others.

PS1 Design Intended for use by a suitably qualified independent design professional in circumstances where the BCA accepts a producer statement for establishing reasonable grounds to issue a Building Consent;

PS2 Design Review Intended for use by a suitably qualified independent design professional where the BCA accepts an independent design professional's review as the basis for establishing reasonable grounds to issue a Building Consent;

PS3 Construction Forms commonly used as a certificate of completion of building work are Schedule 6 of NZS 3910:2013 or Schedules E1/E2 of NZIA's SCC 2011²

PS4 Construction Review Intended for use by a suitably qualified independent design professional who undertakes construction monitoring of the building works where the BCA requests a producer statement prior to issuing a Code Compliance Certificate.

This must be accompanied by a statement of completion of building work (Schedule 6).

The following guidelines are provided by ACENZ, IPENZ and NZIA to interpret the Producer Statement.

Competence of Design Professional

This statement is made by a Design Firm that has undertaken a contract of services for the services named, and is signed by a person authorised by that firm to verify the processes within the firm and competence of its designers.

A competent design professional will have a professional qualification and proven current competence through registration on a national competence based register, either as a Chartered Professional Engineer (CPEng) or a Registered Architect.

Membership of a professional body, such as the Institution of Professional Engineers New Zealand (IPENZ) or the New Zealand Institute of Architects (NZIA), provides additional assurance of the designer's standing within the profession. If the design firm is a member of the Association of Consulting Engineers New Zealand (ACENZ), this provides additional assurance about the standing of the firm.

Persons or firms meeting these criteria satisfy the term "suitably qualified independent design professional".

*Professional Indemnity Insurance

As part of membership requirements, ACENZ requires all member firms to hold Professional Indemnity Insurance to a minimum level.

The PI Insurance minimum stated on the front of this form reflects standard, small projects. If the parties deem this inappropriate for large projects the minimum may be up to \$500,000.

Professional Services during Construction Phase

There are several levels of service which a Design Firm may provide during the construction phase of a project (CM1-CM5 for Engineers³). The Building Consent Authority is encouraged to require that the service to be provided by the Design Firm is appropriate for the project concerned.

Requirement to provide Producer Statement PS4

Building Consent Authorities should ensure that the applicant is aware of any requirement for producer statements for the construction phase of building work at the time the building consent is issued as no design professional should be expected to provide a producer statement unless such a requirement forms part of the Design firm's engagement.

Attached Particulars

Attached particulars referred to in this producer statement refer to supplementary information appended to the producer statement.

Refer Also:

- ¹ Conditions of Contract for Building & Civil Engineering Construction NZS 3910: 2013
- ² NZIA Standard Conditions of Contract SCC 2011
- ³ Guideline on the Briefing & Engagement for Consulting Engineering Services (ACENZ/IPENZ 2004)
- ⁴ PN Guidelines on Producer Statements

www.acenz.org.nz
www.ipenz.org.nz
www.nzia.co.nz



Structural Engineering Design Features Report

**80 BYRON STREET NEW OFFICE ADDITION
FOR SPAGHETTI JUNCTION LTD.**

Project: HV5604
14th December 2016



HV5604 Clip n Climb New Office Design Features
Report
Page 1 of 14

Latest issue prepared by

Reviewed by



Michael Barnes
BE(Hons), GIPENZ



Julia Clendon
Structural Engineer
BE(Hons), GIPENZ

Revision No.	Date	Engineer	Description
A	14/12/2016	MB	Concept Issue

This Design Features Report (DFR) is confidential and shall not be reproduced without prior written approval of Structex Harvard Ltd. It has been prepared on behalf of and for the exclusive use of Structex Harvard's Client and is subject to and issued pursuant to the provisions of the agreement between Structex Harvard and its Client. The DFR incorporates the information made available to Structex Harvard at the time of writing this report and is issued subject to the information provided and the scope of instruction. Structex Harvard accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this DFR by any third party.



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1. General

1.1 OBJECTIVE

This Design Features Report is intended to give an overview of the project and structural design.

The purpose of the report is to:

- Communicate key aspects of the structural design to the Client
- Provide an overview of the structural design to other members of the design team to assist with co-ordination
- Provide a summary of structural design philosophy and key parameters used to assist in peer review of the design by internal and external reviewers, and the Territorial Authority
- Communicate the assumptions, loads and structural system for future users or if alternations are made

Acknowledging that building design is an iterative process with a number of stages in the design process, we aim to update this Design Features Report at key milestones during the project, to reflect latest decisions and additional detail as appropriate, or if there is a major change in design brief.

1.2 PROJECT DESCRIPTION

This project involves a new office building adjacent to the existing warehouse and workshop located at 80 Byron Street, Christchurch. In general, this includes:

- 100m² office extension as shown in Figure 1. The location of this on the site is indicated in Figure 2.



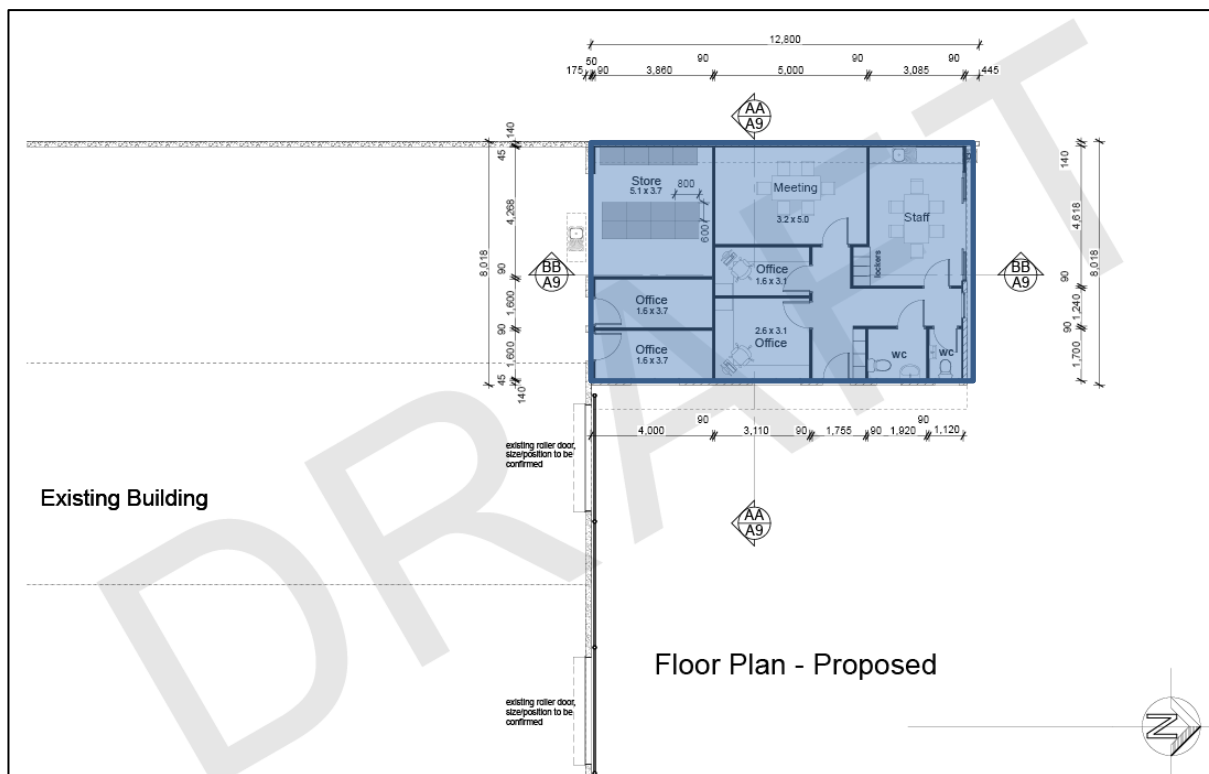


Figure 1. Proposed New Office Building

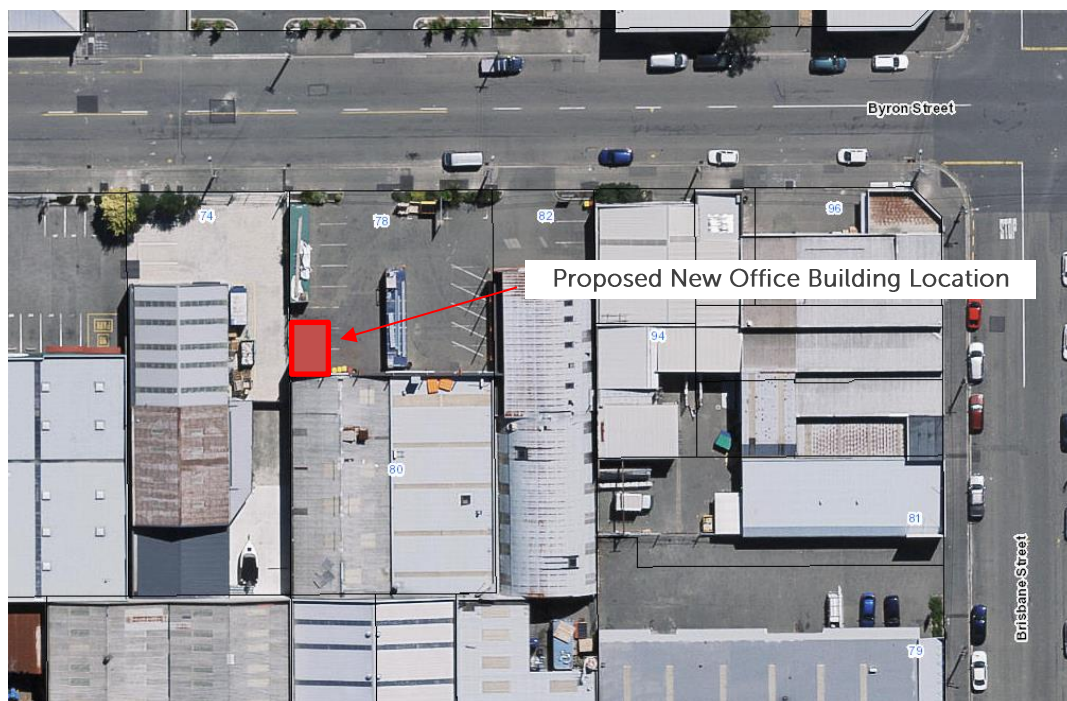


Figure 2. Aerial view of new office location

1.3 PARTIES

Client:	Spaghetti Junction Ltd.
Architect & Project Manager:	Architectural Design Group
Structural Engineer:	Structex Harvard Ltd
Fire Engineer:	Cosgroves

1.4 STRUCTEX DESIGN TEAM

Project Director and Lead Engineer:	Julius Long
Design Engineer:	Michael Barnes
Draughting:	To be coordinated with Architect

1.5 SCOPE

This Design Feature Report describes the overall structural design for the project as a means of coordination and documentation. The design roles and responsibilities of Structex Harvard Ltd. include:

- Structural engineering design of the proposed new office building located at 80 Byron Street

1.6 CONSENTING

Consenting works required for the construction works are out of our scope and are to be arranged by others.



2. Design Philosophy

2.1 OVERVIEW

The proposed new office building consists of concrete block walls on three sides and the south side opening into the existing warehouse/workshop. Cold formed DHS purlins form the roof structure of the new office building and span between load bearing walls and end walls. The new office has been designed to be seismically separate from the existing structure. Figure 3 shows a floor plan of the new office with gridlines and earthquake directions used in design.

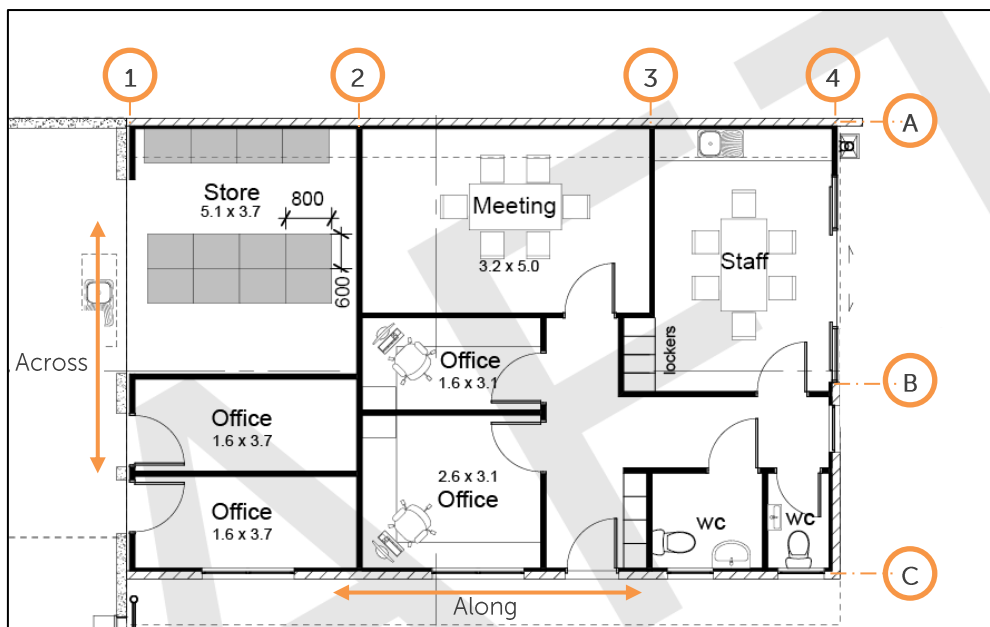


Figure 3. Gridlines and EQ Directions

2.2 GRAVITY LOAD STRUCTURE

- Lightweight steel roof cladding over Dimond DHS purlins
- DHS purlins spanning along building between load bearing internal walls and external walls
- A steel PFC beam supports the purlins along Grid 1, which is supported by 3 No. SHS posts.
- Floor is 100mm thick mesh reinforced concrete slab on compacted hardfill
- Perimeter concrete thickenings support the concrete block work walls

2.3 LATERAL LOAD STRUCTURE

Lateral loads in the new extension are described below and shown in Figure 4.

- In the along direction, lateral loads are resisted by the concrete block walls on Grids A & C which transfer loads to the foundations. Steel strap bracing distributes the roof inertial load to these walls.
- In the across direction lateral loads are resisted by timber framed shear walls on Grids 2 & 3 and a concrete block wall on Grid 4. Steel strap bracing takes the Grid 1 loads to the Grid 2 shear wall.
- Face load on concrete block walls is resisted by propped cantilever action in the along direction, and in the across direction the block walls are designed to span horizontally between the bracing lines. After fire stability of the block walls is achieved by the design and detailing of the walls to cantilever from the foundations.

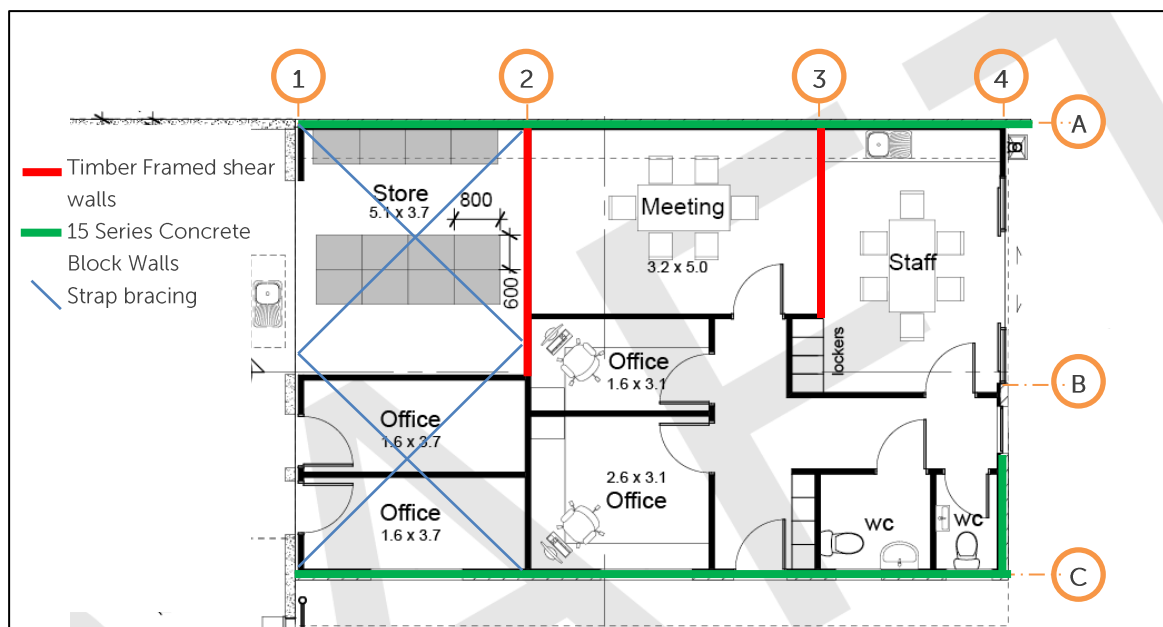


Figure 4. Lateral Load Resisting Systems

2.4 SEISMIC MODELLING

Hand calculations have been used for the load distribution based on tributary areas. Consideration has been given as to the relative stiffness's of the concrete block walls and the timber framed bracing walls. Because there is no rigid ceiling diaphragm the walls are considered to attract the loads based on their tributary area as opposed to their stiffness.

The equivalent static method of seismic load application has been used in accordance with NZS1170.5.

2.5 MEANS OF COMPLIANCE

Compliance with the New Zealand Building Code is generally via MBIE cited compliance documents. The design of the buildings has been undertaken in accordance with what we consider 'current engineering best practice'. Specifically, as follows:

- All relevant cited Standards (including amendments) within B1/VM1
- Draft updates to cited standards where more onerous than official codes, unless good engineering judgement is provided as to why we would not follow draft updates (in this case we would revert back to the cited standards)
 - NZSEE Red Book (2016 draft) for assessment of existing structures
 - NZS3101:2006 Draft Amendment 3

2.6 LOAD SUMMARY

As a minimum, design loads are generally in accordance with the loadings standard AS/NZS 1170 set.

Design Return Periods:

The proposed building importance level for the building is IL2. This is typical for 'normal use' commercial and industrial buildings that aren't used for post-disaster functions, and have an occupancy less than 300 people. This determines the return period for respective environmental loads as summarised below:

	Ultimate Limit State (ULS)	Serviceability Limit State (SLS)
Wind	1/500 year	1/25 year
Snow	1/150 year	1/25 year
Earthquake	1/500 year	1/25 year

Superimposed Dead Load Summary:

The table below summarises the proposed superimposed design loads based on the architectural drawings, building use, and requirements of AS/NZS1170.1.



Element	Description	SDL (G_{SDL})
Roof	Suspended Ceiling	0.2kPa

Roof Live Loading Summary:

Roofs do not generally have readily available access, so the design typically has been based on maintenance loads (which generally doesn't govern over wind and snow). A summary of the roof loads is provided in the table below:

Roof	Roof Use	Live Load (Q)
All Roofs	Maintenance, occasional access from ground level	0.25kPa, 1.1kN

Wind Loading Summary:

The building is very exposed to wind in all directions due to the lack of nearby obstructions and terrain. In particular, the north-west direction wind would be very strong. Accordingly, refer the summary table below for the extensions (wind capacity of the existing structure has not specifically been checked) :

Factor	Description	
Wind region	Christchurch	A7
Regional wind speed	V_{500} and V_{25}	45m/s, 37m/s
Terrain category	$M_{z,cat}$ (terrain cat 3 – Numerous closely spaced obstructions ranging from 3m-10m, $z=4m$)	0.83
Directional multiplier	M_d (any direction)	1.0
Shielding factor	M_s	1.0
Topographic multiplier	M_t	1.0
Basic wind pressure	P_u , and P_s	0.839kPa, 0.567kPa
Wind zone	Equivalent NZS3604 zone	Medium



Snow Loading Summary:

As the altitude of site is less than 100m above sea level, the design snow load is as typical for Christchurch. The table below summarises the design loads:

Factor	Description	
Snow region	Sub-alpine	N4
Ground snow	S_g	0.9kPa
Exposure reduction coefficient	C_e	1.0
Roof slope	μ_{ij} (<10 degrees typical)	0.7
Roof snow	S_u , and S_s	0.63kPa, 0.43kPa

Earthquake Loading Summary:

The design earthquake loads are based on sub-soil class D as a conservative upper limit – deep or soft soil. The table below summarises the earthquake loads:

Factor	Description	
Seismic hazard zone factor	Z	0.3
Risk factor	R_{500} , and R_{25}	1.0, 0.25
Near fault factor	$N(T,D)$	1.0
Fundamental period	T_1	0.4sec
Base seismic coefficient	$C_h(T_1)$ (sub-soil class D)	3.0
Seismic coefficient	$C(T_1)$	0.9
Displacement ductility	μ	1.25 Concrete block walls and strap bracing 3.0 Timber framed bracing walls
Seismic design coefficient	$C_d(T_1)_u$	0.728 ($\mu = 1.25$), 0.294 ($\mu = 3.0$)



3. Health, Safety and Environment

3.1 SAFETY IN DESIGN

Safety in design will continue to be considered as the design progresses, and coordinated with the other consultants as needed. Key features considered in the structural engineering design include:

- Conventional structural materials utilised
- Site welding limited

3.2 SAFETY IN CONSTRUCTION

The new office extension elements have been detailed based on conventional construction techniques, accordingly it is expected the contractor would be familiar with all construction safety requirements including fall restraint at height, mobile plant, and scaffolding.



4. Durability

4.1 COMPLIANCE

Durability issues with regard to the structural elements, and within our scope of work are implicitly covered by our design using the referenced standards for B1 (Structure). An example is concrete durability, which is addressed by providing adequate concrete strength and cover to reinforcement as specified in the Concrete Standard NZS 3101, and referred to as a compliance method in the section B2, cl 3.0 of the Building Code.



5. Fire

Structex has received and considered the project fire design report by Cosgroves, dated November 2016.

The key aspects of the fire report affecting the structural design are:

- The life safety fire resistance rating requirement is 60 minutes, including suspended floors and their supporting structure
- The Property fire resistance rating requirement is 120 minutes
- The Western external wall of the proposed extension meets the required 120 minute FRR inherent in the 15-series concrete block. The wall has also been detailed to meet the post-fire structural stability requirements of the NZBC by cantilevering above floor level.



Construction Monitoring – Building Regulation Clause(s) B1

Issued By:	Structx Harvard Ltd.	Date:	11 April 2017
To:	Clip 'n' Climb		
To be Supplied To:	Christchurch City Council		
In Respect Of:	Proposed Office Addition		
At:	80 Byron Street, Sydenham, Christchurch	Lot:	1 DP: 449853

Construction monitoring is limited to structural elements as described in the Producer Statement – PS1 Design.

Structex Harvard Limited has been engaged by Clip 'n' Climb to undertake construction monitoring of the work covered by our Producer Statement – PS1 Design. The extent of the construction monitoring will be to CM3 level and appropriate to the scale and complexity of the project and will include inspections and observations of the following:

- Excavation (subgrade beneath foundation footprint) to be inspected by geotechnical engineer.
- Foundations before casting.
- Concrete block walls after reinforcing but before grouting.
- Structural steelwork after erection.
- Connections between structural components.

At completion, and on request, Structex Harvard Limited will supply a Producer Statement – Construction Review (PS4) of the standard form agreed by Joint ACENZ/NZIA/IPENZ committee, in conjunction with the Contractor's Producer Statement – Construction (PS3).

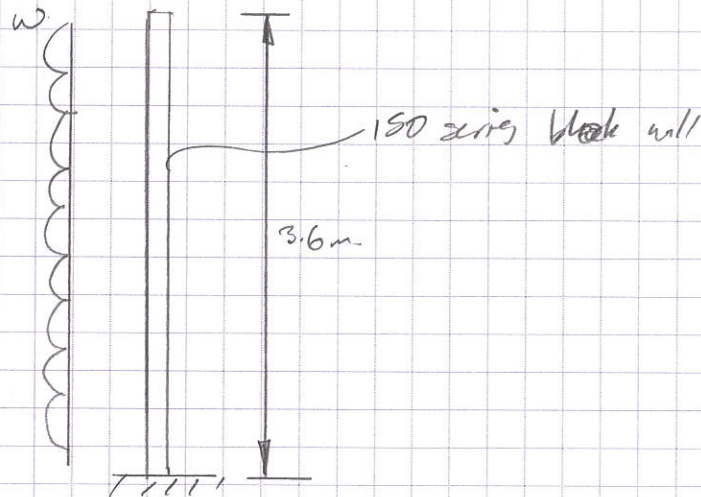
A record of each site visit made by our firm to check Building Code compliance matters will be left on site at the completion of that site visit.



Julia Clendon
Structural Engineer



Design Cantilever block wall on Grid A.
check fire first (0.5 kPa)



$$W_{\text{fire}} = 0.5 \text{ kPa}$$

$$M^u = \frac{0.5 \times 3.6^2}{2}$$

$$= 3.24 \text{ kNm}$$

Try H12's @ 400 c/m

$$A_s R_y = 12^2 \times \frac{\pi}{4} \times \frac{1000}{400} \times 500$$

$$= 141371$$

$$\phi M_n = A_s R_y \left(d - \frac{a}{2} \right)$$

$$a = A_s R_y / \alpha_s f_c b$$

$$= 141371 / 0.85^2 \times 15 \times 1000$$

$$= 13\text{mm} = 16\text{mm}$$

$$\phi M_n = 141371 \times \left(75 - \frac{13}{2} \right) \times 10^{-6}$$

$$= 9.68 \text{ kNm} \times 0.85$$

$$= 8.23 \text{ kNm} > 3.24 \text{ OK}$$

Earthquake loads

$$T = 0.4 \text{ seconds}$$

$$\eta(T, 0) = 1$$

$$\mu = 1.25 \text{ seismic}$$

$$Z = 0.3$$

Soil Class D

$$\mu = 1.25 \text{ (minimally ductile)}$$

$$S_p = 0.9$$

$$C_u(T_1) = 3.0$$

$$\begin{aligned} (f) &= Z \mu \times C_u(T_1) \times \eta(T, 0) \\ &= 0.3 \times 1.25 \times 3.0 \\ &= 0.9 \end{aligned}$$

$$\begin{aligned} R_m &= (1.25 - 1) \times \frac{0.4}{0.7} + 1 \\ &= 1.14 \end{aligned}$$

$$\begin{aligned} (d(T_1)) &= \frac{S_p C_u(T_1)}{R_m} \\ &= \frac{0.9 \times 0.9}{1.14} \\ &= 0.71 \end{aligned}$$

Seismic Mass of wall:

$$\begin{aligned} W_{eq} &= 24 \text{ kN/m}^3 \times 0.14 \\ &= 3.36 \text{ kN/m}^2 \times 0.91 \\ &= 2.39 = 2.45 \text{ kN/m}^2 \leftarrow 0.728 \end{aligned}$$

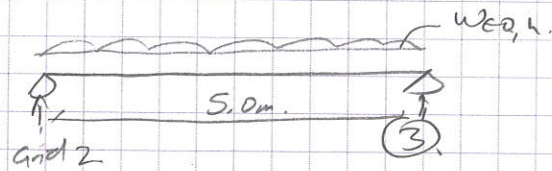
Pure Cantilever

$$\begin{aligned} M^* &= \frac{wL^2}{2} \\ &= \frac{2.39 \times 3.6^2}{2} \end{aligned}$$

$$= 15.85 \text{ kNm} \rightarrow \text{Not going to achieve this}$$

→ Distribute out-of-plane load back into timber framed bracing walls on Grids 2 & 3.

→ check horizontal span between 2 & 3.



$$w_{eq,h} = 2.45 \text{ kN/m}$$

$$M_u = \frac{wL^2}{8}$$

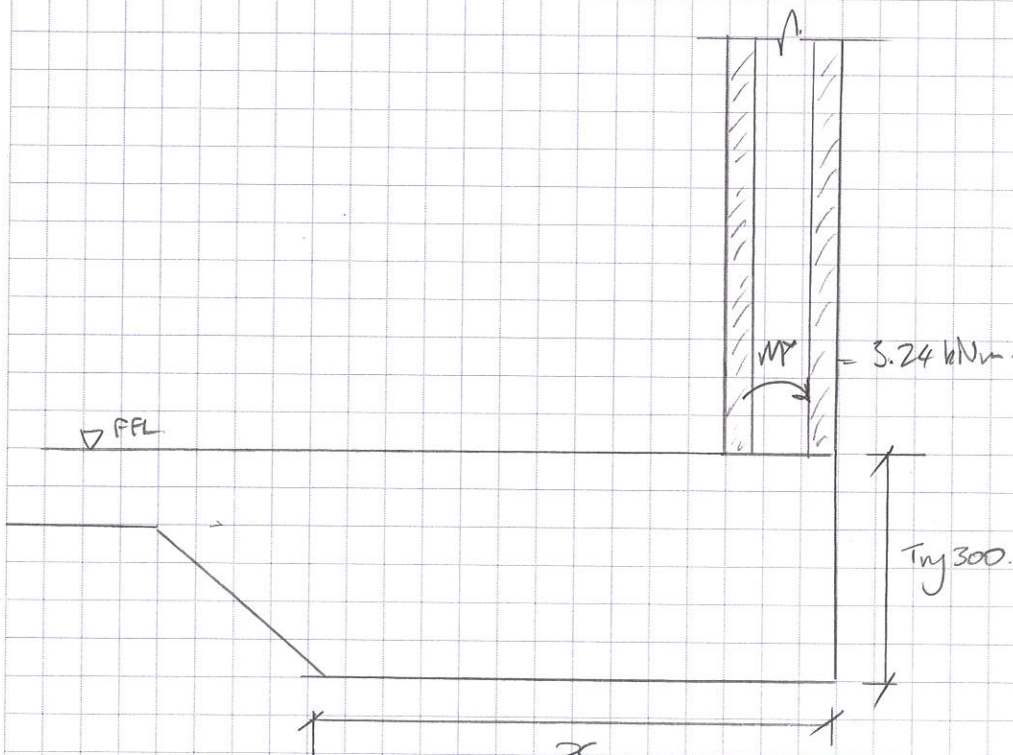
$$= \frac{2.45 \times 5^2}{8}$$

$$= 7.47 \text{ kNm} < 8.23$$

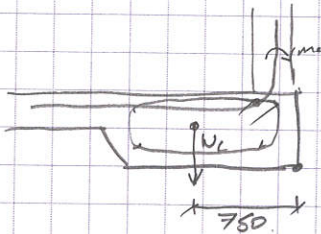
$$7.66 \text{ kNm.}$$

→ HRS @ 400mm Horizontal
OK

Design foundation to take 3.24 kNm of Moment



Try $\alpha = 1500 \text{ mm}$.



$$\begin{aligned} M_R &= 1500 \times 300 \times 25 \times 0.75 \\ &= 8.43 \text{ kNm} > 3.24 \text{ OK} \end{aligned}$$

Foundation $\rightarrow$ Gravelly reinforced with 2 layers H12 bars
@ 400 c/s.

Design Timber framed shear wall on Grid 2.

$$\text{Trb width} = 2.5 + 3.8 \\ = 6.3 \text{ m.}$$

Load from block wall:

$$P_{\text{wall}} = 2.39 \text{ kPa} \times 6.3 \times 3.6/2 \\ = 27 \text{ kN.}$$

$$P_{\text{wall},c} = 27/2 \\ = 13.6 \text{ kN}$$

$$P_{\text{roof}} = 0.3 \text{ kPa} \times 0.71 \times 6.3 \times 8 \text{ m} \\ = 10.7 \text{ kN.}$$

$$P_{\text{total}} = 51.3 \text{ kN.}$$

$$\text{OR} = 51.3 \times 20 \frac{\text{BU's}}{\text{MN}} \\ = 1026 \text{ BU's.}$$

(at $n=1.25$, this is very conservative)

$\Rightarrow$ Over 8m length of wall we require.

$$\text{BU's}_{\text{req}} = 1026/8 \text{ m} \\ = 128 \text{ BU's/m for EQ.}$$

$$\text{BLG-H gives a rating of } 145 \text{ BU's} \times \frac{2.4}{3.2} = 106 < 128 \text{ NOT OK}$$

$$\text{GSP-H gives } 150 \text{ BU's/m} \times 0.73 = 110 \text{ BU's/m}$$

Check Wall 3

$$\text{Trb width} = 2.5 + 1.5 \\ = 4 \text{ m.}$$

$$P_{\text{wall},c} = 2.39 \times 4 \times 3.6/2 = 17.2 \text{ kN.}$$

$$P_{\text{wall},c} = 17.2/2 = 8.6 \text{ kN.}$$

$$P_{\text{roof}} = 0.3 \times 0.71 \times 4 \times 8 = 6.9 \text{ kN.}$$

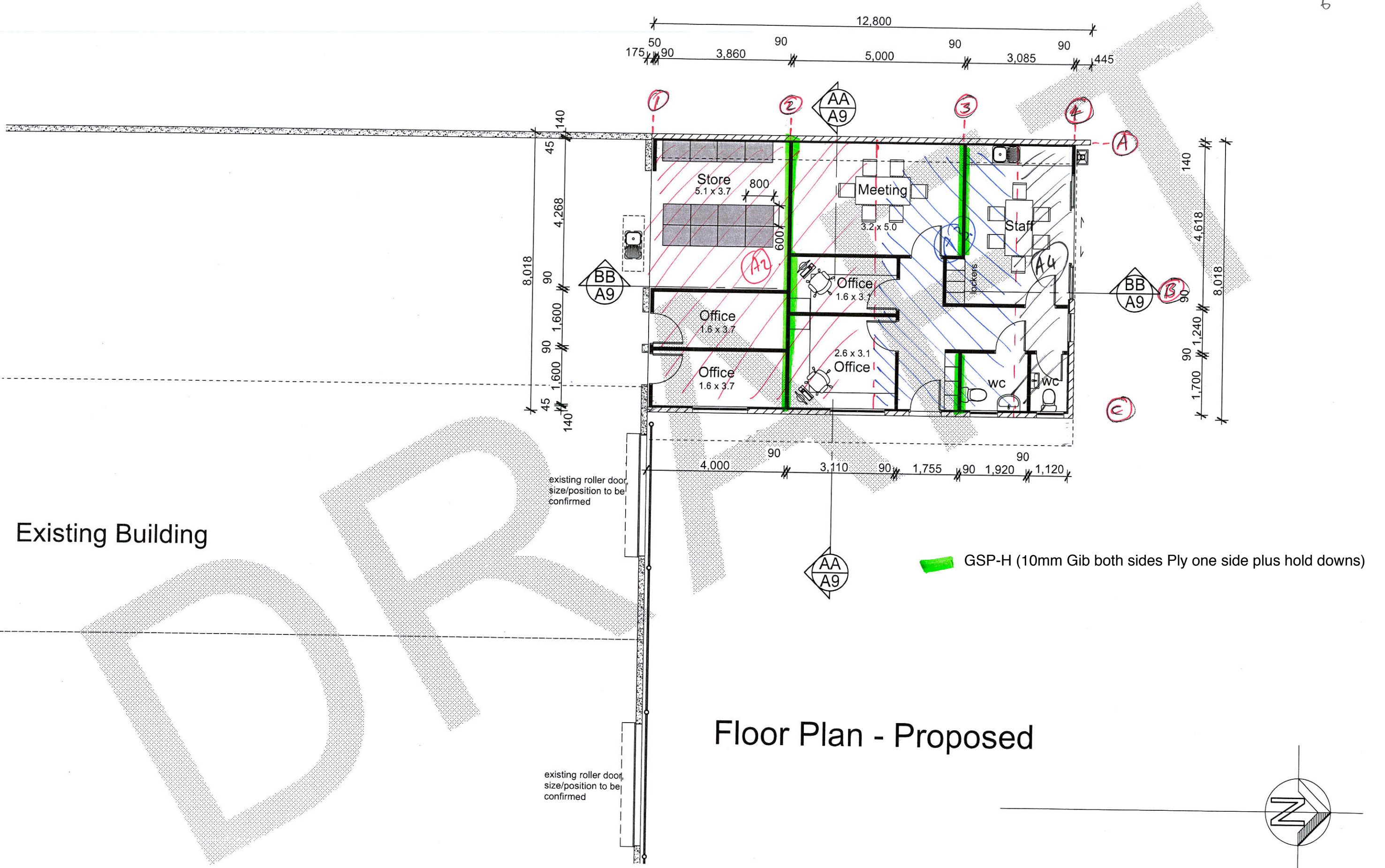
$$32.6 \text{ kN. OR } 652 \text{ BU's}$$

$$\text{Length wall available} = 3 \text{ m} + 1.7 \text{ m.} \\ = 4.7 \text{ m.}$$

$$\text{BU's}_{\text{req}} = 652/4.7 = 138 \text{ BU's/m}$$

This is OK ~~as~~ given we are at $n=1.25$.

$\Rightarrow$ GSP-H for both walls on Grids 2 & 3.



Existing Building

Floor Plan - Proposed

**Architectural Design Group**
A DIVISION OF WALKER COMMERCIAL SERVICES LTD



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office 31 Fifteen Ave, Tauranga

Proposed Proposed Additions
80 Byron Street
Christchurch
For Clip & Climb

Drawing:	Floor Plan - Proposed	Issue:	1
Scale at A3:	1:100	Sheet no.	
Date:	October 2016		
Job no:	5996		
Copyright:	The copyright of these drawings & ideas contained therein remain the property of the author (Architectural Design Group) unless otherwise agreed in writing		

A5
of sheets

Size Partials

will be governed by snow or wind

Snow

$$S_u = S_g \mu_i$$

$$S_g = 0.9 \text{ kPa}$$

$$\mu_i = 0.7 \quad (5^\circ \text{ pitch})$$

$$\Rightarrow S_{u1} = 0.63 \text{ kPa} \quad (\text{ULS})$$

$$S_s = 0.42 \text{ kPa} \quad (\text{SLS})$$

WIND

$$P = 0.5 \rho_{\text{air}} V_{\text{des}}^2 C_{\text{pe}} C_{\text{qm}}$$

$$V_{\text{des}} = V_R M_d (M_{z,\text{cat}} M_s M_t) \quad R = 500$$

$$V_R = 4.5 \text{ m/s}$$

$$M_d = 1.0 \quad (\text{any direction})$$

$$M_{z,\text{cat}} = 0.83 \quad (\text{TCS, light industrial})$$

$$M_s = 1.0$$

$$M_t = 1.0$$

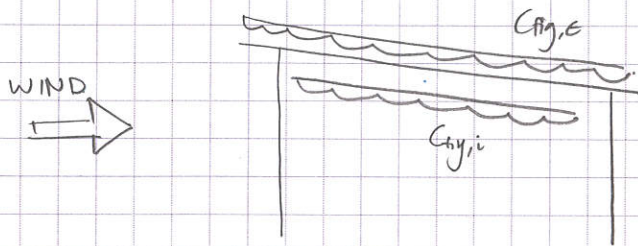
$$V_{\text{des}} = 4.5 \times 0.83$$

$$= 3.74 \text{ m/s}$$

$$\Rightarrow P_{\text{basic}} = 0.5 \times 1.2 \times 3.74^2$$

$$= 0.839 \text{ kPa} \quad (\text{ULS})$$

$$= 0.567 \text{ kPa} \quad (\text{SLS})$$

Determine C_{fig} for roof

$$C_{fig,e} = C_{p,e} K_a K_{ec} K_{ed} K_p$$

$$C_{fig,i} = C_{p,i} K_{ci}$$

$$C_{p,i} = 0.2, -0.1$$

$$K_L = 0.9 \text{ or } 1$$

$$C_{p,e} = -0.9, -0.4$$

$$K_e = 0.9 \text{ or } 1$$

$$C_{fig, total} = 0.2 \times 0.9 + 0.9 \times 0.9$$

$$= 0.99$$

say 1.0

$$P_{uplift} = 0.839 \times 1.0$$

$$= 0.84 \text{ kPa}$$

If we have purlins @ 1200 c/c. $W_u = 0.84 \times 1.2 = 1.0 \text{ kN/m}$

$$W_s = 0.567 \times 1.2 = 0.68 \text{ kN/m}$$

DHS 150/purlins $\rightarrow$ max span = 5.5m w 1 brace. $> 3.8 \text{ OK}$

DHS 250/13 purlins max span = 9.0m w 2 brace. $> 8.0 \text{ OK}$

from DHS loadspan tables,

$\Rightarrow$ use DHS 150/12 purlins on short span

& DHS 250/13 purlins on long span

Size Beam for Grid 1

$$\text{Trib Width} = 3.866 + 10$$

$$= 3950 \text{ mm.}$$

Governed by WIND OR SNOW.

$$P_n = 0.839 \text{ kPa. (snow).}$$

$$P_n + S_n = 0.3 + 0.63$$

$$= 0.93 \text{ kPa (Wind + Grav).}$$

governs.

$$W_u = 0.93 \times 3.95$$

$$= 3.67 \text{ kN/m.}$$

$$W_s = (0.42 + 0.3) \times 3.95$$

$$= 2.84 \text{ kN/m.}$$

largest span: 4.0m.



$$M^* = \frac{W_u L^2}{8}$$

$$= \frac{3.67 \times 4^2}{8}$$

$$= 7.34 \text{ kNm.}$$

$$Z_{req} = \frac{7.34}{0.9 \times 300}$$

$$= 27.2 \times 10^{-6} \text{ m}^3$$

$$= 27.2 \times 10^{-3} \text{ mm}^3$$

$$D_{min} = \frac{SPAN}{500} = 13.5 \text{ mm}$$

OK 12mm.

$$S = \frac{W_u L^4}{384 E I}$$

$$I_{req} = \frac{W_u L^4}{384 \times 12 \times 6}$$

$$= \frac{3 \times 284 \times 10^3 \times 4000^4}{384 \times 12 \times 200 \times 10^9}$$

$$= 39.4 \times 10^6 \text{ mm}^4$$

200 PFC

$$Z_e = 221 \times 10^3 > 27.2 \text{ OK}$$

$$I_x = 19.1 \times 10^6 \text{ mm}^4 < 39.4 \text{ NOX}$$

250 PFC

$$I_x = 45.1 \times 10^6 \text{ mm}^4 > 39.4 \text{ OK}$$

Min B OK

Design Lintel over Sliding door on Grid 4

Length of span = 3.6m

$$\text{Trib Width} = \frac{3.09}{2} \\ = 1.55 \text{ m}$$

$$P_u = 0.93 \text{ kPa (Snow + Grav.)}$$

$$W_u = 0.93 \times 1.55 \\ = 1.44 \text{ kN/m}$$

$$W_s = (0.42 + 0.3) \times 1.55 \\ = 1.12 \text{ kN/m}$$

Try S48 2/190x90 LINTELS

$$\phi M^e = \frac{1.44 \times 3.6^2}{8} \\ = 2.33 \text{ kNm}$$

$$\phi M_n = \phi k_1 k_2 k_3 k_4 Z$$

$$\phi = 0.8$$

$$k_1 = 0.8$$

$$k_5 = k_4 = 1.0$$

$$k_3 = 0.95$$

$$F_y = 14 \text{ MPa}$$

$$L_y/B = 40$$

$$d/B = 2.1$$

$$\phi M_n = 0.8 \times 0.8 \times 0.95 \times 14 \times 541500 \\ = 4.61 \text{ kNm} > 2.33 \text{ OK for ULS}$$

$$Z = \frac{bh^2}{6} \\ = \frac{90 \times 190^2}{6} \\ = 541500$$

Check SLS

$$\Delta = \frac{S_w L^4}{384 EI} \times k_2 \quad k_2 = 1.0$$

$$= \frac{5 \times 1.12 \times 3.6^4}{384 \times 6.7 \times 51.4}$$

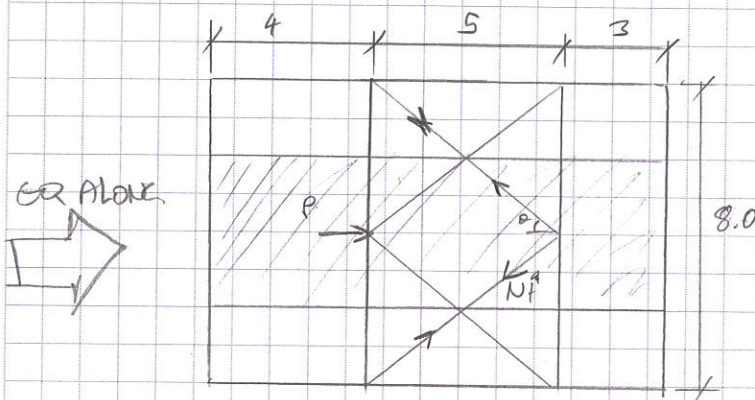
$$= 0.0071 \text{ m}$$

$$= 7.1 \text{ mm} \Rightarrow$$

$$\frac{\text{SPAN}}{500} \quad \underline{\underline{\text{OK}}}$$

$$I = \frac{bh^3}{12} \\ = 51.4 \times 10^6 \\ E = 6.7 \text{ GPa}$$

Design strap bracing to transfer loads to exterior walls



$$\theta = \tan^{-1}\left(\frac{4}{8}\right) = 39^\circ$$

$$\cos \theta = \frac{a}{c}$$

$$P = 0.3 \text{ kPa} \times 4 \text{ m} \times 12 \text{ m} \times 0.71$$

$$= 10.2 \text{ kN}$$

→ This can be taken by purlins with ease.

$$N_t = 10.2 / \cos 39^\circ$$

$$= 6.6 \text{ kN}$$

× Cs factor of 1.1

Using Multibrace (MITech)

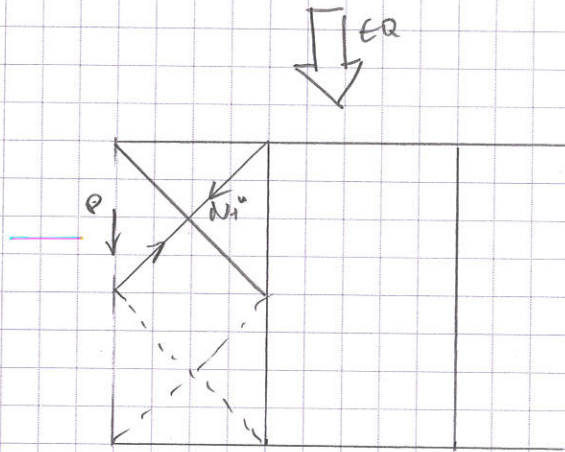
$$Q_n = 14.8 \text{ kN}$$

$$\phi N_t = \phi \times k_c \times 14.8$$

$$= 0.7 \times 14.8$$

$$= 10.36 \text{ kN} > 6.6 \text{ kN} \quad \underline{\underline{OK}}$$

Check Strap bracing can work in other direction



$$P = P_{\text{roof}} + P_{\text{wall}}$$

$$P_{\text{wall}} = 2m \times 5.6 \times 3 \times 0.14 \times 25 \times 0.71 \times 1.5$$

$$= 10.1 \text{ kN}$$

$$P_{\text{roof}} = 0.36 P_g \times 2m \times 8m \times 0.571$$

$$= 3.4 \text{ kN}$$

$$P_{\text{total}} = 13.5 \text{ kN} \quad \text{OK}$$

$$N_s = 13.5 / \sin 45$$

$$= 19.1 \text{ kN} > 10.4 \text{ kN} \quad \text{NOK}$$

NEED TWO BAYS OF STRAP BRACING

$$N_s = 19.1 / 2$$

$$= 9.5 \text{ kN} < 10.4 \text{ kN} \quad \text{OK}$$

Size Cantilever 90x45 S48 - spacing TBD.



$$w_u = P_u \times S$$

$$\phi M_n (90 \times 45) = \phi k_1 k_2 k_3 k_4 \phi_b Z$$

$$Z = \frac{b d^2}{6}$$

$$= 60750$$

$$\phi = 0.8$$

$$k_1 = 10 \text{ (Cantilever)}$$

$$k_2 = k_4 = 10$$

$$k_3 = 10$$

$$f_b = 14 \text{ MPa}$$

$$\phi M_n = 0.8 \times 14 \times 60750$$

$$= 0.68 \text{ kNm}$$

$$w_u = \frac{w L^2}{2} < 0.68 \text{ kNm}$$

$$w < \frac{0.68 \times 2}{L^2}$$

$$< 2.13 \text{ kN/m} = P_u \times \text{Spacing}$$

$$S < 2.13 / P_u$$

$$P_u = 0.839 \times 2$$

$$= 1.678$$

$$S_{\text{max}} = 2.13 / 1.678$$

$$= 1.27 \text{ m}$$

→ C.A. for up so Ait - conservative

Check SLS with 1200mm spacing

$$P_s = 0.567$$

$$w_s = 0.567 \times 1.2$$

$$= 0.68 \text{ kN/m}$$

$$I = \frac{b h^3}{12}$$

$$= 2.73 \times 10^8$$

$$\Delta = \frac{w L^4}{8 E I}$$

$$= \frac{0.68 \times 0.8^4}{8 \times 6.7 \times 2.73}$$

$$= 1.9 \text{ mm} \Rightarrow \text{SPAN OK}$$

Use 90x45 @ 900 cks.

Internal Review of MB design:

lintels span over walls - support purlins & roof

→ geometry: 150 series block wall 140 wide.
140 wide top plate
 $45 \times 3 = 135$ wide lintel.
? Sticks? 90 x 45? Architect can make up?

SK01 - is this a ceiling & spread loads by bracing walls across?
suspended ceiling

→ wall starter height in wall? SK02 - cantilever detail
lintel support at block wall interface?

bracing to pick up
roofing length?

SK03 - "jack" studs. Correct word?
What does 140mm bracing wall mean? 140 thick?

* Load from roof to bracing walls? above lintel etc.
→ Put bracing walls to roof plane.

SK04 - why not extend bracing wall full length? 4 sheets 2.7m tall
plaster board + plywood 1.2 wide = 4.8m
easier than 4.3m

Q: Concept - so not all connection details needed? One that isn't standard.
strap bracing to PFC? → Detail
SHS to block walls?

Purlins 5m span? Continuous or simply supported?
estimate on roof G.

$S_n \downarrow$ $0.63 \text{ kPa} + 1.2(0.2 \text{ kPa} + 0.17 \text{ kPa}) = 1.07 \text{ kPa}$
@ 1200 c/s → 1.3 kN/m

$M_n \uparrow$ $0.839 \text{ kPa} - 0.9(0.2 \text{ kPa} + 0.09 \text{ kPa}) = 0.58 \text{ kPa}$
→ 0.7 kN/m.

DHS 150/15 OK from beam
span tables → restraints
from cladding.

Displacement compatibility to old building and between walls.

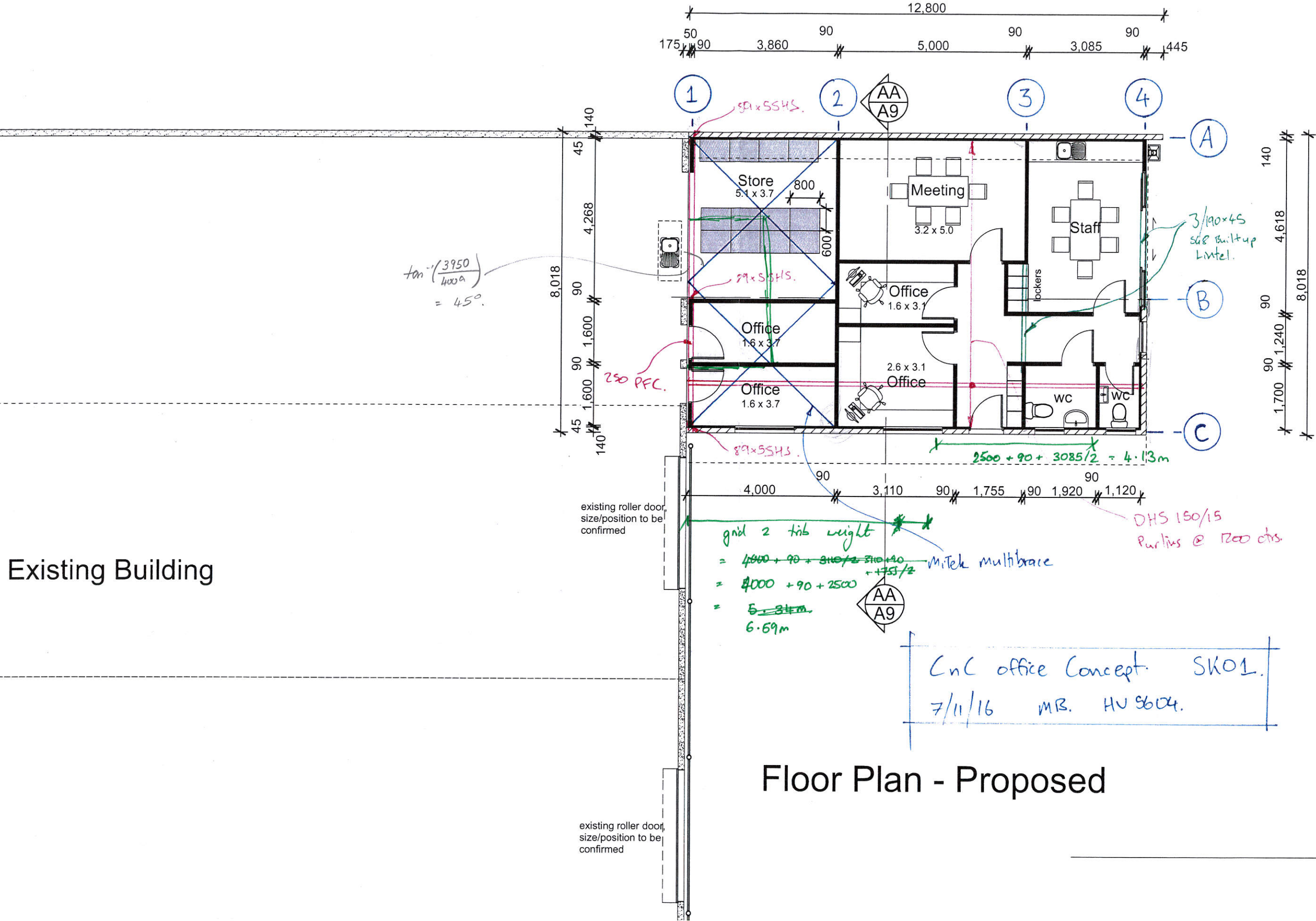
PROJECT GC Office - Internal review.
REF Concept -

DATE 13/12/2016

FILE HV5604

BY JC

Existing Building



Floor Plan - Proposed

$$\text{Trb width} = 4.13\text{m}$$

$$P_A = 2.45 \text{ kPa} \times 4.13\text{m} \times \frac{3.7\text{m}}{2} \\ = 18.7 \text{ kN}$$

$$P_c \approx 10 \text{ kN} \quad (\text{openings})$$

$$\text{Roof} = 0.3 \times 0.728 \times 4.13\text{m} \times 8\text{m} \\ = 7.2 \text{ kN}$$

$$P = 36 \text{ kN} \quad \text{at } u=1.25$$

$$\text{For } u=3: \quad 36 \text{ kN} \times \frac{0.378}{0.728} = 19 \text{ kN} \rightarrow 375 \text{ BU.}$$

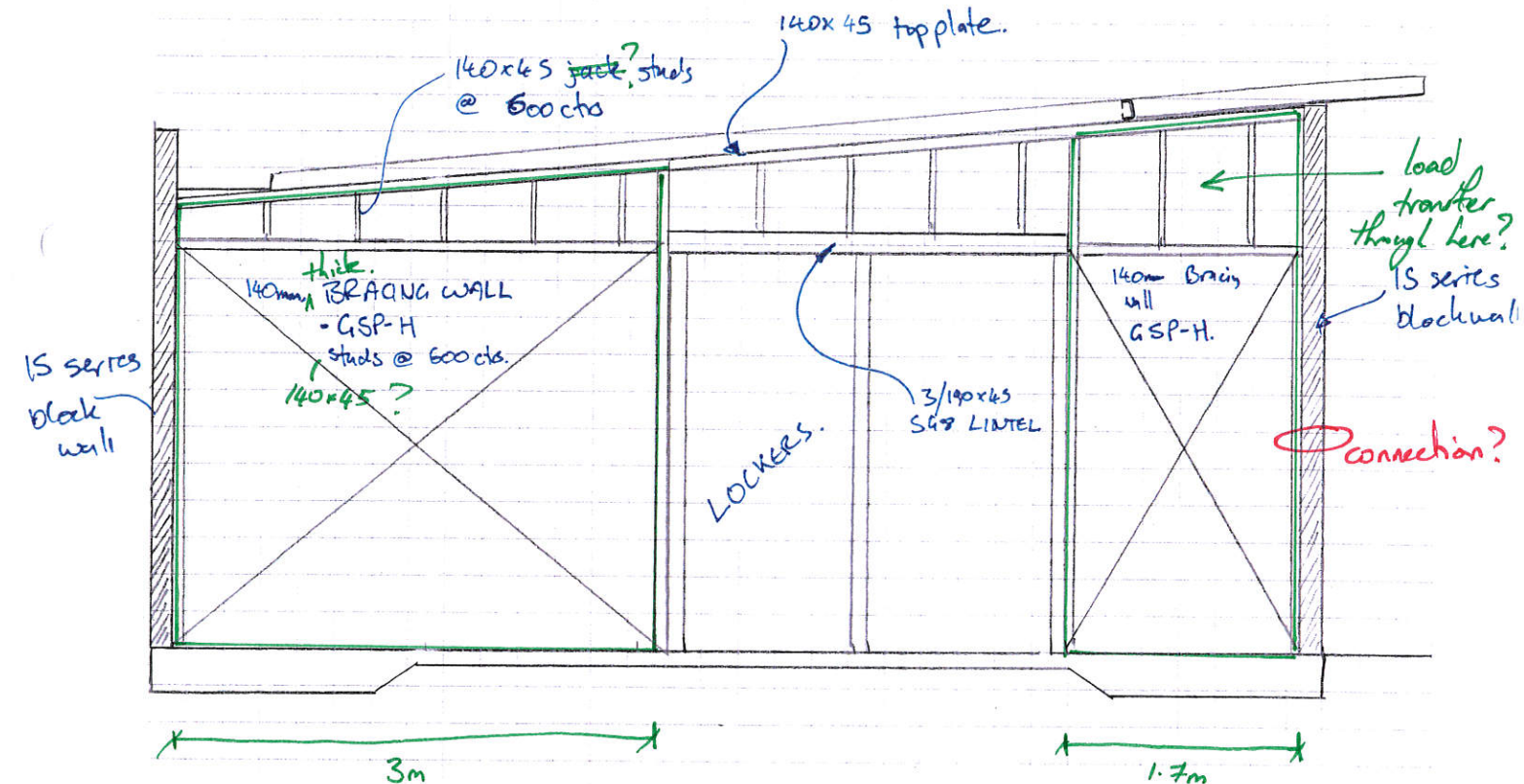
Bracing wall - $\Sigma L = 4.7\text{m}$ available

From average stud height 3.1m and 3.6m

$$\text{BU of GSP-H: } 150 \text{ BU/m} \times \frac{2.4\text{m}}{3.6\text{m}} = 100 \text{ BU/m.}$$

$$100 \times 4.7\text{m} = 470 \text{ BU.} > 375 \text{ BU.} \quad \text{OK.}$$

project *LnL Office* date *7/11/16* **structex**
file *HVS604* by *NWS* ref *SK03*



Full height, full length walls.

GRID 3 ELEVATION.

Wall framing + *NBS3604*

Load onto grid 2

$$2.45 \text{ kPa} \times 6.6 \text{ m} \times \frac{3.6 \text{ m}}{2} = 29.1 \text{ kN from wall A.}$$

~15 kN from wall C (openings)

$$\text{Roof: } 0.8 \text{ kPa} \times 0.728 \times 6.6 \text{ m} \times 8 \text{ m} = 11.5 \text{ kN}$$

$$\Sigma P = 55.6 \text{ kN at } u=1.25$$

$$\text{For } u=3; \quad 55.6 \text{ kN} \times \frac{0.378}{0.728} \text{ or } 0.294 = 29 \text{ kN} \rightarrow 580 \text{ BU}$$

$$\text{GSP-H; } \frac{150 \text{ BU/m}}{150} \times 4.8 \text{ m} = 720 \text{ BU. at 2.4m stud height.}$$

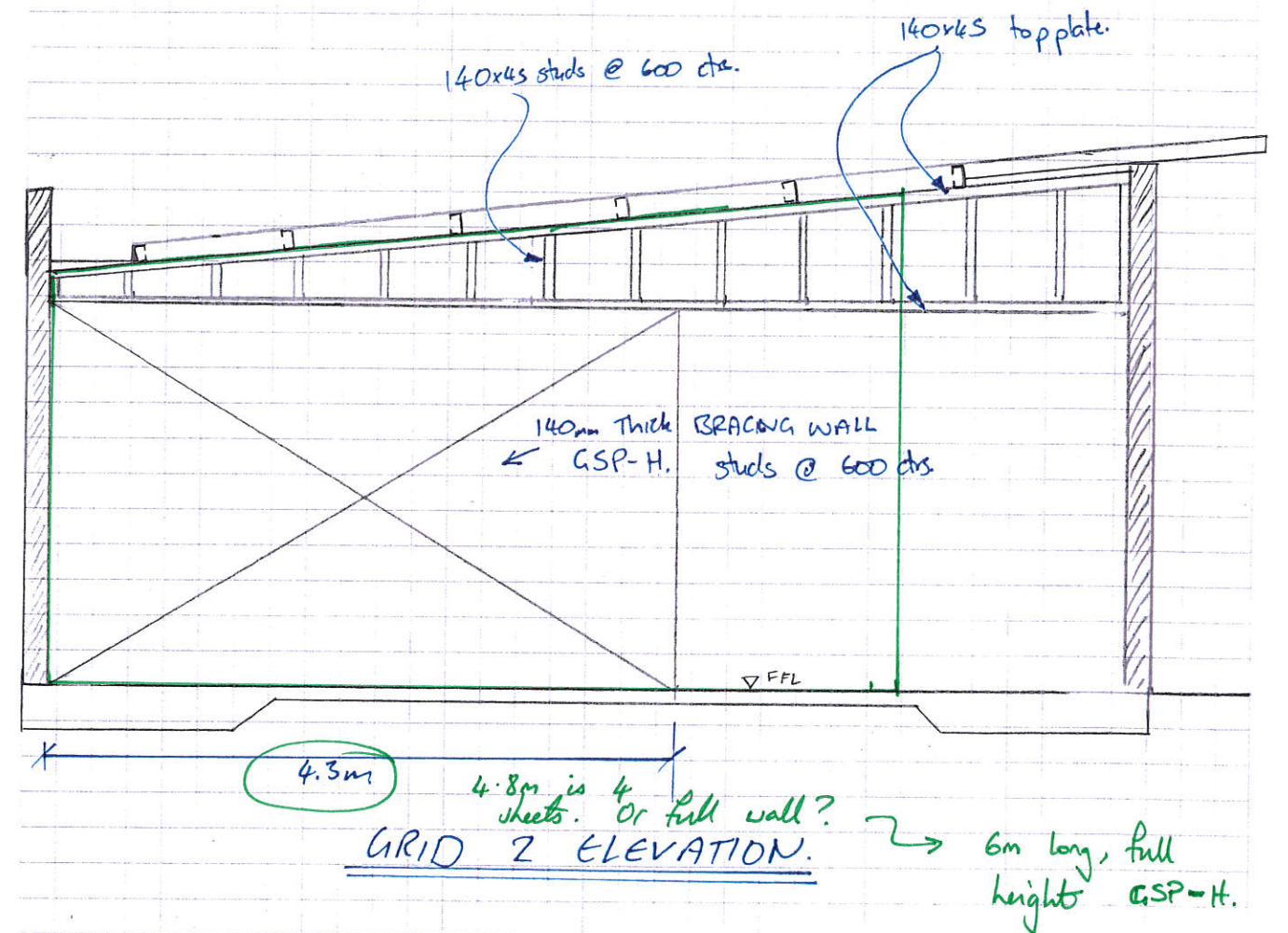
↓

$$\text{average stud height} = \frac{3.7 \text{ m} + 2.9 \text{ m}}{2} = 3.3 \text{ m.}$$

$$150 \text{ BU/m} \times \frac{2.4}{3.3} = 109 \text{ BU/m}$$

$$109 \text{ BU/m} \times 6 \text{ m} = 654 \text{ BU.}$$

Put full height so load gets to wall from roof and upper wall.



Q: connection of block wall to timber wall?

project cul office

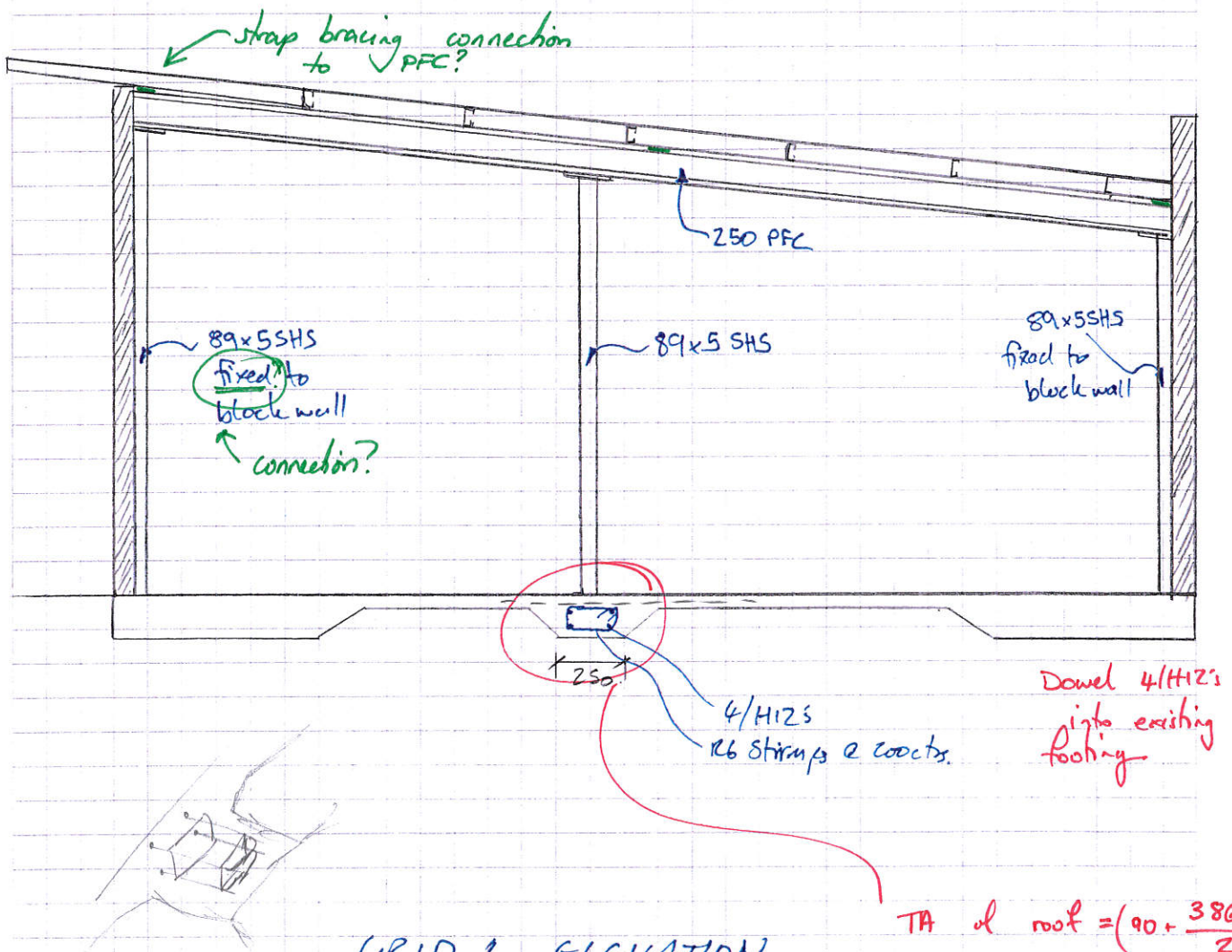
date 7/11/16

structex

file HUS604

by mo

ref SKOS



GRID 1 ELEVATION.

Vertical roof load is snow governed:
 $1.2 S_n = 0.99 \text{ kPa}$

$$P = 0.99 \text{ kPa} \times 7.82 \text{ m}^2 = 7.74 \text{ kN}$$

On 250 square: $\sigma = \frac{7.74 \text{ kN}}{(0.25 \text{ m})^2} = 125 \text{ kPa}$

$$\begin{aligned} \text{TA of roof} &= \left(90 + \frac{3860}{2} \right) \\ &\times \left(\frac{4268}{2} + 90 + 1600 + 45 \right) \\ &= 2020 \times 3870 \\ &= 7.82 \text{ m}^2 \end{aligned}$$

IF 50 kPa safe bearing

$$A = \frac{7.74 \text{ kN}}{50 \text{ kPa}} = 0.155 \text{ m}^2$$

Use this loading strategy • engineering • design

350x500 tie into existing slab.

project

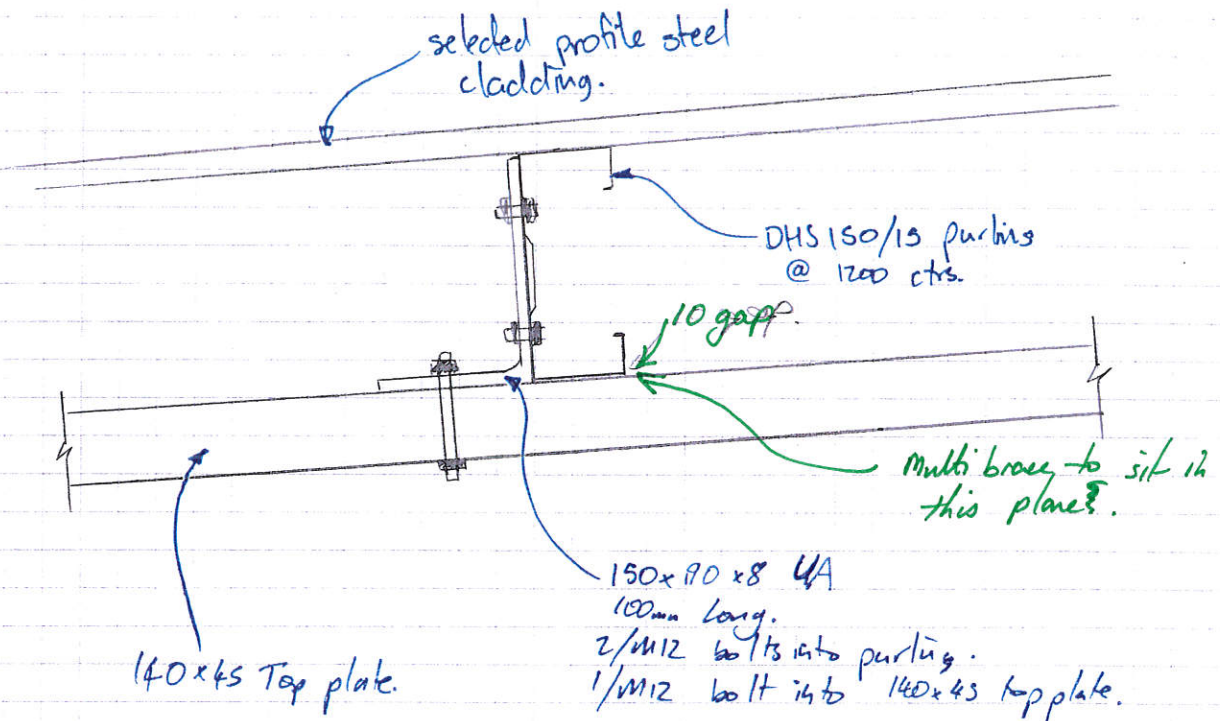
date

file

by

ref

SK06



Typical Purlin cleat.

Grid A and C walls fixed to walls on grid:

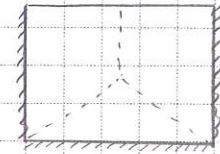
Demand based on tributary width.

2.45 kPa at $\mu = 1.25$

- ① 2m
- ② 4.59m
- ③ 4.13m
- ④ 1.63m

← worst case

← using continuous wall on ③.



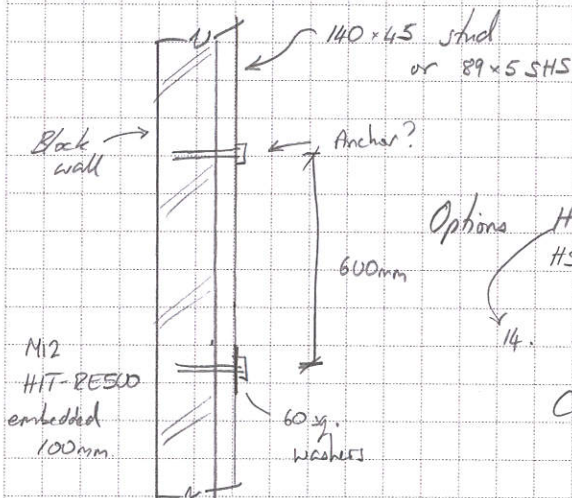
← 3.24 kN/m

$2.45 \text{ kPa} \times 4.59 \text{ m} = 11.24 \text{ kN/m}$ max (grid 2).
tension on fixings

(direct bearing on 140 wide timber)

$8.9 \text{ MPa} \times 140 \text{ mm} \times 0.8 \times 1.0$
 $\times 1000 \text{ mm}$
 $= 900 \text{ kN}$ ok by inspection

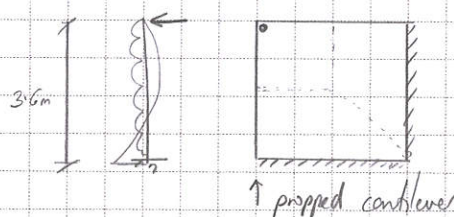
12 kN capacity at 600cs
 $= 6.7 \text{ kN}$ demand.
Washers → 60mm sq.



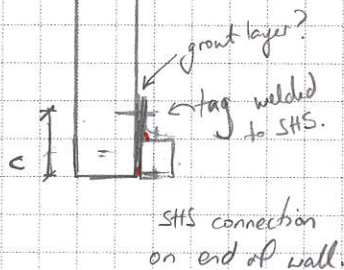
Options: HUS screw anchor (3 or HR)
HST or HCR stud anchor
14. min edge distance $c = 75 \text{ mm}$

Chemical: HIT-RE 500 V3
HIT-HY 200 R

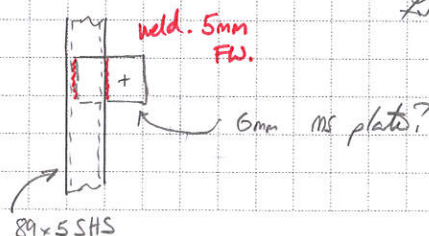
Grid 1 and 4 → all load to corner



Reaction force = $2 \text{ m} \times 2.45 \text{ kPa}$
 $\times \frac{3}{8} \times 3.6 \text{ m}$
 $= 6.6 \text{ kN}$



Anchor: M12 → embedded 105mm
→ 12.3 kN recommended tensile load
for HIT-RE 500 SD.



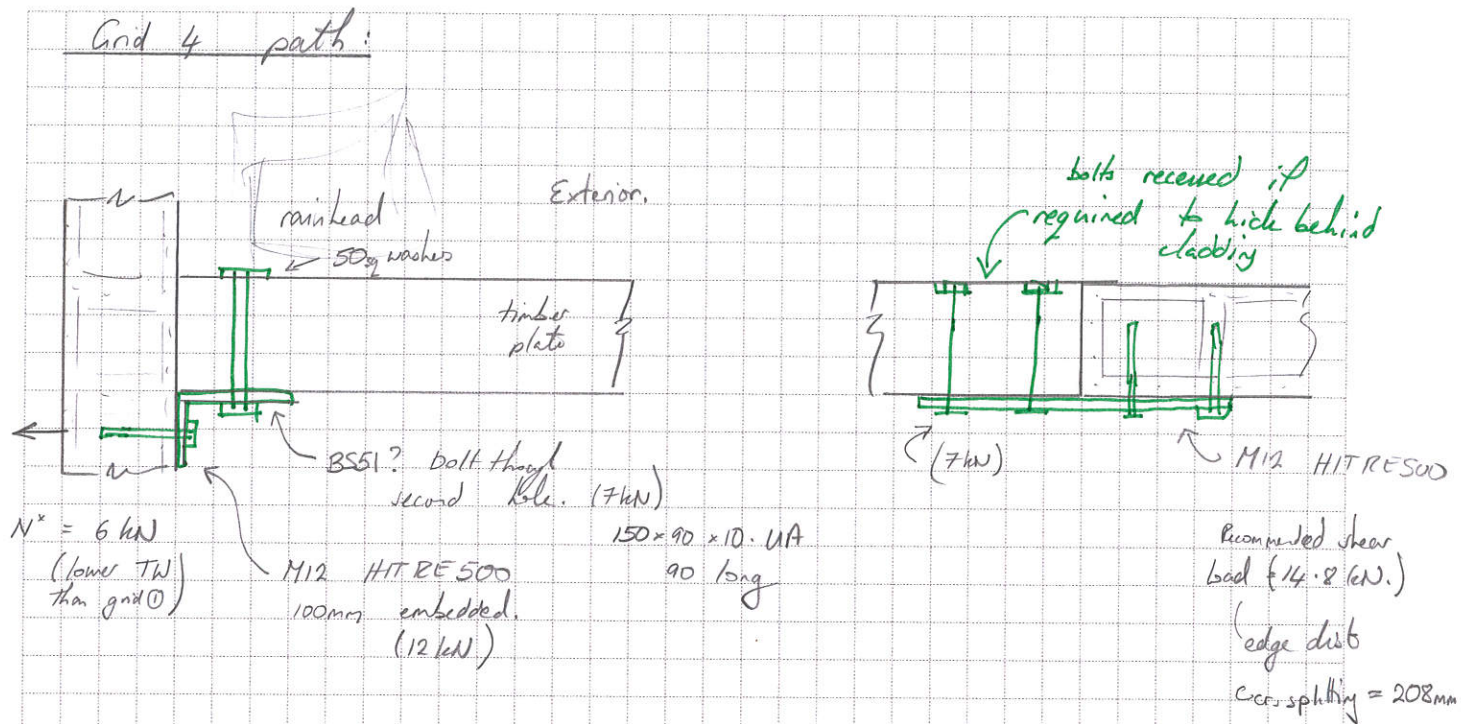
PROJECT

DATE 13/12/2016

REF

FILE

BY JC



In tension - edge distance for timber = $8 \times 12 \text{ mm}$
= 96 mm

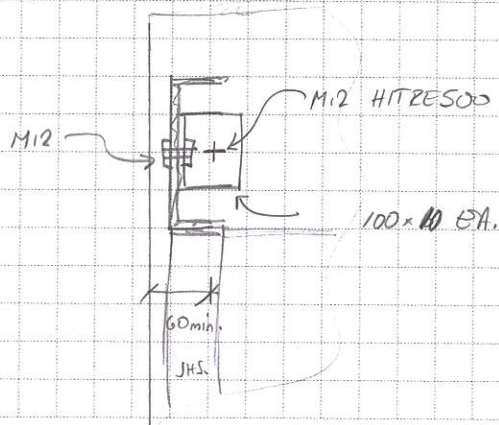
M12 in single shear $0.7 \times 10.4 \text{ kN} = 7.28 \text{ kN}$, 2 of them ok.

Timber plate: 140 x 45 tp plate
 $\phi N_t = 0.8 \times 1.0 \times 6 \text{ MPa} \times 140 \times 45 \text{ mm}^2$
= 30 kN.

Not governing, but use 2 for connections.

Grid 1:

No space to bolt to JHS. Need to connect at PFC level



45 thick timber is narrow to bolt through - min edge distance = $2d = 22 \text{ mm}$ needs 50mm thick min → turn on side as for litch. 90 x 90 $\phi N_t = 38 \text{ kN}$

PROJECT

DATE 13/12/2016

REF

FILE HV5604

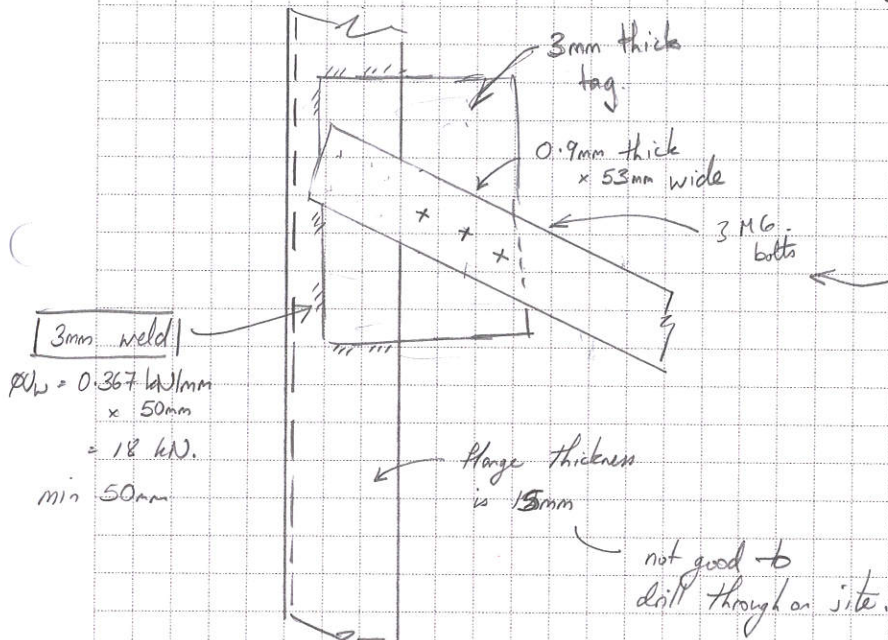
BY JC

Roof bracing Multibrace

- Standard connection is nailing to timber top plate
OK for grid 2.

At grid 1 connection is to ~~250~~ PFC:
250

$$\text{Capacity of brace} = 14.8 \text{ kN} \times 0.7 = 10.36 \text{ kN}$$



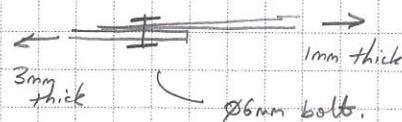
Strap is so thin that tearing of strap out of a connection is critical.

Use thinner weld plate to screw brace onto?

Shear: 2.94 kN for strap thickness (10/11)
→ needs 4 screws min at #7 screws (3.83mm ϕ approx).

$$\phi_w = 0.367 \text{ kN/mm} \times 50 \text{ mm} = 18 \text{ kN. min 50mm}$$

Try 3 M6 Bolts



M6: steel strength in shear

$$\phi = \phi 0.62 f_u (n A) = 0.8 \times 0.62 \times 400 \text{ MPa} \times \frac{(6 \text{ mm})^2 \pi}{4} = 5.6 \text{ kN.}$$

$$3 \phi = 16.8 \text{ kN OK.} \times 0.67 \text{ for threaded area} = 11.2 \text{ kN} \leftarrow \text{still OK.}$$

$$\text{Ply: bearing} = 0.9 \times 3.2 \times 200 \text{ MPa} \times 0.9 \text{ mm} \times 6 \text{ mm} = 4.67 \text{ kN} \rightarrow \times 3 = 14 \text{ kN OK.}$$

20mm spacing min.

PROJECT

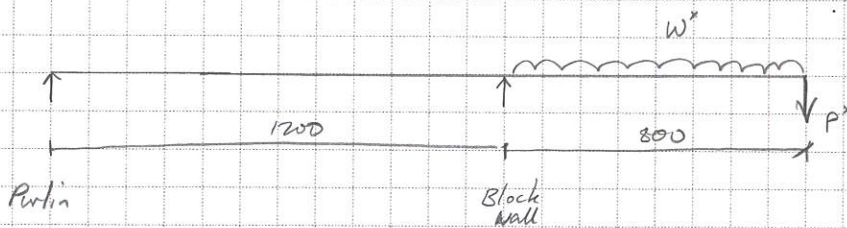
DATE 13/12/2016

REF

FILE HV5604

BY JC

800 overhang:
Connection design.



[ULS] Snow: $0.63 \text{ kPa} + 1.2 \times 0.3 \text{ kPa}$
 $= 0.99 \text{ kPa} \leftarrow$

Wind: 0.839 kPa

[SLS] Wind: 0.567 kPa
 Snow: $0.43 \text{ kPa} + 0.3 \text{ kPa}$
 $= 0.73 \text{ kPa} \leftarrow$

And overhang edge line load needs to be included:

$S_e = 0.5 (0.63 \text{ kPa})^2 / 2.9 \text{ kN/m}^3$ (8 from cl. 5.4.3)
 $P^* = 0.07 \text{ kN/m}$

At 900 CS $W^* = 1 \text{ kPa} \times 0.9 \text{ m}$
 $= 0.9 \text{ kN/m}$
 $P^* = 0.07 \text{ kN/m} \times 0.9 \text{ m}$
 $= 0.063 \text{ kN}$

M^* at block wall $= 0.9 \text{ kN/m} \times (0.8 \text{ m})^2 / 2 + 0.063 \text{ kN} \times 0.8 \text{ m}$
 $= 0.34 \text{ kNm}$

Reaction at purlin to create stability $= \frac{0.34 \text{ kNm}}{1.2 \text{ m}} = 0.3 \text{ kN}$

bolted connection ok by inspection.

At block wall - reaction $= 0.3 \text{ kN} + 0.063 \text{ kN} + 0.9 \text{ kN/m} \times 0.8 \text{ m}$
 $= 1.1 \text{ kN}$

CPC 80 pair ok by inspection

PROJECT

DATE 13/12/2016

REF

FILE H45604

BY JC

Flexural Design for RC Beams

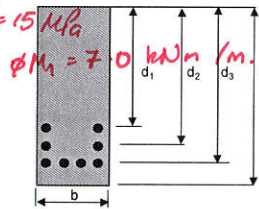
Project #: HV5604
 Project Name: CnC office
 Element Description: Block wall cantilever

By JC

Design Assumptions

- Up to three layers of tension reinforcing can be counted for flexural strength.
- No account is made of the negligible flexural strength increase provided by compression steel.

Limiting Concrete Strain at ULS	0.003 Ref NSZ3101:2006, Clause 7.4.2.3
Reinforcing Steel f_y (MPa)	500
Concrete Strength (MPa)	12
Undercapacity Factor " Φ "	0.85 Ref NSZ3101:2006, Clause 2.3.2.2
α_1	0.85 Ref NSZ3101:2006, Clause 7.4.2.7
β_1	0.85 Ref NSZ3101:2006, Clause 7.4.2.7
Concrete Strain " ϵ_c "	0.0009
c (mm)	16 Alter this to get internal equilibrium
a (mm)	14
Beam Width, " b_w " (mm)	1,000
Beam Depth, " h " (mm)	140
d_1 (mm)	0
d_2 (mm)	0
d_3 (mm)	64
Cover =	58
ϵ_{s1}	0.0000
ϵ_{s2}	0.0000
ϵ_{s3}	0.0025 = f_y/E_s (lower tension steel at yield for ULS)
Shear Stirrup Dia. (mm)	12
Tension Bar Dia. 1 (mm)	0
Tension Bar Dia. 2 (mm)	0
Tension Bar Dia. 3 (mm)	12
# of Bars 1	0
# of Bars 2	0
# of Bars 3	2.5 → = 400 mm centres (excluding allowance for edge cover concrete)
A_{s1} (mm ²)	0
A_{s2} (mm ²)	0
A_{s3} (mm ²)	283
$A_{s \text{ Total}}$ (mm ²)	283
f_{s1} (MPa)	0
f_{s2} (MPa)	0
f_{s3} (MPa)	500
Flexural Steel Ratio " ρ "	0.0044
Min Flexural Steel Ratio	0.0028 Ref NSZ3101:2006, Clause 9.3.8.2.1
Steel Elastic Modulus (MPa)	200,000
Cover to Flexural Reo (mm)	70
Reinforcing steel yield strain	0.0025



MB used $d = 75 \text{ mm}$

$$T = \sum A_s \times f_s = 141,372 \text{ N}$$

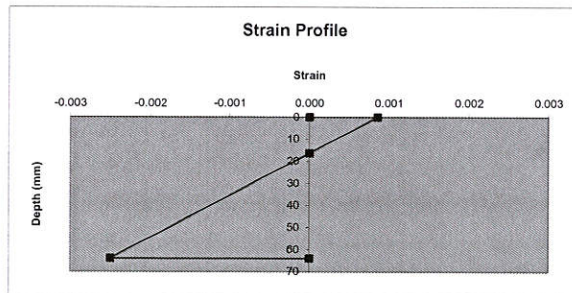
$$C = \alpha_1 \times f_c \times a \times b = 141,372 \text{ N}$$

Use "Goal Seek" to make $T - C = 0$, by changing " c "

$$T - C = 0 \text{ N}$$

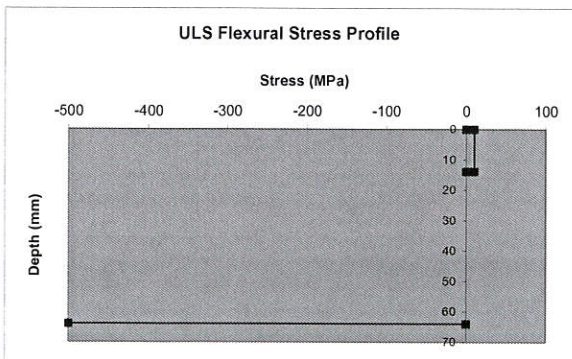
Strain Profile Input Co-ordinates

Desc.	x (strain)	y (depth)
ϵ_c	0	0
c	0.0009	16
ϵ_{s3}	-0.0025	64
ϵ_{s1}	0	64
ϵ_{s2}	0.0000	0



Stress Profile Input Co-ordinates

	x (stress)	y (depth)
$\alpha_1 f_c$	0	0
	10.2	0
	10.2	14
	0	14
f_{s1}	0	0
f_{s2}	0	0
f_{s3}	0	64
	-500	64

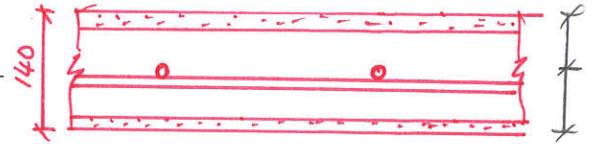


Nominal ULS Flexural Capacity, M_n (kNm)

8.1

Dependable ULS Flexural Capacity, ΦM_n (kNm)

6.9



If bars central.
 worse case direction is
 with acting base cover
 $140 \text{ mm} / 2 - 6 \text{ mm} = 64 \text{ mm}$

H12 @ 400.

starter length to
 get this capacity?

Horizontal span:

Horizontal demand between
 grids 2+3 = 7.66 kNm/m

Max $d_b = 16 \text{ mm}$

$$\text{reqd: } \frac{13}{f_y} \times 12000 \text{ mm}^2$$

$$= 312 \text{ mm}^2 \text{ for HD}$$

$$520 \text{ mm}^2 \text{ for D.}$$

$$2 \text{ } \phi 16 \text{ } A = 402 \text{ mm}^2$$

$$2 \text{ } \phi 12 \text{ } A = 276 \text{ mm}^2$$

$$D16 @ 400 \rightarrow \phi M_n = 7.0 \text{ kNm/m}$$

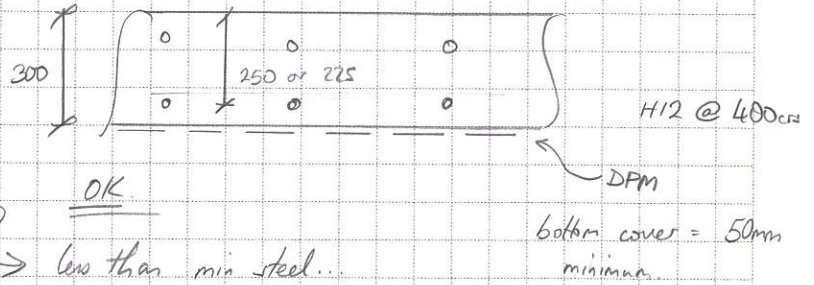
Not OK.

> 3.5 kNm demand MB calcs pg 1

Check footing reinforcing to pick up, and develop required
base fixity for wall stability

3.24 kNm stability demand
6 kNm wall capacity
8.4 kNm footing stability

Current detailed footing:



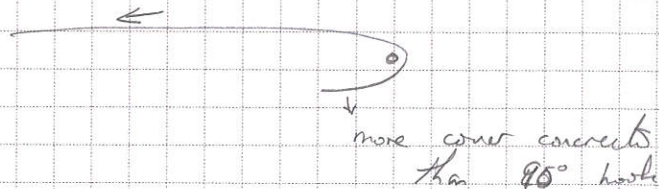
$\phi M_n = 15 \text{ kNm}$

OK
less than min steel..

Bar development of tp bars.. under wall..

H12: $L_{bd} = 600 \text{ mm}$

Use 180° hook



Demand: 3.24 kNm

Tension and compression couple (conservatively taking lever arm as distance between top and bottom steel for $\sqrt{f_c}$ cover lot)

$$e = 300 - 75 - 35 - 12 = 178 \text{ mm}$$

$$T = 3.24 \text{ kNm} / 0.178 \text{ m} = 18.2 \text{ kN}$$

$$f_c = 20 \text{ MPa}$$

$$\therefore V_c = 0.08 \sqrt{20 \text{ MPa}} = 0.358 \text{ MPa}$$

shear friction of concrete only:

$$V_c = k_d k_a V_c A_{cv} = 0.85 \times 1 \times 0.358 \text{ MPa} \times (219 \times 1000 \text{ mm}^2) = 66 \text{ kN}$$

$$\phi V_c = 0.75 \times 66 \text{ kN} = 50 \text{ kN} > 18 \text{ kN} \text{ OK}$$

PROJECT

DATE 13/12/2016

REF

FILE HU5804

BY JC

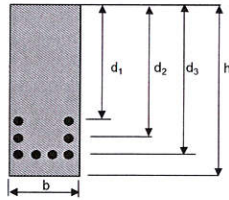
Flexural Design for RC Beams

Project #: HV5604 By JC
 Project Name: 80 Byron St
 Element Description: Footing for after fire stability

Design Assumptions

- Up to three layers of tension reinforcing can be counted for flexural strength.
- No account is made of the negligible flexural strength increase provided by compression steel.

Limiting Concrete Strain at ULS	0.003	Ref NSZ3101:2006, Clause 7.4.2.3
Reinforcing Steel f_y (MPa)	500	
Concrete Strength (MPa)	20	
Undercapacity Factor " Φ "	0.85	Ref NSZ3101:2006, Clause 2.3.2.2
α_1	0.85	Ref NSZ3101:2006, Clause 7.4.2.7
β_1	0.85	Ref NSZ3101:2006, Clause 7.4.2.7
Concrete Strain " ϵ_c "	0.0001	
c (mm)	10	Alter this to get internal equilibrium
a (mm)	8	
Beam Width, " b_w " (mm)	1,000	
Beam Depth, " h " (mm)	300	
d_1 (mm)	0	
d_2 (mm)	0	
d_3 (mm)	219	Cover = 75
ϵ_{s1}	0.0000	
ϵ_{s2}	0.0000	
ϵ_{s3}	0.0025	$= f_y/E_s$ (lower tension steel at yield for ULS)
Shear Stirrup Dia. (mm)	0	
Tension Bar Dia. $_1$ (mm)	0	
Tension Bar Dia. $_2$ (mm)	0	
Tension Bar Dia. $_3$ (mm)	12	
# of Bars $_1$	0	
# of Bars $_2$	0	
# of Bars $_3$	2.5	$\rightarrow = 400$ mm centres (excluding allowance for edge cover concrete)
A_{s1} (mm ²)	0	
A_{s2} (mm ²)	0	
A_{s3} (mm ²)	283	
A_s Total (mm ²)	283	
f_{s1} (MPa)	0	
f_{s2} (MPa)	0	
f_{s3} (MPa)	500	
Flexural Steel Ratio " ρ "	0.0013	
Min Flexural Steel Ratio	0.0028	Ref NSZ3101:2006, Clause 9.3.8.2.1
Steel Elastic Modulus (MPa)	200,000	
Cover to Flexural Reo (mm)	75	
Reinforcing steel yield strain	0.0025	



Use "Goal Seek" to make $T - C = 0$, by changing " c "

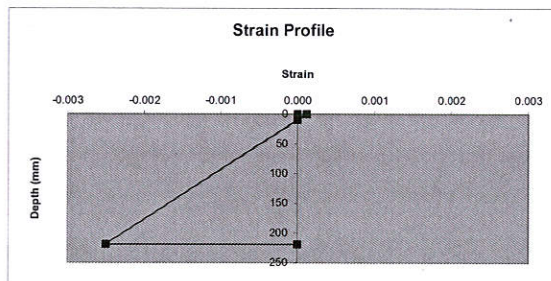
$$T = \sum A_s \times f_s = 141,372 \text{ N}$$

$$C = \alpha_1 \times f'_c \times a \times b = 141,372 \text{ N}$$

$$T - C = 0 \text{ N}$$

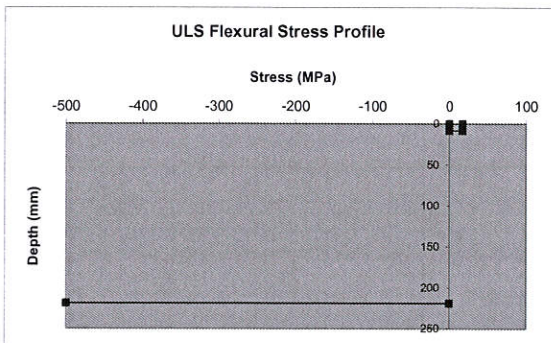
Strain Profile Input Co-ordinates

Desc.	x (strain)	y (depth)
ϵ_c	0	0
c	0.0001	10
ϵ_{s3}	-0.0025	219
ϵ_{s1}	0.0000	0
ϵ_{s2}	0.0000	0



Stress Profile Input Co-ordinates

	x (stress)	y (depth)
$\alpha_1 f'_c$	0	0
	17	0
	17	8
	0	8
f_{s1}	0	0
	0	0
f_{s2}	0	0
	0	0
f_{s3}	0	219
	-500	219



Nominal ULS Flexural Capacity, M_n (kNm) 30.4

Dependable ULS Flexural Capacity, ΦM_n (kNm) 25.8

WARNING! BEAM SECTION HAS LESS THAN MINIMUM FLEXURAL STEEL RATIO

Grid 1 PFC:

$$t_w = \frac{3260\text{mm}}{2} + 90 = 2020\text{mm}$$

$$S_u \downarrow = 1.07\text{ kPa} \times 202\text{m} \\ = 2.2\text{ kN/m}$$

$$Span = 4.3\text{m}$$

$$M^* = \frac{(4.3\text{m})^2 (2.2\text{ kN/m})}{8}$$

$$= 5.1\text{ kNm} \quad \leftarrow \text{less.}$$

MB values over this
JD PFC size will be
OK.

Listel grid 4:

$$w_u = 1.6\text{m} \times 1.07\text{ kPa} = 1.7\text{ kN/m}$$

$$+140 \quad 190 \times 135 \quad \text{listel:} \quad Z = \frac{190^2 \times 135}{6}$$

$$S_{M_n} = 0.8 \times 0.8 \times 0.95 \times 14\text{ MPa} \times Z \downarrow \\ = 6.9\text{ kNm} \quad \text{OK.}$$

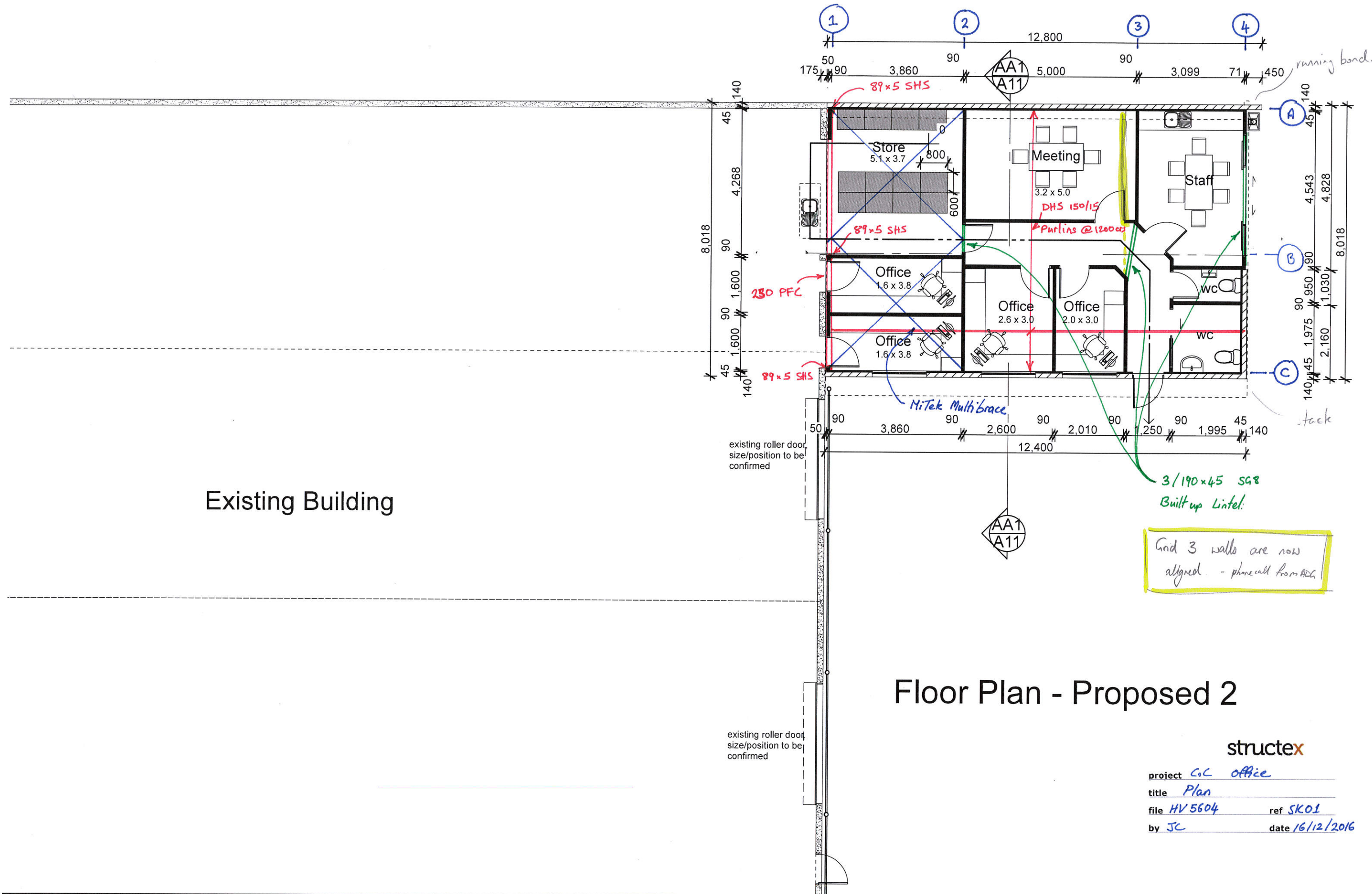
PROJECT

DATE

REF

FILE HVS604

BY JC



Existing Building

Floor Plan - Proposed 2

structex
 project C/L office
 title Plan
 file HV 5604 ref SK01
 by JC date 16/12/2016

Info from Architect → floor plan has changed! (7 Nov 2016...)

Grid 1 unchanged structurally
2 → door in bracing wall.

2 wall lengths 3.3m, 3.4m

109 BU/m → over 6.7m = 730 BU

OK!
Demand = 580 BU

lintel to support purlins + wall above.
Does 3/190 x 45 still work?

$$TW = 3860/2 + 90 + 5000/2$$

$$= 4520 \text{ mm}$$

L = 1m

$$1.2G + S_u = 0.99 \text{ kPa} \quad \text{ULS}$$

$$G + S_s = 0.3 \text{ kPa} + 0.43 \text{ kPa}$$

$$= 0.73 \text{ kPa} \quad \text{SLS}$$

$$M^* = \frac{wL^2}{8} = 0.56 \text{ kNm}$$

OK, No problem!

MB calc $\sigma M_n = 4.6 \text{ kNm}$

$$\text{SLS}; \quad \Delta = \frac{5wL^4}{384EI}$$

$$I = \frac{(135 \text{ mm})(190 \text{ mm})^3}{12}$$

$$= 77.2 \times 10^6 \text{ mm}^4$$

$$\frac{5(3.3 \text{ kN/m})(1 \text{ m})^4}{384(0.7 \text{ kPa} \times 77.2 \times 10^6 \text{ mm}^4)}$$

$$= 0.1 \text{ mm}$$

OK!

3 → offset bracing walls - no problem ~ 300mm

$$100 \text{ BU/m} \times (3.1 \text{ m} + 2.6 \text{ m}) = 570 \text{ BU} > 375 \text{ BU} \quad \text{OK}$$

Keep as load bearing wall - just think the lintel

Smaller lintel spans means can probably decrease depth,
but OK for now.

Lintels must be able to hold bracing walls together and transfer
load between so they act together. Framing and lining in between
should be able to do this no problem.

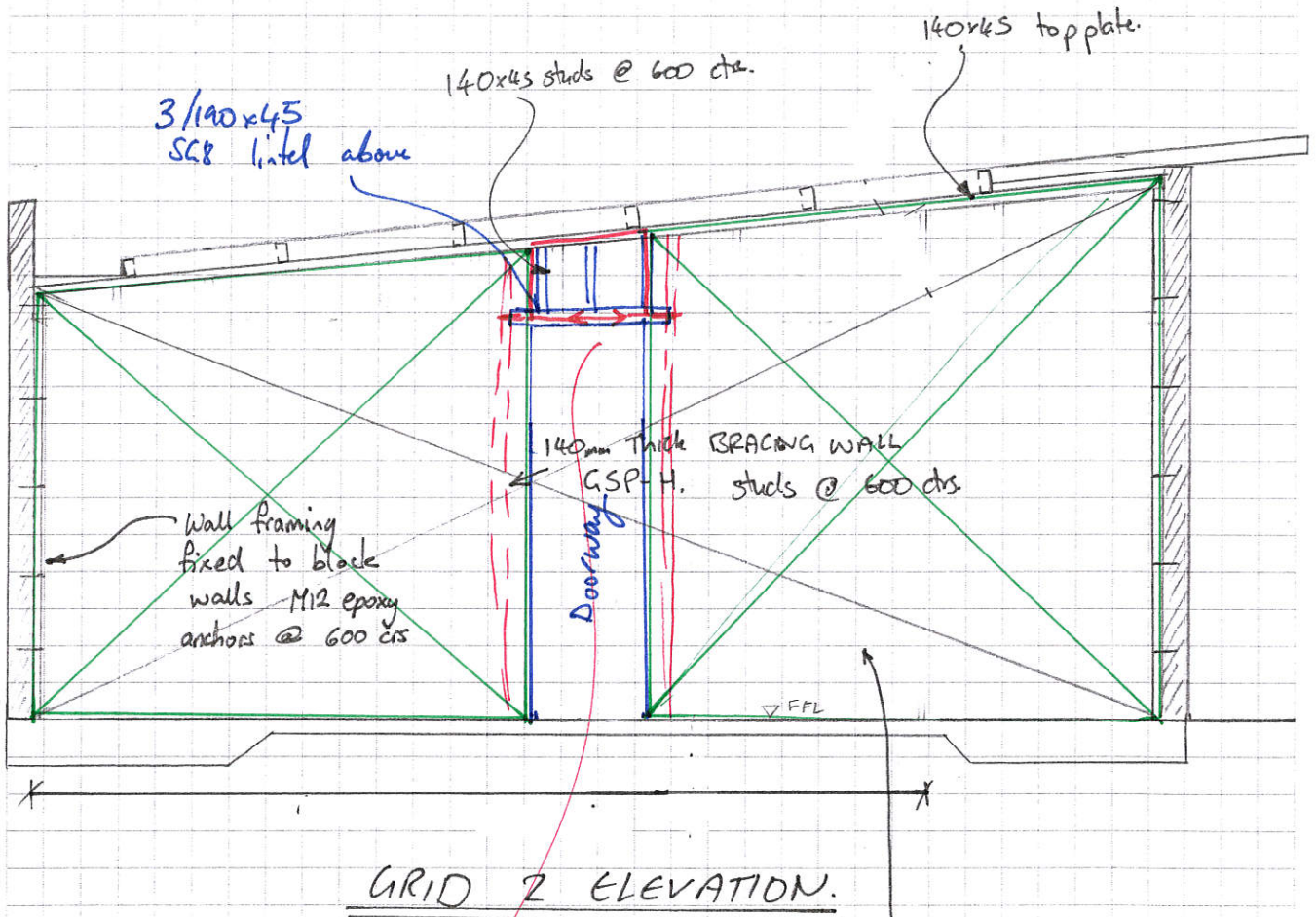
PROJECT C/L Office

DATE 15/12/2016

REF Revision of Plan ①

FILE HV5604

BY JC



Load transfer?

One wall can take all but 11kN of the load.

Wall $C = 15kN$ at $n=1.25$
 $= 7.8kN$ at $n=3$

3.2kN to transfer.
 6kN from roof. Pretty even...

Brace out top of opening to transfer loads if required.

Top plate 140 x 45 has $\phi N_t = 30kN \therefore$ OK. if continuous.

Bracing wall full height and length of wall.
 $\geq 6m$ min

Sheet brace strap 6kN characteristic capacity
 one around studs + lintel

Shear capacity of stack band wall.

$$V_n = v_n b_w d$$

where $d = 0.8L_w$
 $b_w = t$
 $b_w = 140 \leq 3t$ in plane out of plane

$$V_{nm} = 0.7 \text{ MPa}$$

$$\rho_w = \frac{(12\text{mm})^2 \frac{\pi}{4}}{150 \times 400\text{mm}} = 0.188 \%$$

$$V_m = 1.1 \times 0.7 \text{ MPa} = 0.77 \text{ MPa}$$

$$\zeta = 33 (0.00188) \frac{500}{300} = 0.104$$

$$\zeta_2 = 1.0$$

$$V_{n \text{ plane}} = (0.77 \text{ MPa}) 0.8 \times 3190 \text{ mm} \times 140 \text{ mm} = 275 \text{ kN.}$$

OK by inspection.

Stack band only affects face shear

$$(2.45 \text{ kPa} \times 3.71 \text{ m} \times \frac{5}{8}) = 5.7 \text{ kN/m}$$

$$\begin{aligned} \text{shear capacity} &= V_m \times b_w \times d \\ &= 0.77 \text{ MPa} \times 400 \text{ mm} \times \frac{140 \text{ mm}}{2} \\ &= 21.5 \text{ kN} \\ \phi V_m &= 15 \text{ kN} \quad \text{with } \phi = 0.7 \end{aligned}$$

Will be OK.

PROJECT

DATE 21/12/2016

REF

(2)

FILE HV5604

BY JC

Grid 4: wall tied into grid C wall for alternative stability

footing width:

50kPa bearing

$$\begin{aligned} \text{Load} &= 1 \text{ kPa} \quad \text{roof + snow load} \times 1.7 \text{ m TW} = 1.7 \text{ kN/m} \\ 1.2 \times 3.5 \text{ kPa wall} \times 3.7 \text{ m high} &= 15.5 \text{ kN/m} \end{aligned}$$

$$1.2G + S_n = 17.2 \text{ kN/m on section under wall}$$

$$\text{Required footing thickness} = \frac{17.2 \text{ kN/m}}{50 \text{ kN/m}^2} = 0.344 \text{ m wide.}$$

350 wide, 300 deep strip footing under wall

PROJECT

DATE 12/12/2016

REF

④

FILE HVS604

BY JC

Foundation thickenings under load bearing walls

300 wide - 50 kPa safe bearing

$$50 \text{ kPa} \times 0.3 \text{ m} = 15 \text{ kN/m}$$

Roof $G = 0.3 \text{ kPa}$
 $S_u = 0.63 \text{ kPa}$

over $TN = \frac{4.8 \text{ m}}{2} + \frac{3.9 \text{ m}}{2}$
 $= 4.35 \text{ m}$

Walls 140 wide studs 0.25 kPa over $h = 3.79 \text{ m}$ max
 3.11 m min. } 3.5 m avg

$$\begin{aligned} 1.2 G + S_u &= 1.2 \times 0.25 \text{ kPa} \times 3.5 \text{ m} + (1.2 \times 0.3 \text{ kPa} + 0.63 \text{ kPa}) \times 4.35 \text{ m} \\ &= 1.05 \text{ kN/m} + 4.31 \text{ kN/m} \\ &= 5.36 \text{ kN/m} < 15 \text{ kN/m} \end{aligned}$$

300 wide thickening OK.

PROJECT

DATE 16/01/17

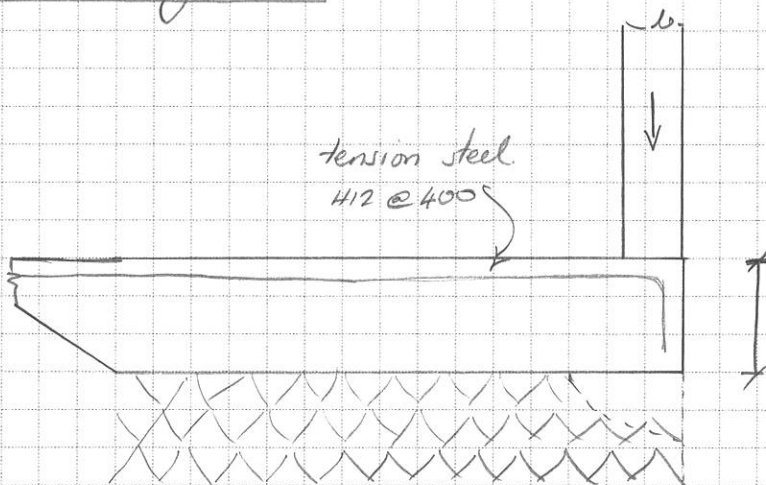
REF

⑤

FILE HV5604

BY JC

West side - grid A



load from masonry wall
 $24 \text{ kN/m}^3 \times 0.14 \text{ m} \times 3.59 \text{ m}$
 $= 12.1 \text{ kN/m}$

roof span parallel to
 west wall.
 Allow for 1.35 G
 $= 16.3 \text{ kN/m}$

300mm cantilever, $M^* = 16.3 \text{ kN/m} \times 0.3 \text{ m}$
 $= 4.9 \text{ kNm/m}$

90° hook length $\geq 12 \times 12 \text{ mm} = 144 \text{ mm}$ $\therefore$ use L_{dh}

$L_{dh} = 0.24 \frac{500 \text{ MPa} \times 12 \text{ mm}}{\sqrt{25} \text{ MPa}} > 3 \times 12 \text{ mm}$
 $= 288 \text{ mm} > 96 \text{ mm}$

$\therefore$ Fully developed at 338mm in from edge (50mm cover).
 $M^* = 5.5 \text{ kNm/m}$

Slab capacity $\phi M_n = 30.7 \text{ kNm/m}$

$\therefore$ able to cantilever more than 400mm OK

PROJECT 80 Byron St

DATE 18/04/2017

REF RFI: BCN/2017/2013 GED-001A

FILE HV5604

BY JC

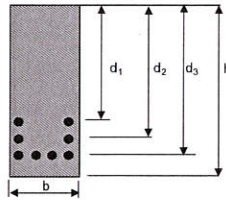
Flexural Design for RC Beams

Project #: HV5604 By JC
 Project Name: 80 Byron St Office
 Element Description: Western side floor slab

Design Assumptions

- Up to three layers of tension reinforcing can be counted for flexural strength.
- No account is made of the negligible flexural strength increase provided by compression steel.

Limiting Concrete Strain at ULS	0.003	Ref NSZ3101:2006, Clause 7.4.2.3
Reinforcing Steel f_y (MPa)	500	
Concrete Strength (MPa)	25	
Undercapacity Factor " Φ "	0.85	Ref NSZ3101:2006, Clause 2.3.2.2
α_1	0.85	Ref NSZ3101:2006, Clause 7.4.2.7
β_1	0.85	Ref NSZ3101:2006, Clause 7.4.2.7
Concrete Strain " ϵ_c "	0.0001	
c (mm)	8	Alter this to get internal equilibrium
a (mm)	7	
Beam Width, " b_w " (mm)	1,000	
Beam Depth, " h " (mm)	300	
d_1 (mm)	0	
d_2 (mm)	0	
d_3 (mm)	259	Cover = 35 <i>top cover.</i>
ϵ_{s1}	0.0000	
ϵ_{s2}	0.0000	
ϵ_{s3}	0.0025 = f_y/E_s	(lower tension steel at yield at ULS)
Shear Stirrup Dia. (mm)	0	
Tension Bar Dia. 1 (mm)	0	
Tension Bar Dia. 2 (mm)	0	
Tension Bar Dia. 3 (mm)	12	
# of Bars 1	0	
# of Bars 2	0	
# of Bars 3	2.5	<i>H12 @ 400cs.</i>
A_{s1} (mm ²)	0	
A_{s2} (mm ²)	0	
A_{s3} (mm ²)	283	
A_s Total (mm ²)	283	
f_{s1} (MPa)	0	
f_{s2} (MPa)	0	
f_{s3} (MPa)	500	
Flexural Steel Ratio " ρ "	0.0011	
Min Flexural Steel Ratio	0.0028	Ref NSZ3101:2006, Clause 9.3.8.2.1
Steel Elastic Modulus (MPa)	200,000	
Cover to Flexural Reo (mm)	35	
Reinforcing steel yield strain	0.0025	



Use "Goal Seek" to make T - C = 0, by changing "c"

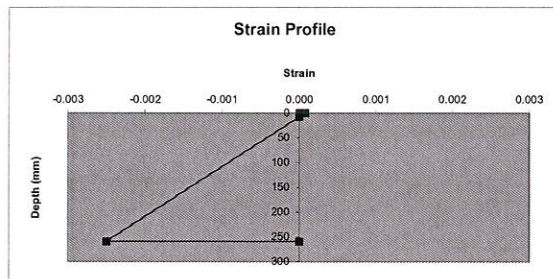
$$T = \sum A_s \times f_s = 141,372 \quad N$$

$$C = \alpha_1 \times f_c \times a \times b = 141,372 \quad N$$

$$T - C = 0 \quad N$$

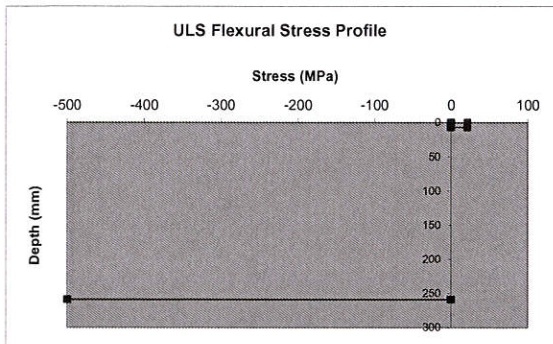
Strain Profile Input Co-ordinates

Desc.	x (strain)	y (depth)
ϵ_c	0	0
c	0.0001	8
ϵ_{s3}	-0.0025	259
ϵ_{s1}	0.0000	0
ϵ_{s2}	0.0000	0



Stress Profile Input Co-ordinates

	x (stress)	y (depth)
$\alpha_1 f_c$	0	0
	21.25	0
	21.25	7
	0	7
f_{s1}	0	0
	0	0
f_{s2}	0	0
	0	0
f_{s3}	0	259
	-500	259



Nominal ULS Flexural Capacity, M_n (kNm) 36.1

Dependable ULS Flexural Capacity, ΦM_n (kNm) 30.7

WARNING! BEAM SECTION HAS LESS THAN MINIMUM FLEXURAL STEEL RATIO



Design

WALL OR BRACING LINE		BRACING ELEMENTS PROVIDED		
1	2	3	4	5
Line Label (and lines)	Minimum BUs Required	Bracing Element No.	Bracing Type	Length Element (m) L
(A)	ok gives capacity.		running band block	
B			wall ok by insp	
(C)			running band block	
D			wall ok by insp	
E				1
F				1.5
			0.6	
			2.4	

WIND	
6 W	7 W
Rating BU/m W	BUs Achieved (BU/m x L) W
<u>hon.</u>	(Full 6)
<u>hon.</u>	
171 km	3420
256 km	5120
102 km	2040
410 km.	8200

[illegible]

3600
tall

	Totals Achieved
From Sheet A	Totals Required

W achieved	
W required*	
W achieved must exceed W required*	

* from Calculation Sheet A

E achieved	
E required*	
E achieved must exceed E required*	

$n=3$ demand from NZS1170.5. (refer calcs.)

WALL OR BRACING LINE		BRACING ELEMENTS PROVIDED		
1	2	3	4	5
Line Label	Minimum BUs Required	Bracing Element No.	Bracing Type	Length Element (m) L
1 1			strap brace to line 2.	
2 2	580 ✓	1	GSP-H	3.3
		2	GSP-H	3.4
3 3	375 ✓	1	GSP-H	3.1
		2	GSP-H	2.7
4 4	ok given capacity	1	Stack bond block wall	3.1
8				

WIND	
6 W	7 W
Rating BU/m	BUs Achieved (BU/m x L) W
W	W
$150 \times \frac{2.4}{3.3}$	360
109	370
100	310
100	270
1233404	5500
(kN x 20)	

EARTHQUAKE	
6 E	7 E
Rating BU/m E	BUs Achieved (BU/m x L) E
109	360
109	370
100	310
100	270
	5500.

avg stud
3.3m.

avg stud
2 3.6m

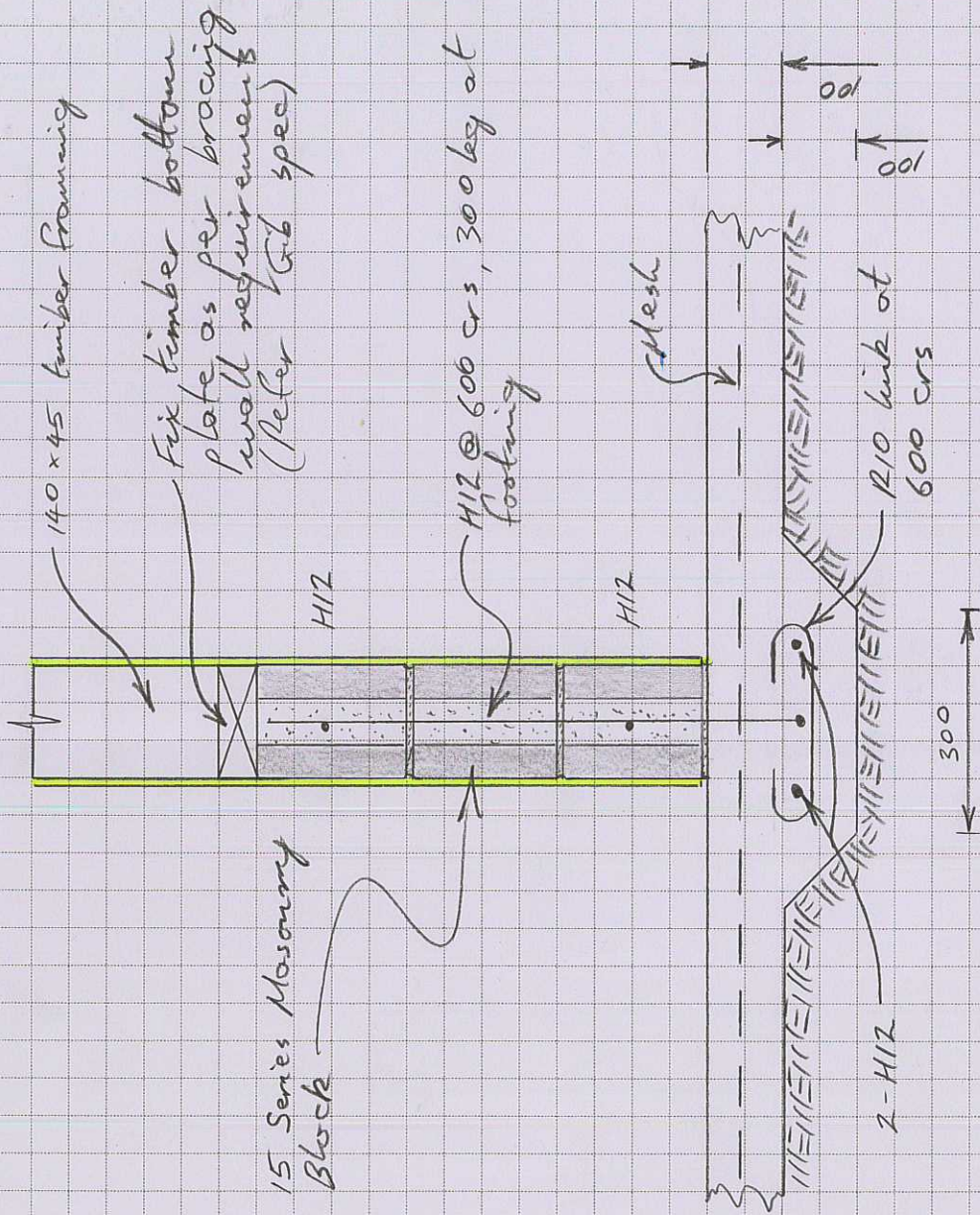
Totals Achieved	
From Sheet A	Totals Required

W achieved	6810.
W required*	
W achieved must exceed	
W required*	

* from Calculation Sheet A

E achieved	6810
E required*	
E achieved must exceed E required*	

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INTERNAL BRACING WALL LOWER
DETAIL (TYPICAL)

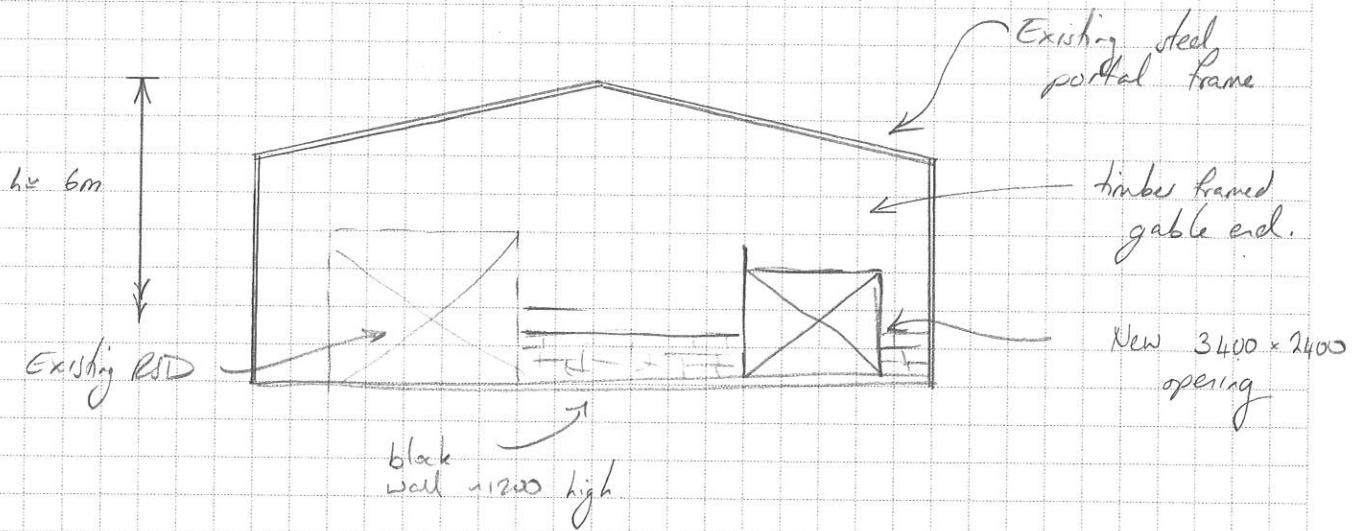
Scale 1:10 (A4)

PROJECT 80 Byron Street
Extension

DATE 26/6/17
FILE HV5604

BY J.L.

Existing warehouse wall:



- Lateral bracing provided by portal frame - unaffected by alterations.
- Gravity supports - gable framing only + corrugated cladding

$$w = 0.12 \text{ kPa (framing @ 600cs)} + 0.1 \text{ kPa (cladding)} = 0.22 \text{ kPa}$$

average height of wall above 3.5m (6 - 2.4 = 3.6m)

$$w_{NLS} = 0.22 \text{ kPa} \times 1.35 \times 3.5 \text{m} = 1.2 \text{ kN/m}$$

$$N_{SLS} = 0.88 \text{ kN/m}$$

$$\text{span}/300 = 11 \text{mm}$$

At span of 3.4m

$$M^* = 1.73 \text{ kNm}$$

$$V^* = 2.04 \text{ kN}$$

$$A_{SLS} = 1.53 \text{ kNm}^3 / EI$$

$$E = 67 \text{ GPa}$$

$$\begin{aligned} \text{SC8 } 190 \times 45 \\ Z = 0.271 \times 10^6 \text{ mm}^3 \\ I = 25.7 \times 10^6 \text{ mm}^4 \end{aligned}$$

$$\Delta = \frac{5(0.88 \text{ kN/m})(3.4 \text{m})^4}{384(67 \text{ GPa})(25.7 \times 10^6 \text{ mm}^4)} = 8.9 \text{ mm}$$

$$45 \times 240 \quad \Delta = 4.4 \text{ mm} \times 2 = 8.8 \text{ mm OK}$$

$$\phi M_n = 2.9 \text{ kNm} \times 0.8 = 2.32 \text{ kNm} \rightarrow \text{OK } 90 \times 240 \text{ Lintel}$$

PROJECT 80 Byron St

DATE 01/08/2017

REF RFI's - B1-016 part 8.

FILE HV5604

BY JL

Accessible Facilities Report Template

Applicant Information Sheet and Report Template

CCC Use Only:	Project No:	TRIM Ref:
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Project Address: 80 Byron Street, Sydenham, Christchurch

[include Level and Unit No]

If you have not used this template previously or need to reacquaint yourself on how to use this template please refer to the notes section on the last two pages for guidance notes.

All proposed features (including upgrade actions) must be shown on the plans and specifications.

COMPLETE SECTIONS 1-17 FOR BOTH NEW AND EXISTING BUILDINGS

Required Feature	Reference where found on drawings / specification, e.g. sheet 3, detail 2. (all buildings)	Current Situation (existing buildings only)	Upgrade action proposed under Sections 112 or 115 of the Building Act. (existing buildings only)
1. CAR PARKS (NZBC D1.3.5 & D1/AS1/10 (AS 2890.1), NZS 4121 SECTIONS 5 & F3)			
☐ NOT APPLICABLE (specify reason why):			
Provided at the ratio of 1 for up to 20, 2 for up to 50, plus 1 more for every additional 50 parks (or part thereof)(NZS 4121). Although this differs from our Proposed City Plan, our Planners will accept this Standard.	Sheet A2	No change	Ratio of 1 for up to 20 (NZS 4121)
Identified by the symbol of access (on ground or post)	Sheet A2	No change	Accessible parking symbol on parking surface
Location of accessible car park is either visible from a vehicle at the entrance to the car park area, or is sign posted from the entrance to the parking area.	Sheet A8	No change	Accessible sign located on wall in front of parking space between 1400 & 1700mm from the ground level
Min. 3500mm width (NZS 4121). Min. 3200mm width (AS2890.1 Fig. 2.2) but 3500mm if beside an obstruction (D1/AS1/10.1.1 Comment)	Sheet A2	No change	3,500 X 5,400 (NZS 4121)
Located on an accessible route, as close as possible to the building accessible entry	Sheet A2	No change	Accessible parking space located next to main entrance
Located on a surface with a max. 1:50 slope	Sheet A2	No change	Existing tar seal is reasonably flat 1:100

Required Feature	Reference where found on drawings / specification, e.g. sheet 3, detail 2. (all buildings)	Current Situation (existing buildings only)	Upgrade action proposed under Sections 112 or 115 of the Building Act. (existing buildings only)
Located to avoid conflict between vehicles and people, and provided with direct access to an accessible route without having to pass behind parked cars	Sheet A2	No change	Parking space is located next to main entrance
2. RAMPS & FOOTPATHS (NZBC D1, D1/AS1/2.3, 3.0 & 6.0, NZS 4121 SECTION 6)			
☐ NOT APPLICABLE (specify reason why):			
Where the footpath surface is more than 25mm above adjacent ground, either a 75mm high kerb or a low barrier rail is required.	Sheet A2, A8	No change	A ramp with 1:20 slope and a landing 1,200X2,000X100 with a 75mm high upstand
Accessible routes have a cross fall of no more than 1:50.	Sheet A2	No change	Access routes are flat
Footpaths and ramps have a min. 1200mm clear width (1000mm between handrails)	Sheet A2, A8 & A7	No change	A ramp with 1:20 slope and a landing 1,200X2,000X100
Footpaths and ramps have non slip surface (refer D1/AS1 Table 2)	Sheet A10	No change	Refer to notes on Sheet A10
Portable ramps are not permitted.	Sheet A2, A8	No change	Ramp and landing are of concrete construction
Ramps have a max. gradient of 1:12 (preferably 1:14)	Sheet A8	No change	Ramp has a 1:20 slope
Ramps have landings top and bottom, extending 1200mm beyond any doorway or door swing. Landings may have a maximum gradient, in the direction of travel, of 1:50	Sheet A2 & A8	No change	Landing will be 1200 wide X 2000 long
All ramps have an upstand or a low rail to prevent wheel-chair wheel from running off edge	Sheet A8	No change	75mm upstand
Ramps steeper than 1:20 have handrails both sides, continuing for 300mm beyond head and foot of ramp, plus an intermediate safety rail where not against a wall or barrier (NZS 4121 Fig. 12)	Sheet A8	No change	Ramp will be 1:20 no hand rail required
Height of handrails is between 840mm and 1000mm vertically above "plane" surface of ramp	None required	No change	None required
Handrail diameter is between 32mm and 50mm (or to Fig. 26(b) D1/AS1)	None required	No change	none required
Handrails have clearance between 45mm and 60mm from wall	None required	No change	None required
Handrails have projecting ends (NZS 4121 Fig. 13)	None required	No change	None required
Ramp landings (and rest areas) allow 1200mm space clear of door swings	Sheet A2	No change	Landing will be 2,000mm long
Max. rise between landings is 750mm	None required	No change	None required
3. KERB RAMPS (D1/AS1/3.4, NZS 4121 SECTION 13) AND STEP RAMPS (NZS 4121 SECTION 6)			
☐ NOT APPLICABLE (specify reason why):			
Footpath portion of kerb ramp has gradient no steeper than 1:8, and no longer than 1500mm	None required	No change	None required
Road/gutter segment of kerb ramp has gradient no steeper than 1:20	Sheet A2, A8	No change	North elevation

Required Feature	Reference where found on drawings / specification, e.g. sheet 3, detail 2. (all buildings)	Current Situation (existing buildings only)	Upgrade action proposed under Sections 112 or 115 of the Building Act. (existing buildings only)
Kerb ramp has no lip at common surface (gutter channel)	Sheet A8	No change	Transition from paving to ramp shall have no lip
Kerb ramp has contrasting colour and texture to adjacent footpath, gutter or road.	Sheet A2	No change	Ramp shall be of contrasting colour and texture to parking lot
Step ramps replace isolated steps, and are no steeper than 1:8, max. 190mm high, and max. 1520mm long, with min. 1200mm long landing. (NZS 4121 Fig. 16)	None required	No change	None required
4. MAIN ENTRANCE AND ALL ACCESSIBLE ROUTES, INCL. CORRIDORS, DOORWAYS & DOORS (NZBC D1.3.4(f), D1 AS1/7.0, FIG.27, NZS 4121 SECTION 7)			
☐ NOT APPLICABLE (specify reason why):			
The main entrance is on the accessible route	Sheet A2	No change	Main entrance is at the end of accessible landing
If the main entrance is not accessible, it has signage indicating location of accessible entrance.	None required	No change	None required
Preferably there are no thresholds in doorways. If they cannot be avoided, they are max. 20mm high, or 56mm high if a 1:8 max. ramp is provided both sides (NZS 4121 Fig. 17)	Sheet A6	No change	Refer to floor plan note
There are accessible routes extending from the accessible entry to all spaces that are required to be accessible, 1200mm min. width	Sheet A7	No change	Refer to dimensions on Framing plan
If existing corridors are less than 1200mm wide, doorways off it are made wider to compensate.	None required	No change	None required
Doorways have 760mm min. clear opening (unless from narrow corridors where wider clear openings are required)	Sheet A6	No change	Refer to door dimensions on floor plan
Double doors have at least one leaf which provides 760mm min. clear opening.	None required	No change	None required
Doors are colour-contrasted with their surroundings	Sheet A10	No change	Refer to notes on sheet A10
Doors with dual swing have visibility glazing panels	None required	No change	None required
Doors with full height glazing have manifestation markings 700 -1000mm above floor.	None required	No change	None required
Clear space between successive doors is 1200mm min. (Fig. 27 D1/AS1)	None required	No change	None required
Where doors open towards wheelchair, an unobstructed wall space not less than 300mm wide is required at side of door adjacent to door handle	Sheet A7	No change	Refer to door to wall dimensions on Framing plan
Forces required to open non-fire doors are within limits	Sheet A10	No change	Refer to notes on Sheet A10
5. PUBLIC FACILITIES (NZBC G5.3.4, NZS 4121 SECTION 11)			
☒ NOT APPLICABLE (specify reason why): Not a retail outlet			
Where public counters or desks are provided in reception areas, bars, shops and supermarkets, at least one is accessible, for both the public and for the staff using it.			

Required Feature	Reference where found on drawings / specification, e.g. sheet 3, detail 2. (all buildings)	Current Situation (existing buildings only)	Upgrade action proposed under Sections 112 or 115 of the Building Act. (existing buildings only)
Accessible portion of counter has top of work surface 775mm max. above floor, with 675mm min. height clearance under for a depth of 540mm.			
Public telephones comply with NZS 4121 Section 11.2			
6. LIFTS (NZBC D1.3.4 (c), D2.3.5, D2/AS1/71, NZS 4121 SECTION 9)			
☒ NOT APPLICABLE (specify reason why): <i>No lifts required</i>			
Lifts are required as follows: • In all buildings with four or more floors • In a three floor building when the total gross floor area of the two upper floors is 500m² or more and the design occupancy exceeds 50 persons • In a two floor building when the gross floor area of upper floor is 400m² or more and the design occupancy exceeds 40 persons • Notwithstanding any of the above, a lift is required if an upper floor is used for: a place of assembly for 250 or more persons, public reception area for a bank, central and local government offices and facilities (including libraries), medical and dental rooms, health care centres • Notwithstanding any of the above, lifts are not required in two or three storey hotels and motels provided that the accessible accommodation units, reception office, restaurant, bars and other communal facilities are on the ground floor (NZS 4121 clause 14.4.1)			
At least one lift is on the accessible route			
Lobbies have 1800mm min. unobstructed depth in front of lift doors			
Car floor has 1400mm x 1400mm min. internal dimensions			
Doors have 900mm min. clear opening			
Doors are readily distinguishable from their surroundings			
Doors remain open for at least 5 seconds before starting to close			
Car has handrails on walls to NZBC D1/6.0 or NZS 4121 Fig. 26			
All controls are located between 900mm and 1350mm above the floor			
All controls have tactile features			
Lift indicators are provided as NZS 4121:2001 clause 9.2.5			
7. STAIRS (NZBC D1.3.4(g)(h)(i), D1/AS1/4.0, 4.2, 4.4, 4.5. NZS 4121 SECTION 8)			
☒ NOT APPLICABLE (specify reason why): <i>No stairs required</i>			
All multi-storeyed buildings that are required to be accessible have at least one accessible stair.			

Required Feature	Reference where found on drawings / specification, e.g. sheet 3, detail 2. (all buildings)	Current Situation (existing buildings only)	Upgrade action proposed under Sections 112 or 115 of the Building Act. (existing buildings only)
Stair treads 310mm min.; Risers 180mm max. (of uniform height over each flight)			
Stair has 900mm min. width between handrails			
Landings have 900mm min. depth (1200mm recommended)			
Max. total rise of 2500mm between landings			
No open risers, no winders, no spiral stairs			
Nosings are rounded, and colour contrasted with rest of tread			
Colour-contrasted change of floor surface texture are provided at head and foot of stair. (NZS 4121 Fig. 22)			
8. STAIR HANDRAILS (NZBC D1.3.4(i), D1/AS1/6.0, NZS 4121 SECTION 8.6)			
☒ NOT APPLICABLE (specify reason why): No hand rails required no stairs and have 1:20 slope on ramp			
Are provided on both sides of the stair			
Have no obstruction to the passage of the hand along the rail			
Are continuous around landings (except at doorways)			
Extend 610mm min beyond the foot of the stair and 300mm min beyond the head of the stair			
At the same slope as the pitch line			
Between 900mm and 1000mm above pitch line			
Profiles are to D1/AS1 Fig. 26(b)			
Have no projecting ends, and have domed buttons 150mm from the ends (NZS 4121 Fig. 23)			
9. TOILET FACILITIES (NZBC D1.3.2 (c) & G1.1 & 1.3.4 G1/AS1, NZS 4121 SECTION 10)			
☐ NOT APPLICABLE (specify reason why):			
Accessible toilets are on the accessible route			
Route to accessible toilets does not traverse different tenancies			
Minimum dimensions of space are 1900mm x 1600mm, and the layout of fittings is correct			
In certain large buildings having more than 300 occupants, accessible toilets are evenly distributed			
If doors are hinged, they swing outwards unless the space is sufficiently large (sliding doors are also acceptable)			
Door has 760mm min. clear opening (with 1200mm clear space in any lobby between door swing arcs)			
If hinged, the door has a grab rail on inner face			

Required Feature	Reference where found on drawings / specification, e.g. sheet 3, detail 2. (all buildings)	Current Situation (existing buildings only)	Upgrade action proposed under Sections 112 or 115 of the Building Act. (existing buildings only)
Indicator bolt is of sufficient size so as to be usable by person with limited hand movement			
Horizontal leg of grab rail beside WC pan is fixed 700mm above floor			
Vertical leg of grab rail is fixed between 150mm and 250mm from front of WC pan			
Top of WC pan seat is 460mm above floor			
Front edge of WC pan is 700mm - 750mm from wall behind it			
Toilet paper holder is located in the correct zone			
Washbasin has 675mm min. underside clearance from floor, and is located 300mm min. from the front of the WC pan			
Taps on washbasin have capstan or lever handles (hot tap to left of cold tap)			
Any nappy-changing tables do not intrude into the wheelchair manoeuvring space			
10. SHOWERS (NZBC G1.3.4, G1/AS1/TABLE 9, NZS 4121 SECTION 10)			
☒ NOT APPLICABLE (specify reason why): <i>No shower required</i>			
If the building requires showers, at least one is accessible. If the building use does not require showers, but has two or more showers, at least one is accessible (BIA News No.131)			
Minimum internal dimensions of combined toilet/shower space are 2100mm x 1900mm			
Accessible shower is on an accessible route			
If doors are hinged, they swing outwards unless the space is sufficiently large (sliding doors are also acceptable)			
Shower door has 760mm min. clear opening			
Shower has self draining floor with no lip or upstand			
Floor covering is of impervious, non-slip material			
Grab rail is of correct shape, size and position			
Mixing valve is lever-operated, and is fixed 1100mm above floor			
Hand-held shower rose on flexible hose			
Shower head can be fixed to slide rail between 1000mm and 1900 mm above floor. Slider rail is to be as strong as a grab rail			
Shower seat is 800mm min. length x 450mm, in correct position			
Clothes-hanging device is located between 1200mm and 1350mm above the floor			

Required Feature	Reference where found on drawings / specification, e.g. sheet 3, detail 2. (all buildings)	Current Situation (existing buildings only)	Upgrade action proposed under Sections 112 or 115 of the Building Act. (existing buildings only)
11. DOOR & WINDOW CONTROLS AND LIGHT SWITCHES (NZBC D1.3.4(f), G9/AS1, NZS 4121 Sections 4,7, C5)			
☐ NOT APPLICABLE (specify reason why):			
Doors can be opened with one hand	Sheet A10	No change	Refer to note on sheet A10
Door handles are fixed between 900mm and 1200mm (1000mm optimum) above floor	Sheet A10	No change	Refer to note on sheet A10
Door handles are lever action, with end returned towards door (knob handles are not permitted)	Sheet A10	No change	Refer to note on sheet A10
Door closers have minimum tension required to bring door to closed position	Sheet A10	No change	Refer to note on sheet A10
Electronic access units are located as NZS 4121 clause 4.11.5	None required	No change	None required
Window locking and opening controls are located between 900mm and 1200mm above the floor	Sheet A11	No change	Refer to Cross Section A-A
Light switches throughout building are horizontally aligned with door handles	Sheet A10	No change	Refer to sliding door detail and notation
Socket outlets are located 500 -1200mm above the floor	Sheet A10	No change	Refer to sliding door detail and notation
12. VISIBILITY FACTORS (NZBC F2, G7 AND G8, NZS 4121 215, D1/AS1/1.5.4 & 1.8)			
☐ NOT APPLICABLE (specify reason why):			
All signs, information boards and all elements of accessible routes are well illuminated	Sheet A10	No change	Refer to notes
Check D1/AS1 1.5 "Obstructions"	None required	No change	No obstructions in building
13. ALERTING DEVICES (F7/AS1/2.1, NZS 4121 CLAUSES 4.12 & 4.13)			
☐ NOT APPLICABLE (specify reason why):			
Alerting devices (where required) have both audible and visual signal (see 'ACCESSIBLE ACCOMMODATION' section 16)		No change	Refer to fire report
14. PLACES OF ASSEMBLY, ENTERTAINMENT & RECREATION (D1/AS1/8.0, G5.3.5, NZS 4121 Sections 12, H)			
☒ NOT APPLICABLE (specify reason why): Not a place of entertainment/recreation			
Where a sound amplification system is installed, it has a listening system for people with hearing aids			
Two wheelchair spaces are provided for up to 250 seats, plus one for every additional 250			
Wheelchair spaces are located amongst other seating, and evenly distributed where possible			
An accessible route is provided to podium or stage area, including to all back-stage areas (portable ramps are not permitted)			
Swimming pools have unaided access into the water (preferably by a ramp at max. 1:12 slope)			
Sports tracks and fields are accessible			

Required Feature	Reference where found on drawings / specification, e.g. sheet 3, detail 2. (all buildings)	Current Situation (existing buildings only)	Upgrade action proposed under Sections 112 or 115 of the Building Act. (existing buildings only)						
15. SIGNS (BUILDING ACT CL. 47A(5), NZBC G5.3.5, 5.3.6 & F8.3.4, F8/AS1/5.0, NZS SECTIONS 3.6 & 4.8)									
☐ NOT APPLICABLE (specify reason why):									
Signs are positioned on walls, doors, etc, between 1400mm and 1700mm above the floor	Sheet A10	No change	Refer to sheet A10						
International symbol of access is displayed outside the building or so as to be visible from outside it.	Sheets A2, A8	No change	Refer to East elevation						
Access symbol on main information board(s) identifies location of lift, accessible routes, toilets, rooms with listening aids, etc.	Sheet A10	No change	Refer to note on sheet A10						
Accessible toilets / showers are identified with an access symbol on entrance door.	Sheet A10	No change	Refer to notes on sheet A10						
All symbols have correct proportional layout, lettering and colour contrast with background.	Sheet A10	No change	Refer to notes on sheet A10						
Identify facilities: - accessible car park spaces - accessible entrance - services available in building - accessible routes, lifts and / or stairs - toilet / shower facilities - rooms with listening aids	Sheet A2, A8, A10	No change	Refer to all sheets and notation						
16. ACCESSIBLE ACCOMMODATION UNITS (NZS 4121 SECTION 14, D1/AS1/9.0, G3.1(c), G9/AS1)									
☒ NOT APPLICABLE (specify reason why): <i>Not an accommodation provider</i>									
In hotels, motels, hostels, halls of residence, holiday cabins, groups of pensioner flats, boarding houses, guest houses, old peoples homes, and other buildings providing accommodation for the public, accessible units (including kitchen, bedroom, shower/toilet arrangement, laundry and all other accessible features and route requirements) are provided as follows: <table border="1"> <tr> <td>Total guest units</td><td>1-10</td><td>11-25</td></tr> <tr> <td>Accessible units required</td><td>1</td><td>2</td></tr> </table> For every additional 25 guest units, 1 accessible unit is required.				Total guest units	1-10	11-25	Accessible units required	1	2
Total guest units	1-10	11-25							
Accessible units required	1	2							
An accessible car park is available at the main accessible entrance to assist those booking in/out									
Reception counters are accessible (see 'PUBLIC FACILITIES' on page 3)									
In hotel or motel complexes, an accessible telephone and toilet is available in public areas for guests, casual patrons and staff									
Bedrooms, sitting and dining areas, kitchens and laundries have 1500mm dia. wheelchair turning circle									
If the unit has kitchen and/or laundry facilities, these are fully accessible (refer to NZS 4121 Section 14 for detailed requirements)									
If a building has common laundry facilities, at least one of these is accessible (BIA News No.67 Pg. 2, 3)									

Required Feature	Reference where found on drawings / specification, e.g. sheet 3, detail 2. (all buildings)	Current Situation (existing buildings only)	Upgrade action proposed under Sections 112 or 115 of the Building Act. (existing buildings only)
Socket outlets are fixed between 500mm and 1200mm above the floor, at least 500mm from internal corners of rooms, and within a 500mm horizontal dimension from the front edge of any bench or fixed unit			
Telephone, television and radio controls, wardrobe rails, curtain pull cords, are easily reachable			
At least one room light has a bedside switch			
Where an ablution block contains communal toilet/shower facilities, there is also one or more all-gender accessible toilet/shower(s) provided			
17. OTHER FACILITIES USED BY PEOPLE WITH DISABILITIES (in order for persons with disabilities to carry out 'normal activities and processes in that building' as Building Act 2004 section 118(1)(b))			
☒ NOT APPLICABLE (specify reason why): <i>Not a retail outlet</i>			
Fitting rooms in clothes shops (or the like) having 1500mm dia turning circle, clothes hooks at 1350mm max. above floor (or two adjoining rooms of a similar overall size, with a drawable curtain between)			

COMPLETE IN FULL FOR ALL EXISTING BUILDINGS

Report Prepared by: *Adrian Ellis*

Contact Details: **Phone:** [Day]: 075782899 **Mobile:** 0211892850 **Email:** *Adrian@architecturaldesigngroup.co.nz*

Has a site visit been carried out? ☐ Yes ☒ No **Date of Visit:** 06/01/2017

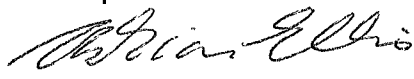
Has the building previously been upgraded?

☐ No

☒ Unknown

☐ Yes - provide details, e.g. project number(s):

I declare that this report is a true and accurate reflection of the accessible features currently in the building.

Signed:  **Dated:** 16/02/2017

Signature of: *Adrian Ellis* ☐ Owner / ☒ Agent [on behalf of and with the consent of the owner]

[print name]

The following pages are guidance notes and do not need to be submitted to Council with your application.

14 March 2017

Our Ref: 47003 - Rev 1

Julius Long
Structex Harvard Ltd
248 Montreal Street,
Christchurch, NZ
Email: JLong@structex.co.nz

**RE: 80 BYRON STREET, SYDENHAM
GEOTECHNICAL LETTER FOR PROPOSED EXTENSION**

Dear Mr Julius Long

1.0 INTRODUCTION

Engineering Design Consultants Ltd (EDC) has been engaged to provide a brief geotechnical investigation and soil bearing assessment for the proposed extension of the western warehouse building at 80 Byron Street in Sydenham, henceforth referred to as 'the site'. The new single storey extension will be used as offices.

1.1 Site Identification

The site's legal description is Lot 1 DP 449853. The property is rectangular, covers an area of 1280m² and is located on the south side of Byron Street in Sydenham, as shown below on Figure 1:



Figure 1: Site Location

1.2 Proposed Extension

The client has provided an extension drawing set, drafted by Architectural Design Group (ADG) Ltd (Ref: 5996; January 2017) for the proposed offices.

These drawings indicate that the proposed extension is to be situated near the northwest corner of the existing west building, as shown on Figure 1 above. The drawings also indicate that the extension is approximately 13m long (north-south), 7.8m wide (east-west) and one-storey. The foundation is proposed to be a concrete slab and is to be tied into the existing buildings concrete slab.

A copy of the proposed extension drawings is attached in Appendix A.

2.0 NEARBY GEOTECHNICAL INVESTIGATION

The site owner has supplied a geotechnical report completed for the property at 83 Byron Street (approx. 40m northeast of extension; see Figure 1) by Engco Consulting Engineers (Ref: 16363) in January 2017. The following is a summary of relevant information:

- Engco undertook 2 No. Cone Penetration Tests (CPT') and 2 No. Hand Augers (HA's) across the site. The HA's indicated that the shallow ground profile consists gravel fill to 0.3m below ground level (bgl), underlain by clayey silt to 2.0m bgl.
- Groundwater was not encountered during the HA's.
- Estimated '*Free-Field*' index (upper 10m) ground settlements, based on the on-site CPT's, range between 60mm and 90mm under SLS 2 (0.19g 6.0Mw) earthquake conditions and 90mm to 115mm under ULS earthquake conditions. Very little settlement is anticipated in the upper 4.5m under SLS or ULS conditions.
- The risk of lateral spreading as a result of liquefaction is considered low and the risk of lateral stretch is considered to within the MBIE minor to moderate category (less than 200mm).
- Due to the liquefaction risk, conventional shallow foundations are not recommended.
- A piled foundation is considered a viable solution for a single-storey warehouse building. It is anticipated that piles would need to be founded at 12.5m bgl. The CPT's indicated that the soil layer between 12m and 16m bgl has sufficient bearing capacity (>15MPa) and thickness for deep piles.

Based on the level of estimated settlement from the Engco on-site CPT's, the ground performance in a future earthquake event would be considered equivalent of CERA Technical Category 3 (TC3) if the site were residential.

The Engco geotechnical report is available upon request.

3.0 DESK BASED INFORMATION

3.1 Historical Imagery

Historical aerial imagery indicates that the site was residential in 1941, with two dwellings located in the northern half of the property (not covering location of the current building). Between 1941 and 1994 the site was subject to several developments, none of which were in the area of the proposed extension. By 1994 the site appeared as it does currently (March 2017).

3.2 Historical Land Use

The Environment Canterbury (ECan) Listed Land Use Register (LLUR) holds all known information about Hazardous Activities or Industries (HAIL) that have historically (and/or currently) taken place on the site or within the vicinity of the site.

The ECan LLUR indicates that a known HAIL activity has not occurred on the site, however there are two properties identified on the LLUR within 50m as follows:

- 71 Byron Street, located approximately 45m northwest of the site. This portion of land has been listed for 'F4 – Motor Vehicle Workshops'. The impacts of this HAIL activity have not been investigated as the activity is on-going.
- A small portion of land in the northeast corner of 83 Byron Street, located approximately 45m northeast of the site has been listed for 'A17 – Storage tanks or drums for fuel, chemicals or liquid waste'. This HAIL activity was investigated in 2011 during decommissioning and soil testing results indicated that hydrocarbons were present in the soil, though the level of contamination was below industrial/commercial guideline values.

These nearby HAIL activities are considered unlikely to present a geotechnical constraint for the proposed extension.

The ECan LLUR is attached in Appendix B.

3.3 New Zealand Geotechnical Database

3.3.1 CERA Technical Classification

The site is located in an un-zoned CERA area as it is non-residential.

3.3.2 Geology and Hydrology

The GNS Geological QMap shows the site as being located on '*Modern river floodplain/low-level degradation terrace. Un-weathered, variably sorted, gravel/sand/silt/clay*'. Nearby geological investigation data suggests that the ground profile in vicinity of site (~50m northwest) consists 0.8m of fill, underlain by silt with occasional sand to 4.5m bgl and fine to medium sand from 4.5m to at least 15.0m bgl.

The GNS 'Depths to Water Table' maps indicate that the mean depth of groundwater is generally 0.0m – 2.0m bgl in the area of the site. The EQC 'Event Specific Depths to

Water Table' maps indicate that the depth to groundwater was generally closer to 1.0m – 2.0m bgl for each of the major 2010/2011 earthquakes.

3.3.3 Seismic

The EQC 'Vertical Ground Movements' map indicates that the area of the might have subsided between 100mm and 200mm following the 2010/2011 Canterbury Earthquake Sequence.

The EQC 'Horizontal Ground Movements' map indicates that the area of the site may have experienced 170mm of lateral movement in a south-westerly direction. However this amount of movement is highly consistent for the surrounding area.

EDC has reviewed post-earthquake aerial photos taken for the 2010/2011 Canterbury Earthquake sequence. No liquefaction ejecta was evident on-site or on surrounding areas following any of the major earthquakes during the 2010/2011 Canterbury Earthquake Sequence. Additionally, EQC did not observe any ground cracks on-site or within the surrounding area following the 2010/2011 earthquakes.

Estimated Peak Ground Accelerations (PGA's) for the site, based on a model by Bradley et al, indicate that the site experienced a median PGA of 0.33g during the February 2011 event (greatest shaking at the site) and therefore, the site can be considered 'sufficiently tested' to a Serviceability Limit State (SLS) earthquake event, but not to an Ultimate Limit State (ULS) earthquake. It is noted that the site was not 'sufficiently tested' during any of the other 2010/2011 earthquakes.

Important Notice

This section (Section 3.3) and information where NZGD has been referenced in this document was created from maps and/or data extracted from the Canterbury Geotechnical Database (<https://canterburygeotechnicaldatabase.projectorbit.com>), which were prepared and/or compiled for the Earthquake Commission (EQC) to assist in assessing insurance claims made under the Earthquake Commission Act 1993. The source maps and data were not intended for any other purpose. EQC and its engineers, Tonkin & Taylor, have no liability for any use of the maps and data or for the consequences of any person relying on them in any way. This "Important notice" must be reproduced wherever this information or any derivatives are reproduced.

It is understood that damage to the existing building from the earthquakes was light and limited.

3.4 Seismic Subsoil Classification

Based on the above, a seismic subsoil classification 'Class D –Deep or Soft Soil', as defined in NZS 1170.5 is considered appropriate for the site.

3.5 Flooding

The Christchurch City Council (CCC) has indicated that the site is located within a District Plan Flood Management Area (FMA) and therefore a Finished Floor Level (FFL) of 14.39m RL is required for new building at the site. LiDAR information indicates that the average ground level at the site is 13.82m RL, approximately 0.6m below the required FFL.

4.0 INTRUSIVE WORKS

4.1 Rational

Due to the relatively small footprint of the proposed extension and the lack of earthquake related ground damage at and within vicinity of the site, it was considered that two shallow intrusive holes would be adequate to gain an understanding of the ground conditions and that deep investigation/liquefaction analysis was not necessary.

4.2 Investigation

EDC visited the site on 03 March 2017 to undertake the shallow intrusive investigation to determine the subsoil conditions.

Two exploratory holes comprising a Hand Auger (HA) and Scala Penetrometer (SC) were undertaken at either end of the proposed extension footprint, as indicated below on Figure 2:

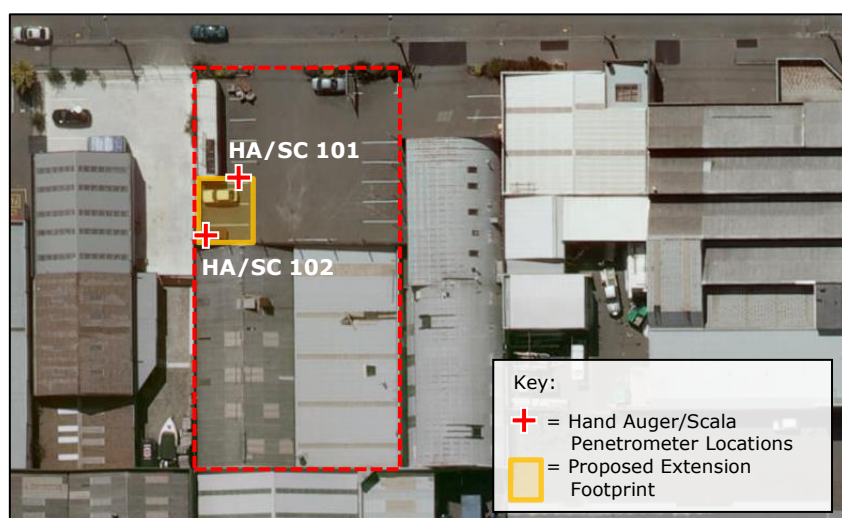


Figure 2: Intrusive Investigation and Extension Locations

Both HA's were drilled to the target depth of 3.2m below existing ground level (begl). SC 101 extended to its target depth of 3.9m begl and SC 102 extended to its target depth of 2.9m begl.

4.3 Ground Summary

Table 1 below is a summary of the ground profile encountered during EDC's HA's:

General Range (begl)	Depth	Ground Description	Density/ Consistency	Water Content
Surface to 0.025m		Asphalt	-	-
0.025m to 0.40m/0.50m		FILL - Fine to coarse sandy gravel with occasional cobbles (hardfill)	Medium dense	-
0.4m to 0.65m/0.75m		FILL - Dark grey organic silt with occasional ash and fine sand	Soft to firm	Moist to wet

General Range (begl)	Depth	Ground Description	Density/ Consistency	Water Content
0.65m to 2.50m		Light grey mottled orange clayey SILT	Firm to stiff	Moist to wet. Saturated from 1.8m/1.9m
2.50m to at least 3.20m		Bluish grey fine to medium sandy SILT	Firm	Saturated

Table 1: Summary of Ground Profile

Groundwater was encountered at 1.8m begl in HA 101, rising to 1.6m begl after one hour. Groundwater was encountered at 1.9m begl in HA 102.

A 150mm diameter plastic pipe was encountered at 0.9m depth in HA 102. Additionally, the natural soil below 1.0m at the location of HA 102 had a greenish colour and produced a slight hydrocarbon smell. It was not clear if the two changes in the soil are related.

A copy of the exploratory hole logs are attached in Appendix C.

4.4 Geotechnical Ultimate Bearing Capacity

The Scala Penetrometer results have been assessed for the approved bearing strata using a correlation between Scala blowcount and allowable bearing capacity by Stockwell, 1977. Using this correlation, the Scala Penetrometer results indicate that the Geotechnical Ultimate Bearing Capacities (UBC) shown in Table 2 can be assumed:

Soil Type	UBC (kPa)
Fill	150
Natural Silt (upper 3.0m)	300

Table 2: Available UBC

A copy of the Geotechnical UBC graph is attached in Appendix D.

5.0 CONCLUSIONS & RECOMMENDATIONS

No historical activities have been identified that are likely to present geotechnical constraints for the proposed extension.

It is understood that damage to the existing building from the earthquakes was light and limited.

A geotechnical report for the adjacent land to the north indicates estimated '*Free-Field*' index ground settlements of between 60mm and 90mm under 'worst case' SLS earthquake conditions and 90mm to 115mm under ULS earthquake conditions.

The risk of lateral spreading as a result of liquefaction is considered low and the risk of lateral stretch is considered to within the MBIE minor to moderate category (less than 200mm).

Notwithstanding the above, estimated Peak Ground Accelerations (PGA's) for the site, indicate that during the February 2011 event (greatest shaking at the site) the site was considered 'sufficiently tested' to a Serviceability Limit State (SLS) earthquake event. Following this event no liquefaction ejecta was evident on-site or on surrounding areas.

The liquefaction analysis for the adjacent site indicates that little settlement is anticipated in an SLS or ULS event in the upper 4.5m despite a groundwater of 0.5m being used in the analysis. Based on this and the lack of significant earthquake damage from the Canterbury Earthquake Sequence it is considered that shallow foundation types are suitable for the proposed lightweight building extension.

The GNS 'Depths to Water Table' maps indicate that the mean depth of groundwater is generally 0.0m – 2.0m bgl in the area of the site. The EDC HA's indicated groundwater to be at approximately 1.6m depth.

EDC's HA's encountered a consistent soil profile comprising: 25mm asphalt, hardfill to approximately 0.45m depth, fill comprising dark grey organic silt to approximately 0.7m depth, firm to stiff silt to at least 3.2m depth.

The Scala Penetrometer results indicate the following Geotechnical Ultimate Bearing Capacities (UBC) can be assumed:

Soil Type	UBC (kPa)
Fill	150
Natural Silt (upper 3.0m)	300

The Christchurch City Council (CCC) has indicated that the site is located within a District Plan Flood Management Area (FMA) and therefore a Finished Floor Level (FFL) of 14.39m RL is required for new building at the site. LiDAR information indicates that the average ground level at the site is 13.82m RL, approximately 0.6m below the required FFL.

6.0 RECOMMENDATIONS

Based on the CCC floor level requirements to mitigate flood risk it is recommended that an assessment of the design implications for the extension is undertaken by the architect and structural engineer for the project.

It is understood that the preferred foundation for the proposed extension is a slab on grade. This is considered a suitable foundation type. The proposed extension is understood to be light weight (distributed load of less than 15kPa). The fill encountered on the site is hardfill to 0.5m over 0.25m thick organic silt fill. Settlement of the topsoil is considered unlikely to be significant (<10mm) if the foundation loads were above the organic fill. In view of this it is considered that the slab foundation can be founded above the organic fill, on the basis that the assumed distributed load of <15kPa is correct. A UBC of 150kPa should be assumed for design. A 300mm thick layer of compacted AP65 should be placed beneath the concrete slab. A layer of geotextile (Bidim A19 or equal) should be placed on the base and sides of the excavation. A layer of geogrid (Cirtex Duragrid 30/30 or equal) should be placed over the geotextile.

The foundation should be designed by a Chartered Professional Engineer.

The gravel hardfill should extend laterally a distance beyond the building footprint that is equal to the depth of gravel. Over excavation will not be possible along the southern and western sides of the excavation due to the site boundary and the existing building. As such, a Chartered Structural Engineer should design the new section of slab to suitably tie into the existing slab and cantilever along the western side.

It is recommended that services (particularly drainage) are not located below the new foundation. All services in the area of the new foundation should therefore be identified (such as the pipe identified at HA 102) and re-aligned (if required) as part of the final design.

It is not likely that dewatering of the excavation will be required.

Advice from a suitably qualified Geotechnical Engineer should be sought if ground conditions different to those encountered in the intrusive investigation are observed during foundation construction works.

Any filling work should be undertaken in accordance with NZS 4431:1989 Code of Practice for Earthfill for Residential Development and MBIE Module 5A: Specification of ground improvement for residential properties in the Canterbury region (MBIE & NZGS, 2015). Validation testing of the compacted gravel should be undertaken and signed off by a suitably experienced Geotechnical Engineer.

PREPARED BY:



Blair Griffiths

Dip Civil Eng GIPENZ
Geotechnical/Geoenvironmental Technician

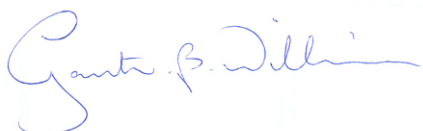
CHECKED BY:



Giles Learman

BSc (Hons) CGeol FGS
Geotechnical Team Leader - Canterbury

AUTHORISED BY:



Gareth B Williams

MSc(Eng) CPEng MIPENZ IntPE(NZ) MInstD MEIANZ
Snr Geotechnical Engineer, Director

LIMITATIONS

Except where required by law, the findings presented as part of this report are for the sole use of our client, as noted above. The findings are not intended for use by other parties, and may not contain sufficient information for the purposes of other parties or other uses. No third party (excluding the local authority) may use or rely upon this report unless authorised by EDC in writing.

To the extent permitted by law, EDC expressly disclaims and excludes liability for any loss, damage, cost or expense suffered by any third party relating to or resulting from the use of, or reliance upon any information contained in this letter. It is the responsibility of third parties to independently make enquiries or seek advice in relation to their particular requirements.

Our professional services are performed using a degree of care and skill normally exercised, under similar circumstances, by reputable consultants practicing in this field at this time. No other warranty, expressed or implied, is made as to the professional advice presented in this report, in regard to its accuracy or completeness. Our opinions and recommendations are based on our comprehension of the current regulatory standards and must not be considered legal opinions. For legal advice, please consult your solicitor. This opinion is not intended to be advice that is covered by the Financial Advisors Act 2010.

The recommendations and opinions contained in this letter are based on our visual reconnaissance of the site, information from geological maps and upon data from the field investigation as well as the results of in situ testing of soil. Inferences are made about the nature and continuity of subsoils away from and beyond the exploratory holes which cannot be guaranteed. The descriptions detailed on the exploratory hole logs are based on the field descriptions of the soils encountered.

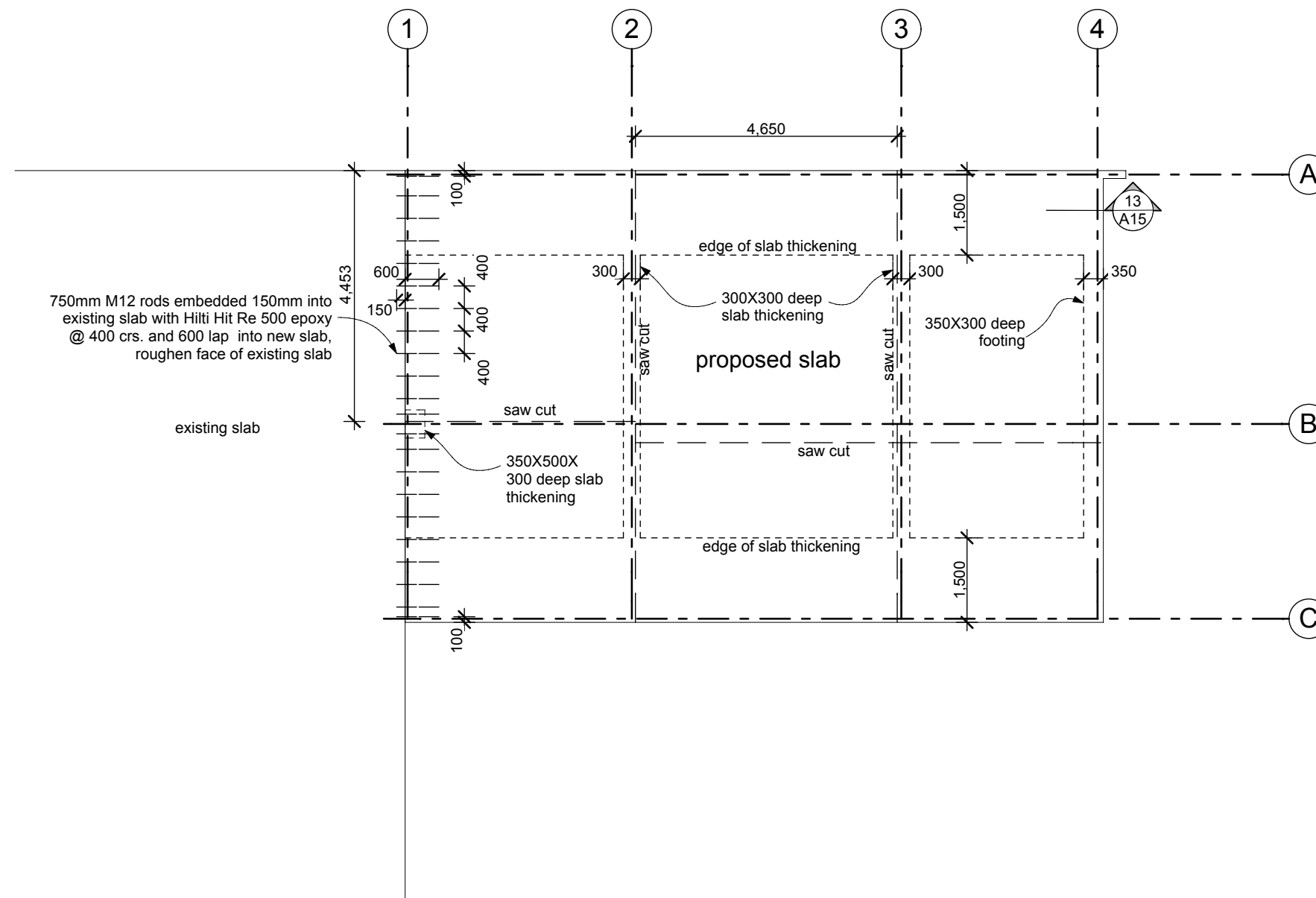
Appendices:

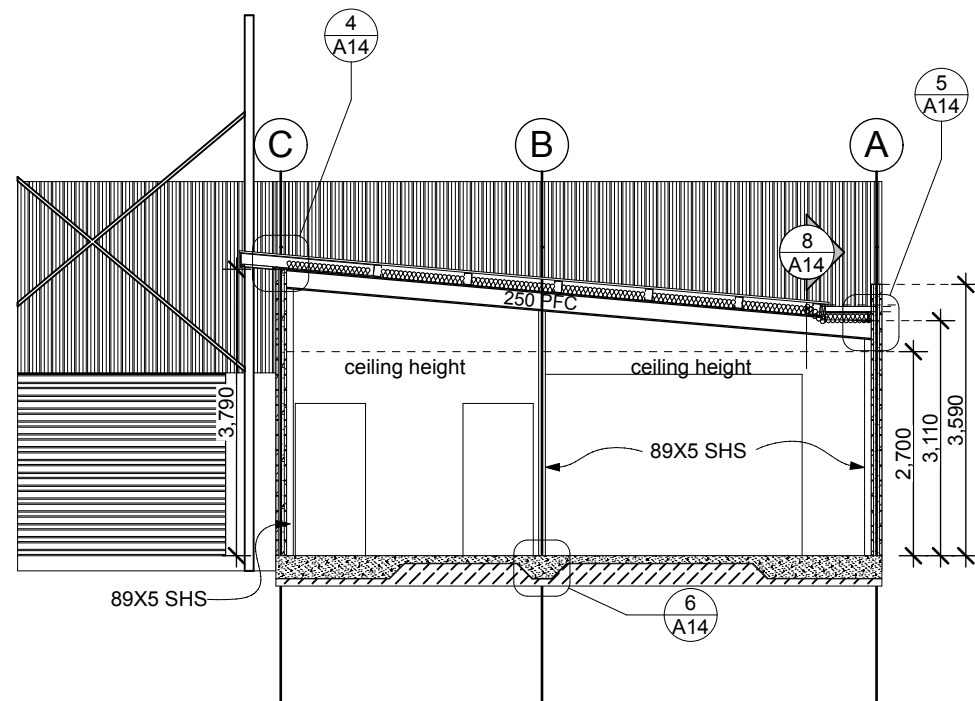
- Appendix A – Proposed Extension Drawing Set by Architectural Design Group (ADG) Ltd (Ref: 5996)
- Appendix B – Environment Canterbury Listed Land Use Register
- Appendix C – Exploratory Hole Logs
- Appendix D – Geotechnical Ultimate Bearing Capacity Graph

Appendices should be read in conjunction with letter and this letter should not be considered complete without them.

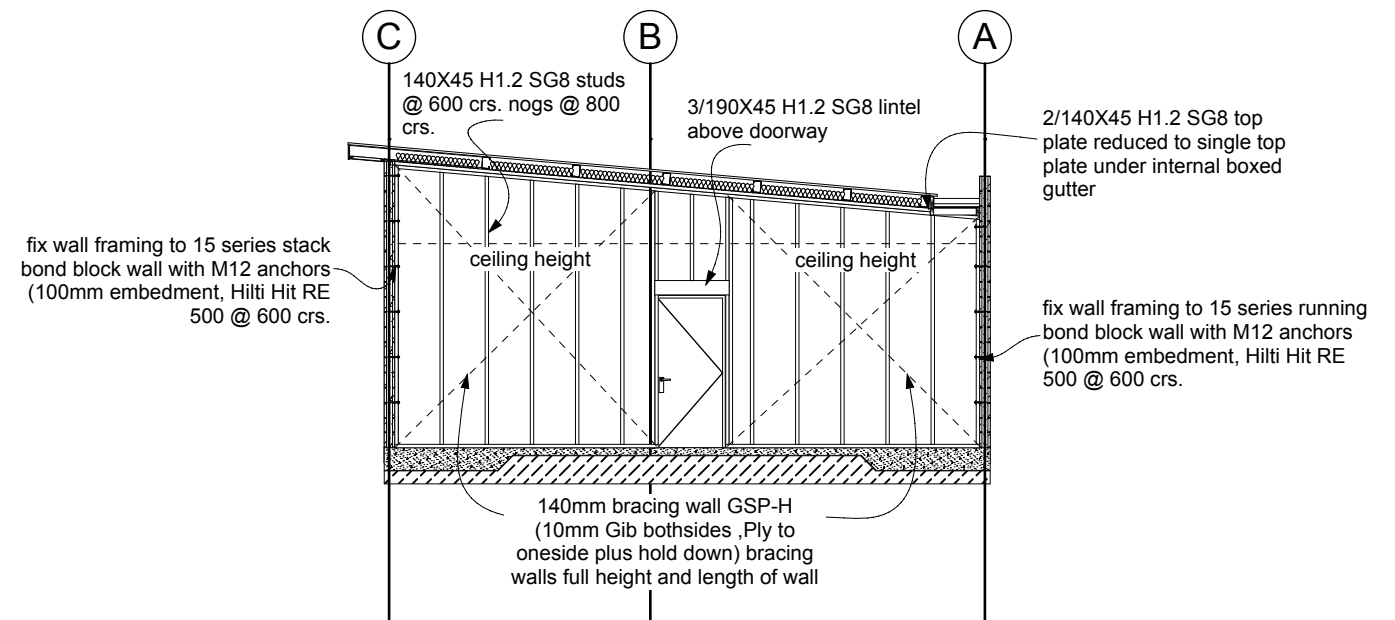
APPENDIX A

Proposed Extension Drawing Set by Architectural Design Group (ADG) Ltd (Ref: 5996)

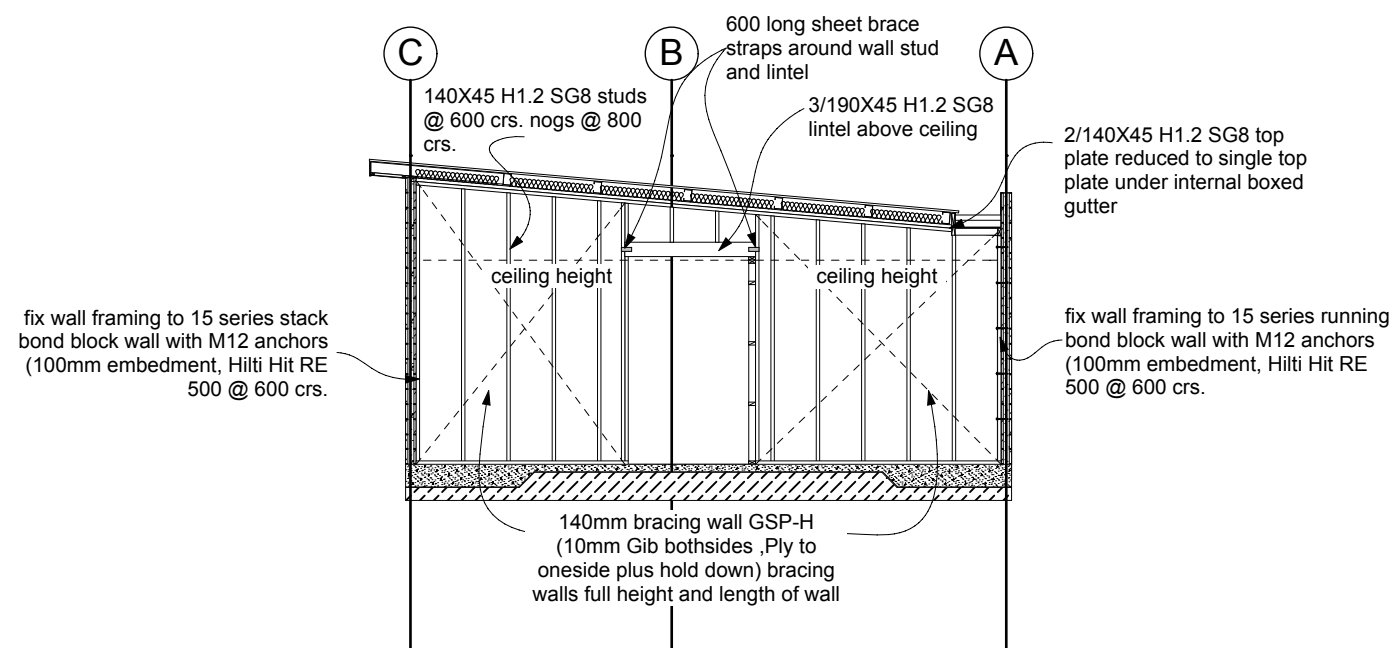




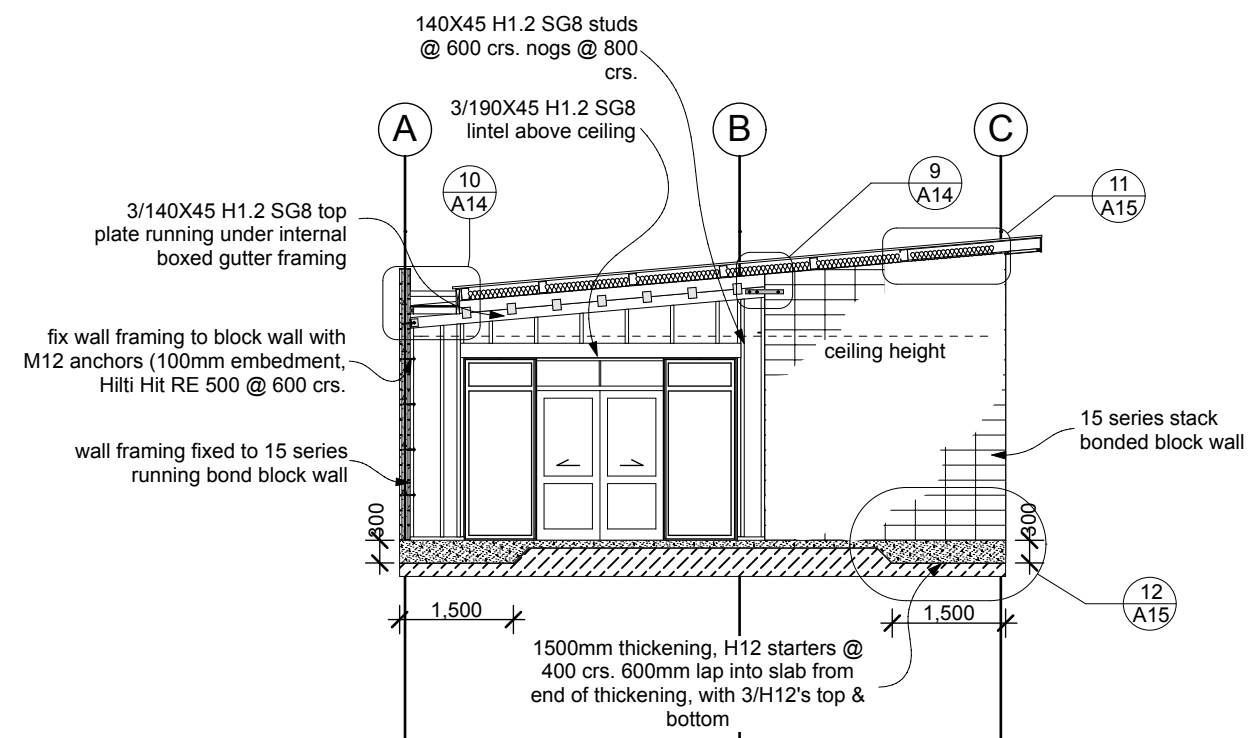
Gridline 1 Cross Section



Gridline 2 Cross Section



Gridline 3 Cross Section

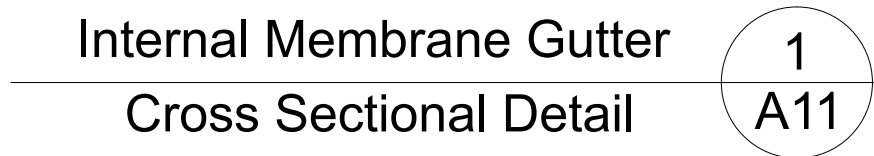


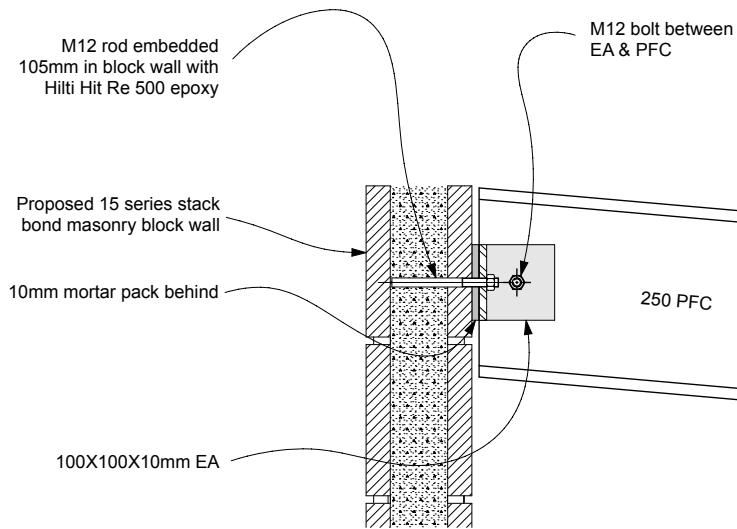
Gridline 4 Cross Section

NOTE:
15 series block walls on grids A & C

- H12's @ 400 crs. verticals
- D16's @ 200 crs. horizontal in 3 courses by roof connection.
- H12's @ 400 crs. horizontal rest of wall.

wall framing to NZS 3604:2011

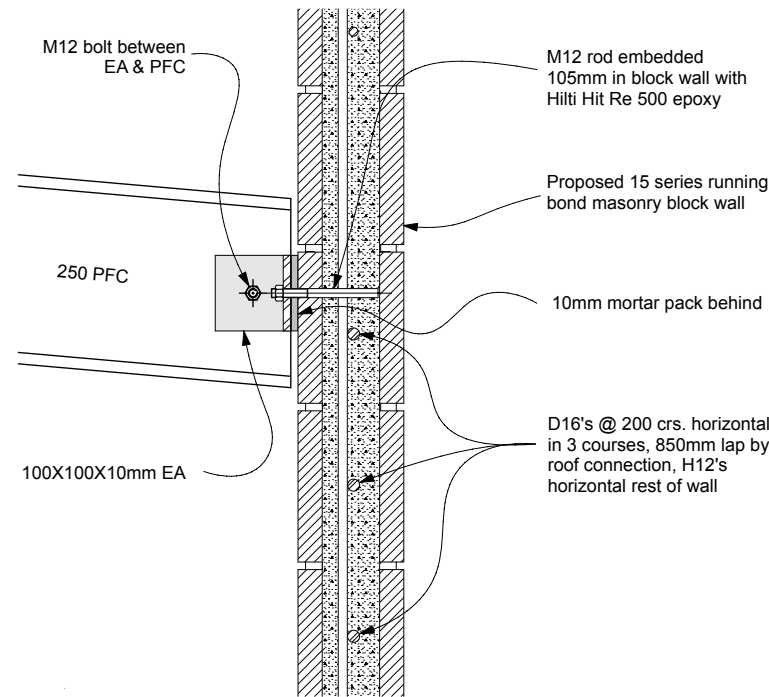




Grids 1 & C PFC To Block Connection

Cross Sectional Detail

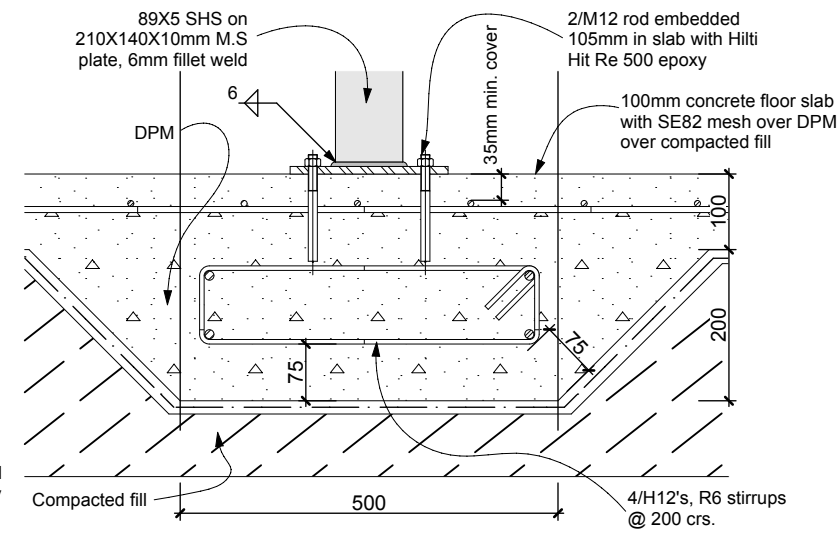
4
A12



Grids 1 & A PFC To Block Connection

Cross Sectional Detail

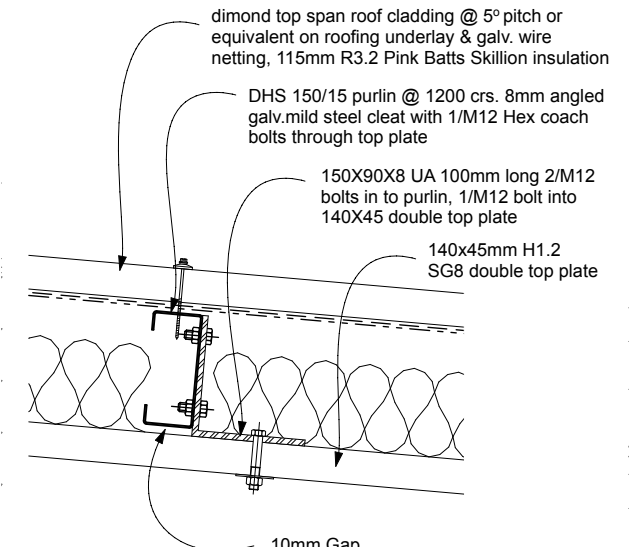
5
A12



Grids 1 & B Slab Thickening

Cross Sectional Detail

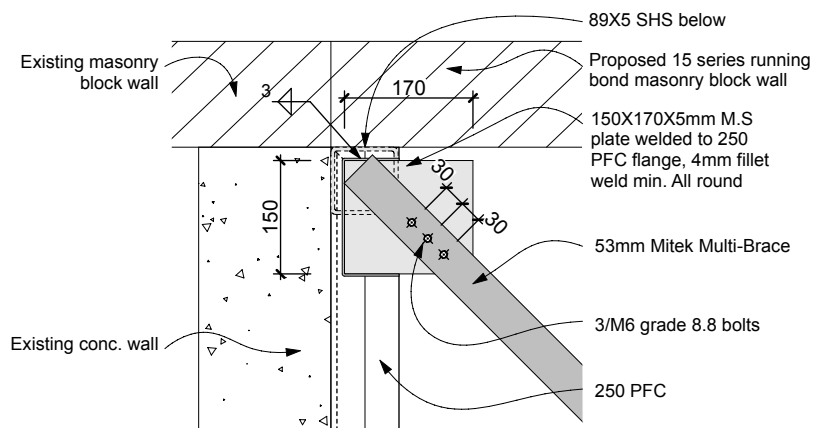
6
A12



Typical Purlin Cleat

Cross Sectional Detail

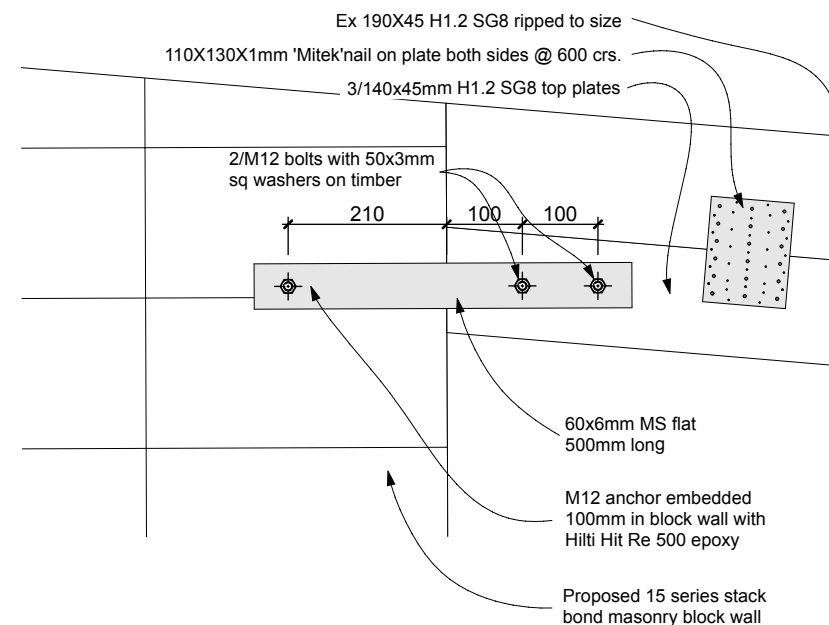
3
A11



Grids 1 Roof Brace To PFC Connection

Plan Detail

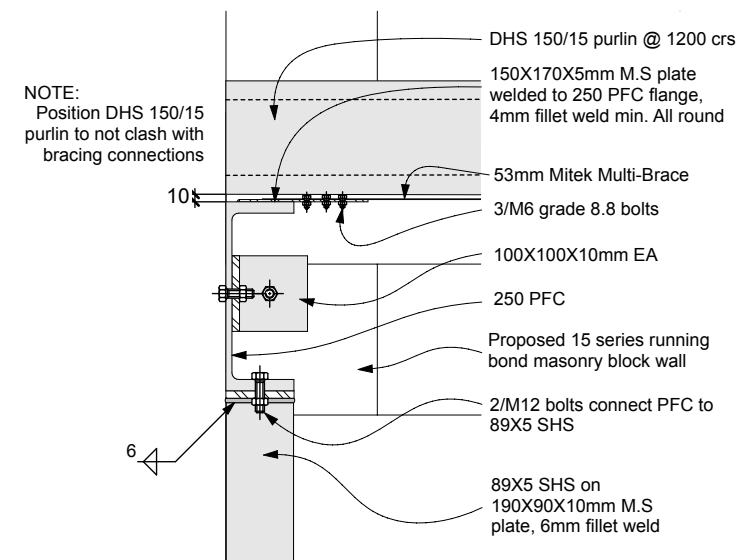
7
A17



Grids 4 Wall Tie Connection

Section Detail

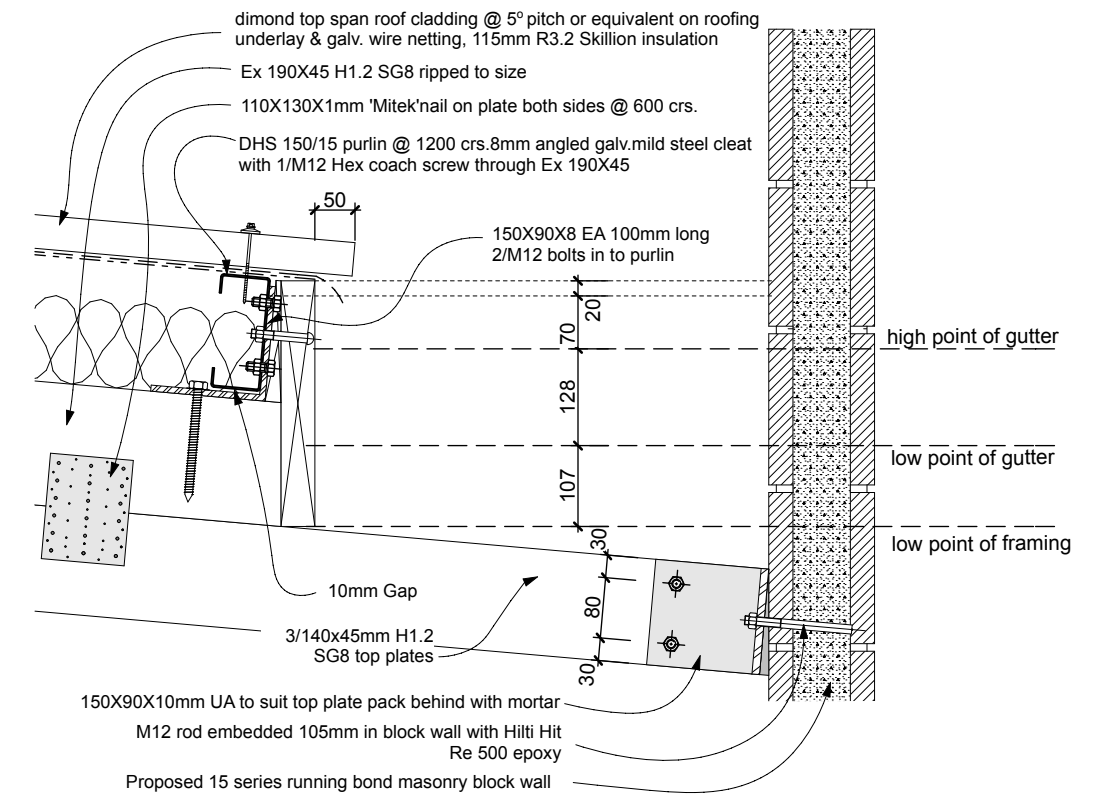
9
A12



Grids 1 Roof Brace To PFC Connection

Section Detail

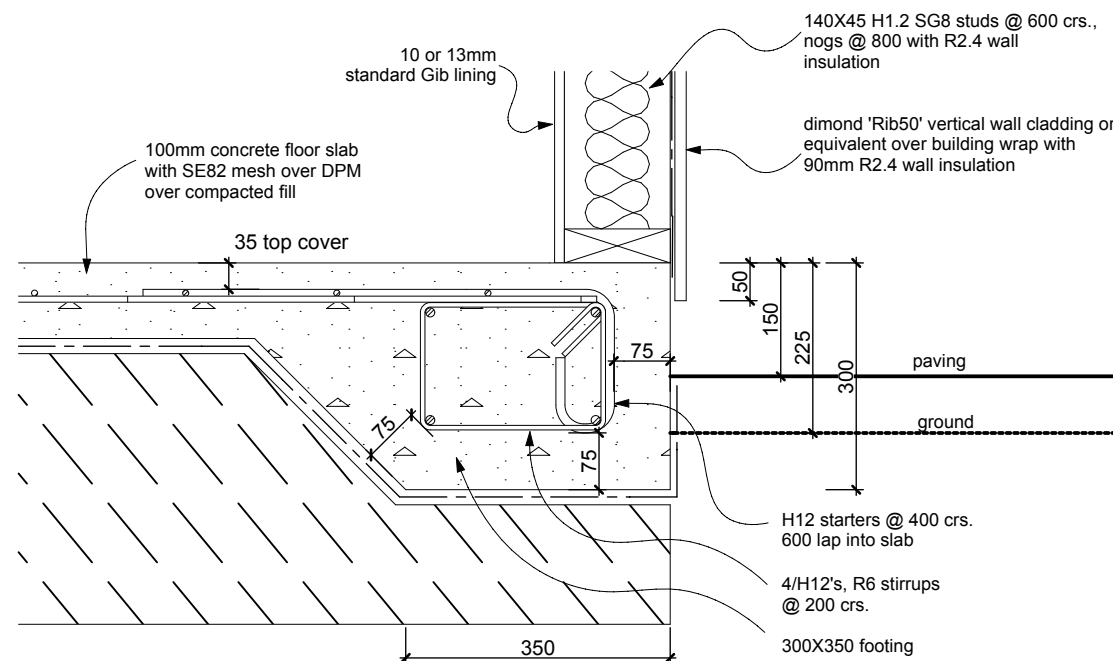
8
A12



Grids 4 Wall Tie Connection

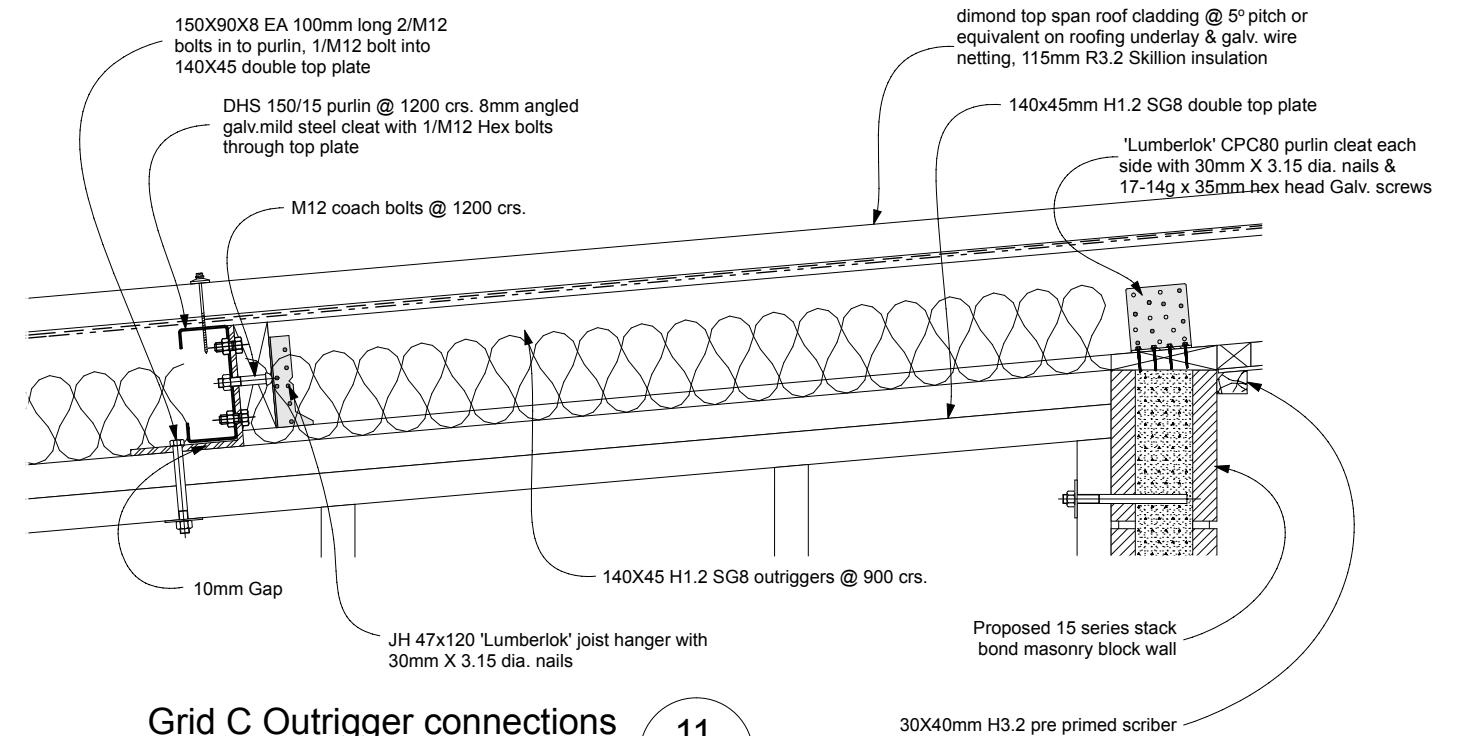
Section Detail

10
A12



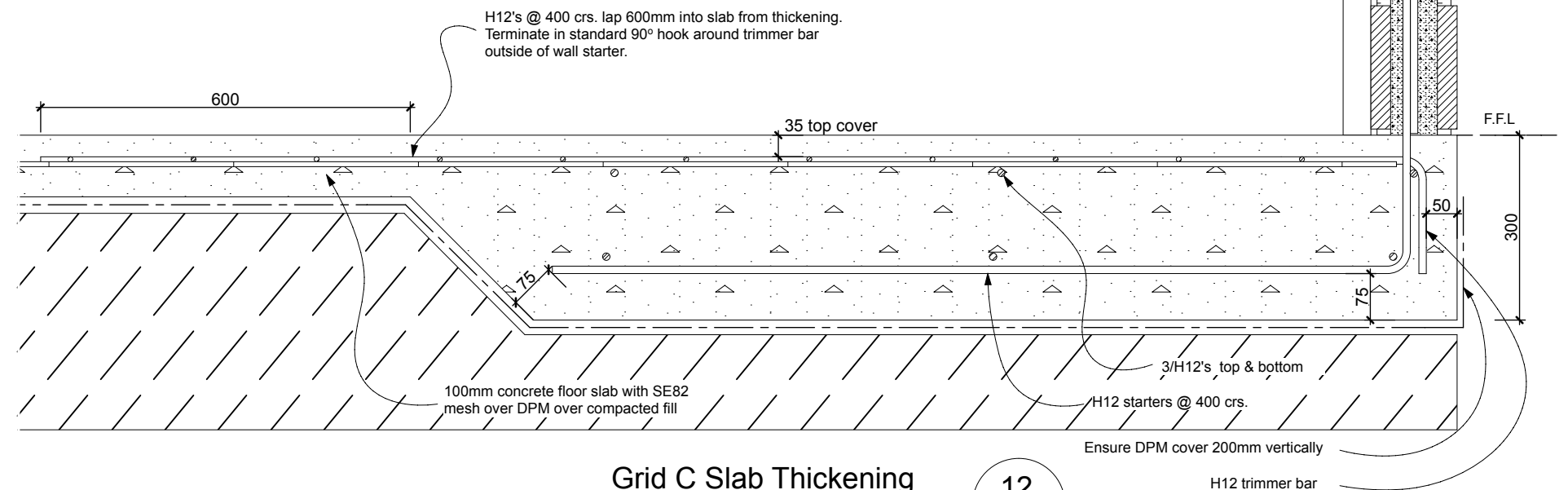
Grid 4 Slab Foundation
Section Detail

13
A9



Grid C Outrigger connections
Section Detail

11
A12



Grid C Slab Thickening
Section Detail

12
A12



Architectural Design Group
A DIVISION OF
WALKER COMMERCIAL SERVICES LTD

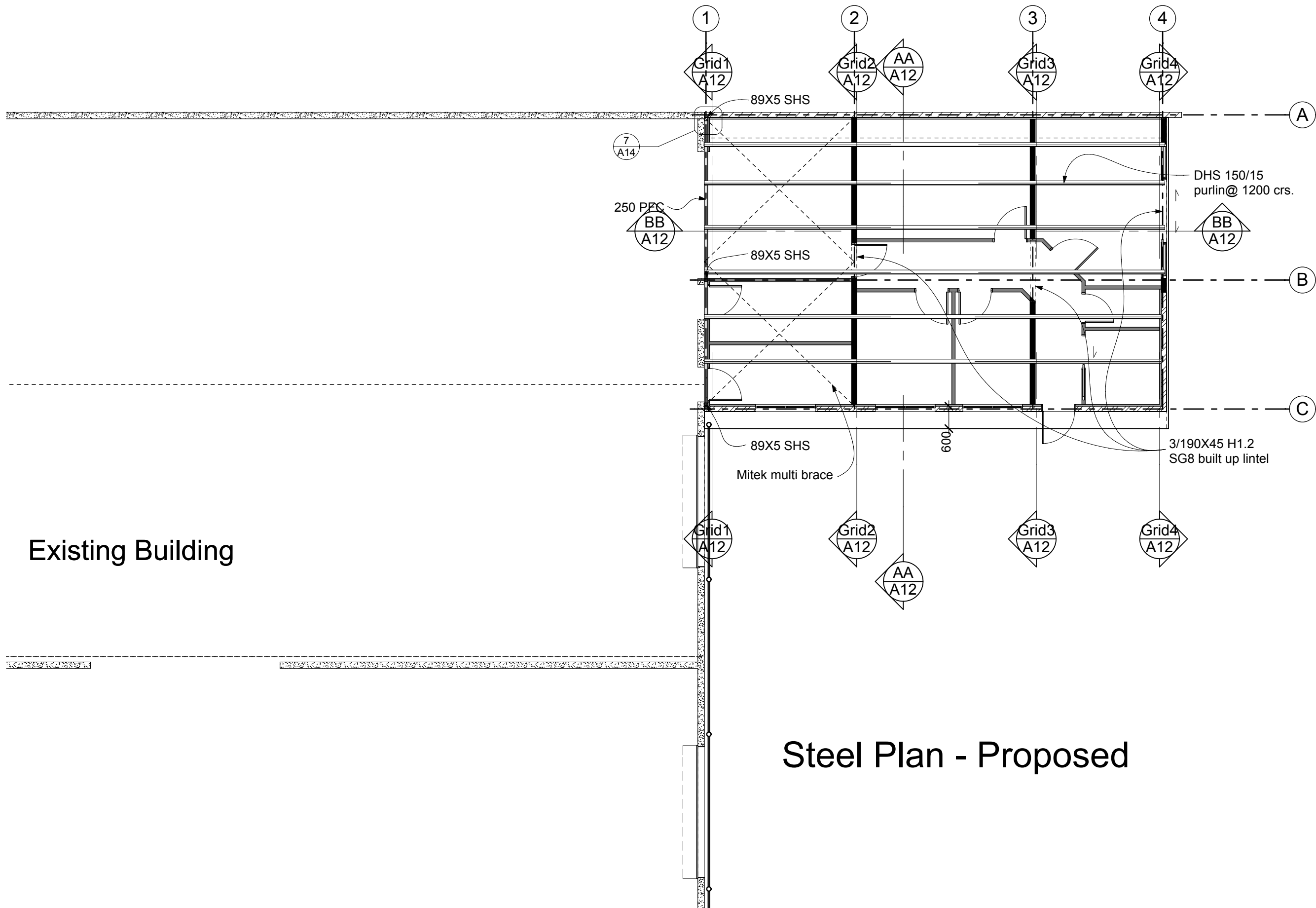
ADG

t/f 07 578 2899
e adg_architecture@xtra.co.nz
p PO Box 70131 Fraser Cove
Tauranga 3155
office 31 Fifteen Ave, Tauranga

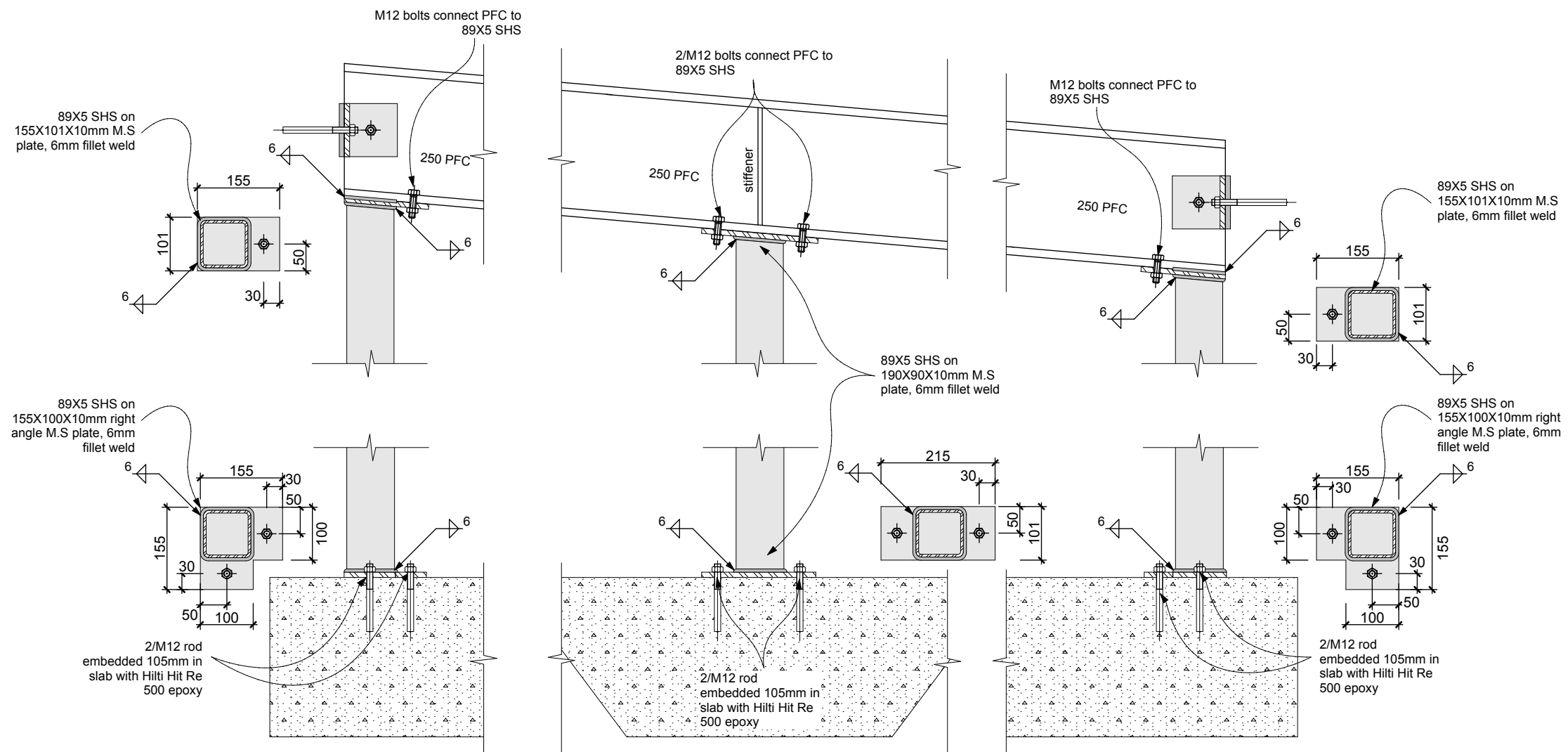
Proposed Additions
80 Byron Street
Christchurch
For Clip & Climb

Drawing: Architectural Details
Scale at A3: 1:10
Date: January 2017
Job no: 5996
Copyright:
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Issue: 1
Sheet no.
A15
of sheets



Steel Plan - Proposed



Gridline 1 Steel Details



Architectural Design Group
A DIVISION OF
WALKER COMMERCIAL SERVICES LTD

ADG

t/f 07 578 2899
e adg_architecture@xtra.co.nz
p PO Box 70131 Fraser Cove
Tauranga 3155
office 31 Fifteen Ave, Tauranga

Proposed Additions
80 Byron Street
Christchurch
For Clip & Climb

Drawing: Grid 1 Steel Details
Scale at A3: 1:10
Date: January 2017
Job no: 5996

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Issue: 1
Sheet no.

A18

of sheets

APPENDIX B

Environment Canterbury Listed Land Use Register



ENGCO
Consulting Engineers

**GEOTECHNICAL REPORT FOR PROPOSED COMMERCIAL BUILDING
83 BYRON ST, SYDENHAM, CHRISTCHURCH**



Project Reference No: I6363

Prepared for: Spaghetti Junction Ltd

Date: 11/11/2016

Project Summary				
Report Title		Geotechnical Report		
ENGCO Project No		16363		
Client		Spaghetti Junction Ltd		
Rev	Date	Details	Prepared by	Approver
0	25/11/2016	Draft for review	Ragulan Kanapathippillai	
1	30.01.2017	For Consent	Ragulan Kanapathippillai	AL

Approval			
Action	Name	Title	Signature
Prepared by	Ragulan Kanapathippillai	Geotechnical Engineer	
Reviewed by	Dave Brierley	Technical Director CPEng No 225268	
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I INTRODUCTION

The Engineering Company Limited (ENGCO) was requested by Spaghetti Junction Ltd, to undertake a geotechnical assessment for the proposed warehouse building with offices at 83 Byron Street, Sydenham, Christchurch. Refer to Figure I for a plan of the proposed development area. This report evaluates the surface and subsurface conditions of the site and provides preliminary geotechnical recommendations for the proposed building foundations, with reference to Ministry of Business, Innovation and Employment (MBIE) Guidance, and building codes, as appropriate.

Our scope of works included the following:

- Desktop study of relevant, publicly available geotechnical and geological publications;
- Organizing deep geotechnical investigation, comprising Piezocone Penetration Tests (CPTu), Dynamic Cone Penetrometers (DCP) and Hand Augers (HA);
- An assessment of liquefaction potential for the site;
- Preparation of this report, outlining our findings on the ground conditions and including geotechnical advice on foundation conditions and ground remediation if necessary;
- Preliminary foundation recommendations for the proposed warehouse building;

2 SITE DETAILS

2.1 Site description

The site 83 Byron Street, Sydenham is located approximately 1.5k southeast of Christchurch city centre. The vacant site is surrounded by commercial buildings. At the time of our investigation, the site was cleared, the contour was generally flat and the site was occupied by a number of containers.

2.2 MBIE land zoning

The site is classified as a non-residential site and the current liquefaction severity land classification for this site, according to Canterbury Earthquake Recovery Authority (CERA) maps, is “N/A-Urban Non-Residential”. A plan of the site location is provided in Figure 2.

2.3 Regional Geology and Seismicity

The geological map of the area indicates that the site has surface geology consisting of “*Dominantly alluvial sand and silt overbank deposits*”.

2.4 Flood hazard

Ground levels have changed across Christchurch as a result of the Canterbury earthquake sequence. Minimum floor elevation requirements for any rebuild at the site should be confirmed with the Christchurch City

Council to inform the design and construction processes. At the time of writing this report, there was no publically available information regarding the final floor level for the commercial building development proposed.

2.5 Hazardous Activities and Industries List

The ECAN contaminated land registry indicates that the site contained an underground storage tank which was removed in 2011. It should be noted that contaminated land assessment is outside the scope of this report.

2.6 Liquefaction and Lateral Spreading

2.6.1 Observed performance

A site walkover was performed by ENGCO on 31st October 2016. During the inspection, there was no evidence of any earthquake-induced land deformation remaining onsite. A summary of our desktop assessment and site walkover is provided below;

The “EQC Liquefaction Interpreted from Aerial Photography” map layers indicate that the property is located within an area where moderate to severe liquefaction was observed, following the June 2011 earthquake, and minor liquefaction was observed following the December 2011 earthquake. No liquefaction was observed following the September 2010 or February 2011 Earthquake.

The “EQC Liquefaction and Lateral Spreading Observations” map indicates no ground cracking or ejected liquefied material were reported at the site, following the February 2011 earthquake event. The road observation indicates no ejected liquefied material observed, after the June 2011 earthquake.

The “EQC Observed Ground Crack Locations” map indicates there were no ground cracks observed near the site, following the February 2011 earthquake.

3 FIELDWORK SUMMARY

3.1 Site Investigation

On behalf of ENGCO, Land Test Ltd carried out two Piezocone Penetration Tests (CPTu), four Dynamic Cone Penetrometer Tests (DCPs) and two Hand Augur Tests (HAs) on 31st October 2016. In addition, another CPT test was carried out on 15th November 2016. These deep investigations were carried out under the supervision of ENGCO's Engineer. The results of both deep and shallow investigations are summarized in Table 1.

Table 1: Location and Depth of Investigations

Test No	Investigations Type	Depth (m)
1	Piezocone Penetration Tests (CPTu 1)	15m bgl
2	Piezocone Penetration Tests (CPTu 2)	15m bgl
3	Dynamic Cone Penetrometer (DCP1 & HA1)	2.0m bgl
4	Dynamic Cone Penetrometer (DCP2 & HA2)	2.0m bgl
5	Dynamic Cone Penetrometer (DCP3)	2.0m bgl
6	Dynamic Cone Penetrometer (DCP4)	2.0m bgl

The locations of the DCP, HA and CPTu tests are shown on Figure 3, and the results are attached in Appendix 2.

3.2 Shallow Ground Condition

The shallow ground conditions encountered during the investigation have been interpreted from the HAs and DCPs. The subsurface conditions encountered are considered to be generally consistent with published geological information.

The inferred shallow ground condition from specific Hand Augers (HA) are provided in Table 2.

Table 2: Inferred soil profile from Test Pits

HA1	HA2	Summary of Soil Type
0 to 0.3m bgl	0 to 0.3m bgl	Sandy GRAVEL (FILL)
0.3 to 2.0m bgl	0.3 to 2.0m bgl	Clayey SILT

3.3 Groundwater Regime

Groundwater was not encountered during the shallow investigation at this site, in October 2016. The GNS ground water elevation model indicates that the water table may vary between 0.0m and 1.0m bgl at this site. It should be noted that the ground water level may vary, seasonally.

For liquefaction analysis purposes, an in-situ groundwater depth of 2.0m bgl and a design groundwater level of 0.5m bgl were adopted.

3.4 Site subsoil class

In accordance with NZS1170.5, Section 3.1.3, site subsoil classification “*Class D – Deep or soft soil sites*” may be assumed for this site.

3.6 Deep Ground Condition

Based on the existing geotechnical information, the site-specific geotechnical investigation undertaken by ENGCO and the review of published information, the following ground model for the site has been inferred, as outlined in Table 3.

Table 3: Inferred geological model

Soil Layer	Depth range(m bgl)	Soil Description
Layer 1	0.0 to 6.0	Clay & silty clay
Layer 2	0.6 to 16.5	Sand & silty sand
Layer 3	16.5 to 24.5	Clay & silty clay, Silty sand & sandy silt
Layer 4	24.5 to 24.7	Silty sand & sandy silt, Gravel

4 EARTHQUAKE- INDUCED GROUND DEFORMATION

4.1 Predicted vertical deformation

Assessment of earthquake-induced ground deformation at the site has been carried out in accordance with MBIE Guidance, using proprietary liquefaction assessment software. The derivation of the procedures has been based on a conservative approach to give estimates of deformation that may be experienced in the earthquake scenarios at a free-field site, i.e. one with no building present, and not subject to lateral spreading. The results of this analysis are summarized in Table 4.

Table 4: Estimated Total "Free-Field "Ground Surface Settlement from CPT and BH results

Earthquake Scenario	Moment Magnitude (Mw)	Peak Ground Acceleration(PGA,(m/s ²))	Settlement to tested depth (mm)	MBIE "Index Value"(settlement in Upper 10m) (mm)
SLS1	7.5	0.13	65 - 90	55 - 80
SLS2	6.0	0.19	75 - 100	60 - 90
ULS	7.5	0.35	155 - 165	90 - 115

The liquefaction assessment results are provided in Appendix 2.

The analysis results indicates that a non-liquefiable soil layer is located between 3.0m bgl and 7.0m bgl, under ULS conditions.

4.2 Assessed lateral deformation

Following the procedure outlined in Section 12.2 of the MBIE Guidance, an assessment of the global lateral movement of the site and lateral stretch across the site has been undertaken and the results are outlined in Table 5.

Table 5: Assessed lateral deformation at the site

Assessed global lateral movement category of the site	Minor to moderate (less than 300mm)
Assessed lateral stretch category of the site	Minor to moderate (less than 200mm)

Based on the Canterbury Geotechnical database (CGD) horizontal ground movement data, the site is categorized as being subject to minor to moderate global lateral movement. Site observations and subsequent analyses show that the site has been 'sufficiently tested at SLS' to a significant degree, and that a minor global lateral movement category is appropriate for this site.

We consider the risk of lateral spreading, as a result of liquefaction at this site, to be low, as there are no major cracks due to earthquake events (based on desktop studies). We consider that the risk of lateral stretch is in the minor to moderate category as there were no significant ground cracks identified at the site.

5 FOUNDATION RECOMMENDATION FOR THE DEVELOPMENT

5.1 Design considerations

At the time of preparation of this report, the anticipated foundation loads from the proposed structures were not known to ENGCO, but have been assumed to be based on a single level, heavyweight warehouse building. Due to the liquefaction risk at this site, conventional shallow foundations are not recommended.

A specifically designed, piled foundations is a viable solution for the proposed building. The piles would need to be founded at a depth of 12.5m bgl. It should be noted that pile driving operations can cause vibration to adjacent buildings and suitable pile installation methods should be considered for the pile driving, including the potential use of screw piles. The piled foundation solution would require minimal excavation, as the structural loads would be transferred through the piles. It should be noted that the soil layer between 12m and 16m bgl has sufficient bearing capacity (>15MPa) and thickness, to resist superstructure loads, under SLS earthquake conditions.

The design of the building structure and foundations must be carried out to ensure that, as a minimum, SLS and ULS Building Code performance requirement are fulfilled (e.g. low probability of causing loss of amenity through undue deformation, for SLS events, and low probability of rupturing, becoming unstable, losing equilibrium or collapsing, for ULS events).

6. Construction Observation

6.1 Pavement Areas

It is generally advisable that any un-engineered fill or unsuitable material be removed from under any pavement areas, prior to construction, and replaced with compacted granular fill. However, based upon our assessment, the density of existing soils may be adequate for the support of access ways.

6.2 Underground Services

Flexible connections should be constructed where all service drains and ducts enter/exit the concrete floor slabs. Service trench backfill within 1.5m of the buildings is to comprise well graded crushed stone aggregate (i.e. CAP 20), compacted from the surface only.

6.3 Storm water

Concentrated storm water flows from all impermeable areas must be collected and carried in sealed pipes to the Council system. Uncontrolled storm water flows must not be allowed to run onto or saturate the ground so as to adversely affect foundation performance, both statically and during future seismic activity (liquefaction potential and liquefaction induced settlement are both increased with a higher groundwater table, resulting from uncontrolled disposal of storm water).

7 Limitations and Restrictions on Building Consents

7.1 Construction of building on land subject to natural hazards

In terms of Section 71 of the Building Act 2004, Christchurch City Council has an obligation to consider the following matters, and to refuse consent unless satisfied that measures have been or will be taken to remedy identified hazards:

- Erosion, including surface and subsurface erosion, associated with water and wind;
- Falling debris, including rockfall that could impact the site from upslope sources;
- Subsidence, which involves the removal of underlying support by natural or artificial means;
- Slippage, which is defined as the downslope transfer of materials by sliding and/or flowage;
- Inundation, including flooding, overland flow, storm surge, tidal effects, and ponding.

Provided adequate stormwater drainage is in place, erosion is not considered an issue at this site.

As the site is situated on the flat, falling debris is not an issue. Due to the moderate to high potential for soils to liquefy at ULS levels of seismic shaking beneath the site, minor to moderate subsidence could occur during an earthquake event. Provided a foundation system per the recommendations of this report (Section 5.0) is constructed, we consider the proposed foundation system will comply with MBIE industrial building guidance performance criteria. There are no other potential subsidence and/or settlement processes that could

adversely affect the foundation system. The site is far removed from any free edge or major waterway. In terms of slippage, lateral movement is considered to be consistent with the minor category during a ULS seismic event. ENGCO is satisfied that there are no geotechnical issues pertaining to Section 71 of the Building Act 2004 that cannot be addressed by appropriate foundation design and drainage on the site.

8 REFERENCES

- 1) Ministry of Business, Innovation and Employment (MBIE) 2012. Repairing and rebuilding houses affected by the Canterbury earthquakes. Ministry of Business, Innovation and Employment. Available from: <http://www.building.govt.nz/guidance-on-repairs-after-earthquake>.
- 2) Ministry of Business, Innovation and Employment (MBIE) 2014. Clarifications and updates to the Guidance 'Repairing and rebuilding houses affected by the Canterbury earthquakes'. Issue 7.
- 3) Forsyth, P.J.; Barrell, D.J.A; Jongens, R. 2008: Sheet 16 - Geology of the Christchurch Area 1:250,000. Institute of Geological and Nuclear Sciences, Lower Hutt.
- 4) <http://llur.ecan.govt.nz>
- 5) Canterbury Geotechnical Database. EQC Liquefaction Interpreted from Aerial Photography. Map layer CGD0200 – 11 Feb 2013
- 6) Canterbury Geotechnical Database. EQC Liquefaction and Lateral Spreading Observations. Map layer CGD0300 – 11 Feb 2013
- 7) Canterbury Geotechnical Database. EQC Observed Ground Crack Locations. Map layer CGD0400 – 23 Jul 2012
- 8) van Ballegooy, S., Wentz, F. J. & Boulanger, R. W. 2015c. Evaluation of a CPT-based liquefaction procedure at regional scale. Soil Dynamics and Earthquake Engineering, Special Issue: Liquefaction in New Zealand and Japan
- 9) Boulanger, R. W. & Idriss, I. M. 2014. CPT and SPT based liquefaction triggering procedures. (Report No. UCD/CGM-14/01). Center for Geotechnical Modelling, Department of Civil and Environmental Engineering, University of California, Davis, CA
- 10) Robertson and Wride, 1998. Evaluating cyclic liquefaction potential using the cone penetration test. Canadian Geotechnical Journal, Vol. 35, pp. 442 – 459
- 11) Zhang, G., Robertson, P. K., & Brachman, R. W. I. (2002). Estimating liquefaction induced ground

settlements from CPT for level ground, Canadian Geotechnical Journal, 39, 1168–80

12) Ministry of Business, Innovation and Employment (MBIE) 2015. Repairing and rebuilding houses affected by the Canterbury earthquakes - Section 15.3 Updated guidance on site ground improvement, Christchurch.

9 LIMITATIONS

9.1 General

This report, prepared by ENGCO, at the request of our Client, is exclusively for our Client's use, is not to be relied upon by any other person, and is strictly limited to the matters herein.

No responsibility or liability to any third party is accepted for any loss or damages whatsoever arising out of the use of or reliance on this report by any third party, outside of our Client. Nor may the report be used for any other property than the one specified.

The report and its contents are not to be quoted or published without ENGCO's consent.

9.2 Geotechnical

The conclusions of the report are based on the interpretation of a limited number of tests at specific locations, and information gathered from nearby sites and other sources. It shall not be relied upon for any other purpose. The reliance by other parties on the information or opinions contained in this report shall, without our prior review and agreement in writing, be at such parties' sole risk. ENGCO will not accept liability for global stability issues on this site where investigation on a single lot could not reasonably assess the global stability issues.

During excavation and construction, the site should be examined by a Geotechnical Engineer to judge whether the exposed subsoils are compatible with the inferred conditions. It is possible that the nature of the exposed subsoils may require further investigation and the modification of the design based on this report. In any event, it is essential that ENGCO is notified if there is any variation in subsoil conditions from those described in the report, as it may affect the design parameters recommended in the report. There is no investigation, which is thorough enough to preclude the presence of materials at the site, which presently, or in the future, may be considered hazardous.

Should you require any further information, please contact the ENGCO office on 03 366 7955



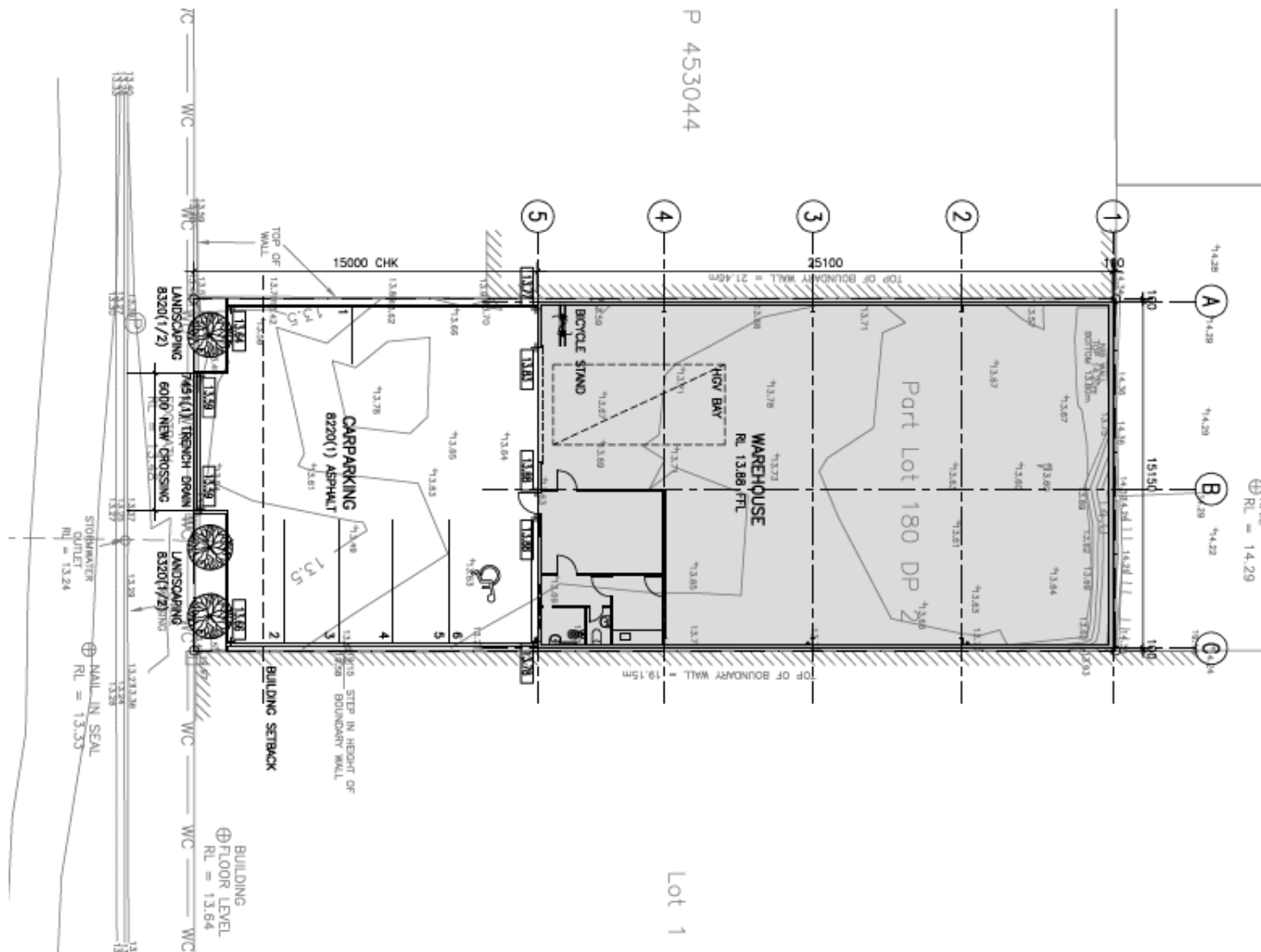
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Appendix I

Figure 1- Site location plan

Figure 2- Site Location plan Showing MBIE Technical Category Map

Figure 3- Field Investigation Location



P 453044

Lot 1

	Figure	I	Date	23/11/2016	Title	Site boundary & Development Area
	Project No	I6363			Reference	N/A

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Foundation Technical Category 1 (TC1):

Future land damage from liquefaction is unlikely, and ground settlements are expected to be within normally accepted tolerances. Standard foundations (NZS 3604) are acceptable subject to shallow geotechnical investigation.

Foundation Technical Category 2 (TC2):

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

Foundation Technical Category 3 (TC3):

Moderate to significant land damage from liquefaction is possible in future large earthquakes. Foundation solutions should be based on site-specific geotechnical investigation and specific engineering foundation design.

Foundation Technical Category map not applicable (N/A):

Normal consenting procedures apply in these areas. This applies to non-residential properties in urban areas, properties in rural areas or beyond the extent of land damage mapping, and properties in the Port Hills and Banks Peninsula.

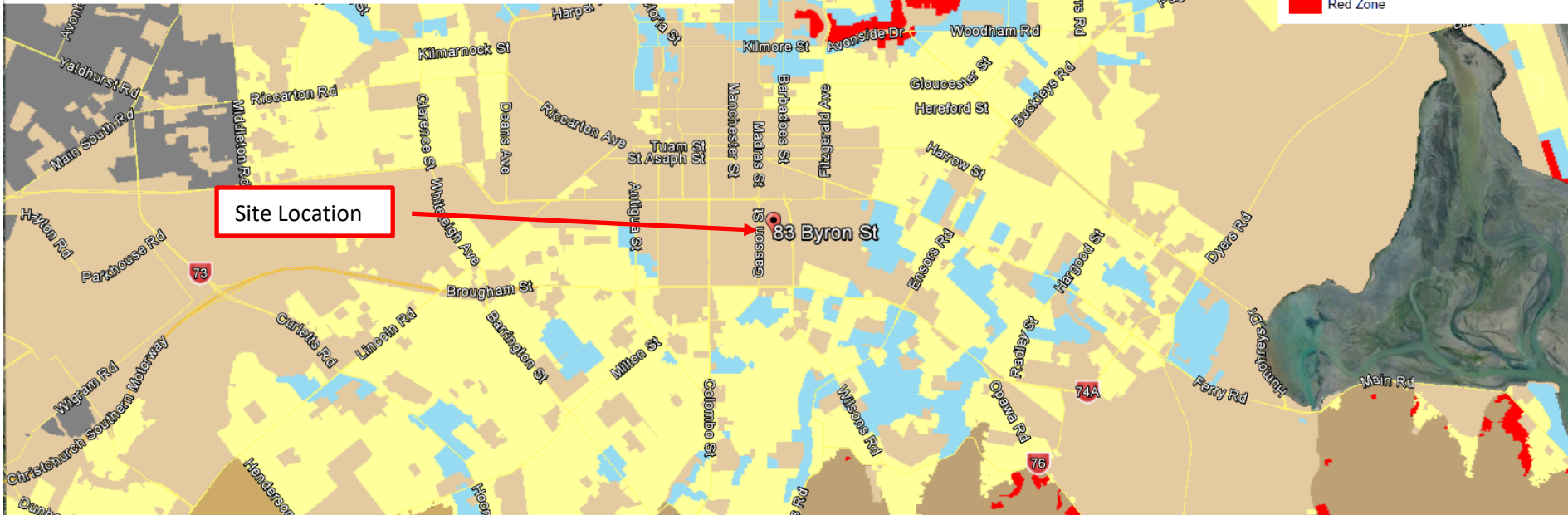


	Figure	2	Date	23/11/2016	Title	Site Location Plan showing MBIE Technical Categories
	Project No	16363			Reference	Canterbury Geotechnical Database.

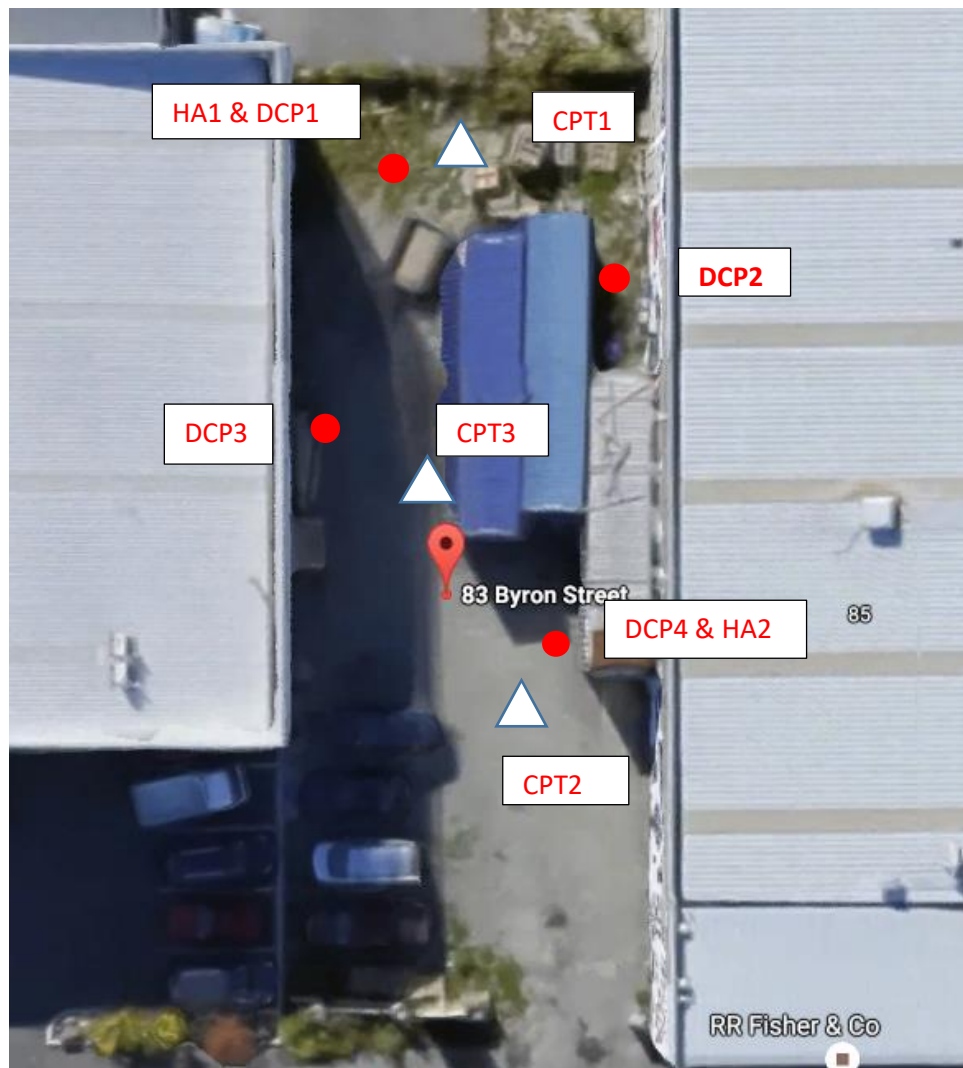


	Figure	3	Date	23/11/2016	Title	Field Investigation Locations
	Project No	16363			Reference	N/A

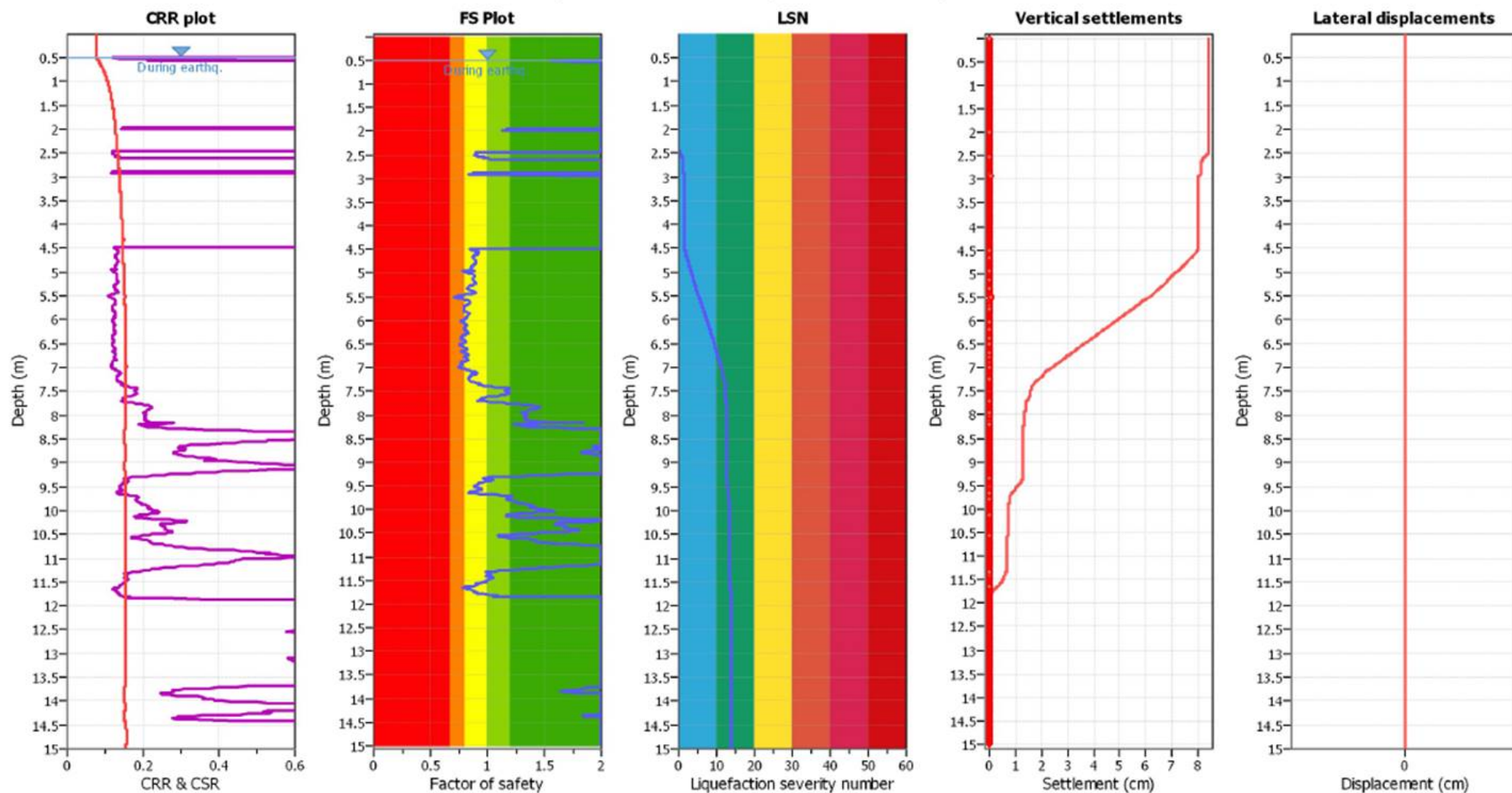


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Appendix 2

Liquefaction Assessment Results

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I_c value	I_c cut-off value:	2.60	K_0 applied:	Yes
Earthquake magnitude M_w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Light Green	Unlike to liquefy
Dark Green	Almost certain it will not liquefy

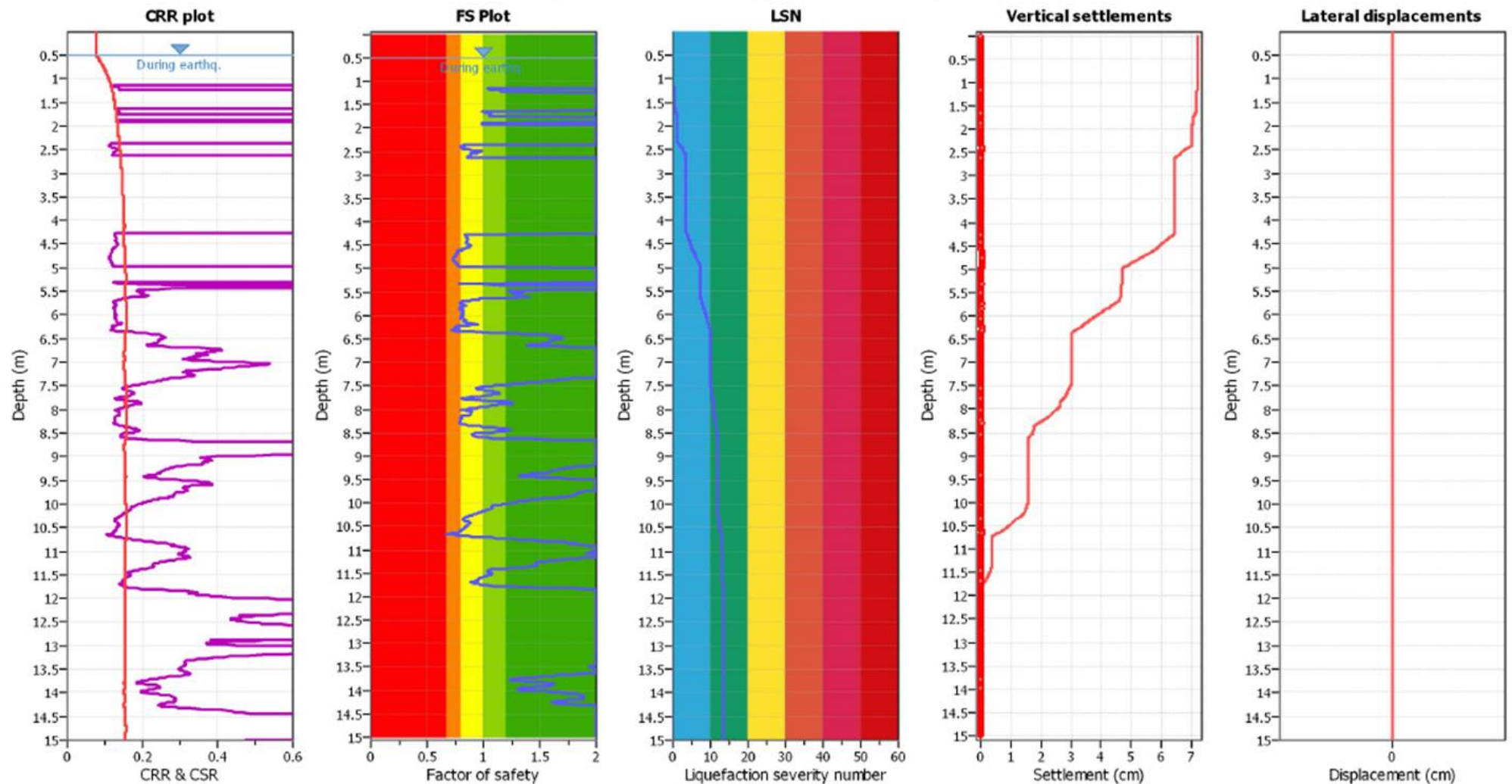
LSN color scheme

Red	Severe damage
Dark Red	Major expression of liquefaction
Orange	Moderate to severe exp. of liquefaction
Yellow	Moderate expression of liquefaction
Light Green	Minor expression of liquefaction
Dark Green	Little to no expression of liquefaction

CLiQ v.1.7.6.49 - CPT Liquefaction Assessment Software - Report created on: 25/11/2016, 12:11:57 p.m.

Project file: C:\Users\Ragulan\Dropbox (Engco)\The Engineering Company Ltd\Jobs 2016\16301-16400\16363 Clip n Climb warehouse\04 - Geotechnical Report\CLiQ with pour water pressure correction.clq

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
 Fines correction method: B&I (2014)
 Points to test: Based on I_c value
 Earthquake magnitude M_w : 7.50
 Peak ground acceleration: 0.13
 Depth to water table (insitu): 2.00 m

Depth to GWT (earthq.): 0.50 m
 Average results interval: 3
 I_c cut-off value: 2.60
 Unit weight calculation: Based on SBT
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect. applied: Yes
 K_0 applied: Yes
 Clay like behavior applied: Sands only
 Limit depth applied: No
 Limit depth: N/A

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Red: Almost certain it will liquefy
 Orange: Very likely to liquefy
 Yellow: Liquefaction and no liq. are equally likely
 Green: Unlike to liquefy
 Dark Green: Almost certain it will not liquefy

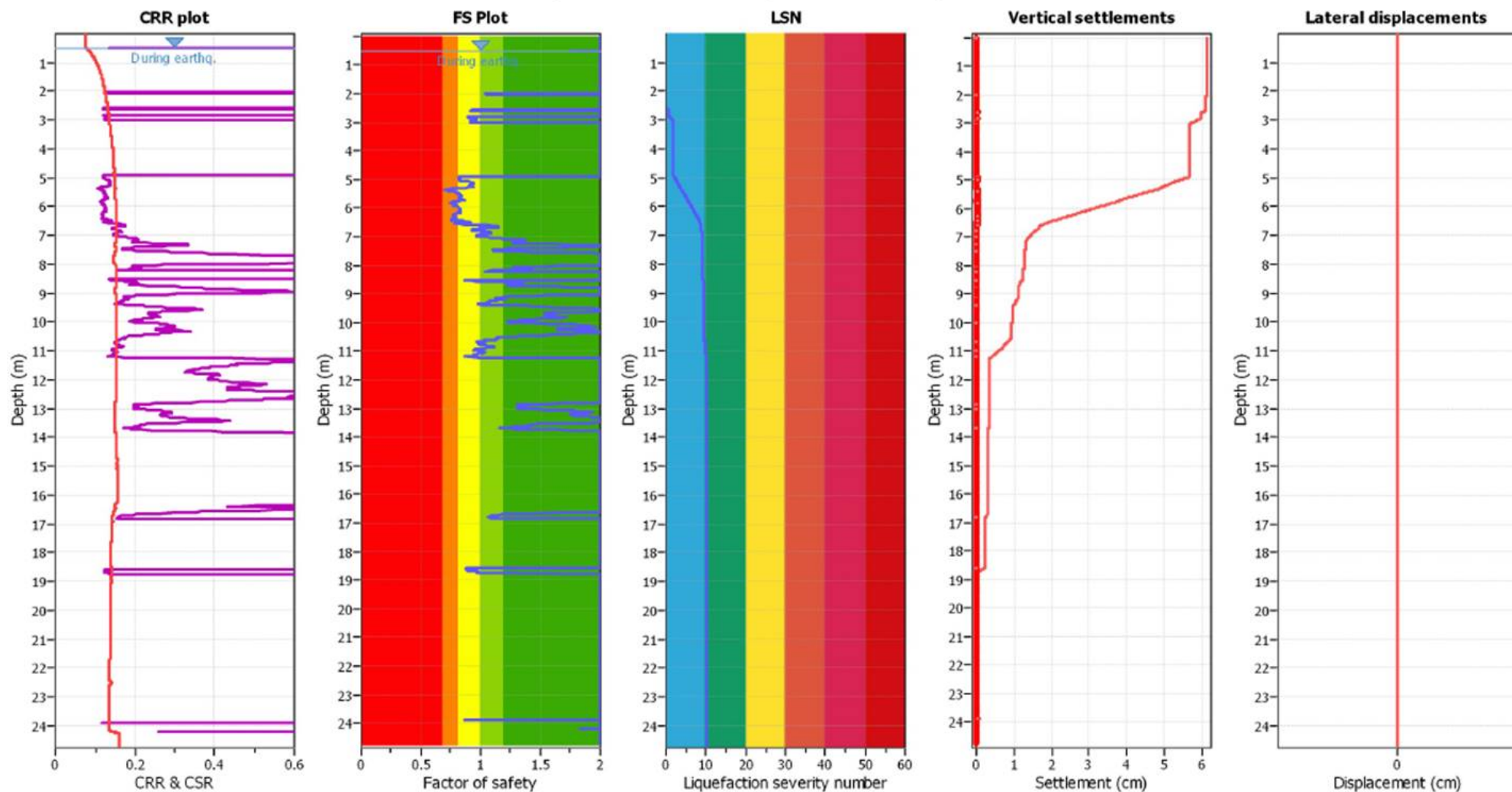
LSN color scheme

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 Dark Red: Major expression of liquefaction
 Orange: Moderate to severe exp. of liquefaction
 Yellow: Moderate expression of liquefaction
 Green: Minor expression of liquefaction
 Blue: Little to no expression of liquefaction

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Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
 Fines correction method: B&I (2014)
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 Earthquake magnitude M_w : 7.50
 Peak ground acceleration: 0.13
 Depth to water table (insitu): 2.00 m

Depth to GWT (earthq.): 0.50 m
 Average results interval: 3
 I_c cut-off value: 2.60
 Unit weight calculation: Based on SBT
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect. applied: Yes
 K_0 applied: Yes
 Clay like behavior applied: Sands only
 Limit depth applied: No
 Limit depth: N/A

F.S. color scheme

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■ Unlike to liquefy
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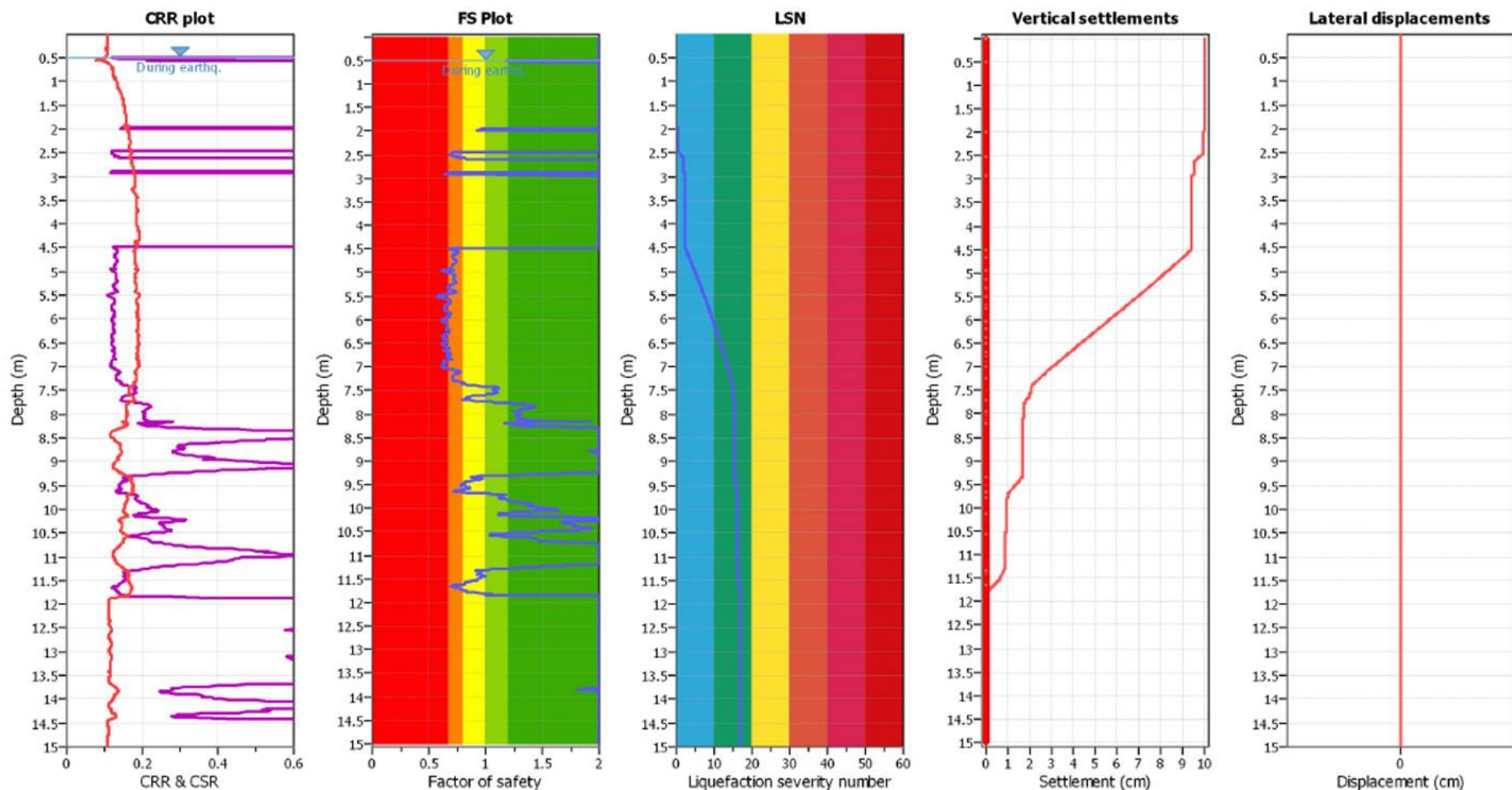
LSN color scheme

■ Severe damage
■ Major expression of liquefaction
■ Moderate to severe exp. of liquefaction
■ Moderate expression of liquefaction
■ Minor expression of liquefaction
■ Little to no expression of liquefaction

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Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
 Fines correction method: B&I (2014)
 Points to test: Based on I_c value
 Earthquake magnitude M_w : 6.00
 Peak ground acceleration: 0.19
 Depth to water table (insitu): 2.00 m

Depth to GWT (earthq.): 0.50 m
 Average results interval: 3
 I_c cut-off value: 2.60
 Unit weight calculation: Based on SBT
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect. applied: Yes
 K_0 applied: Yes
 Clay like behavior applied: Sands only
 Limit depth applied: No
 Limit depth: N/A

F.S. color scheme

■ Almost certain it will liquefy
■ Very likely to liquefy
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■ Almost certain it will not liquefy

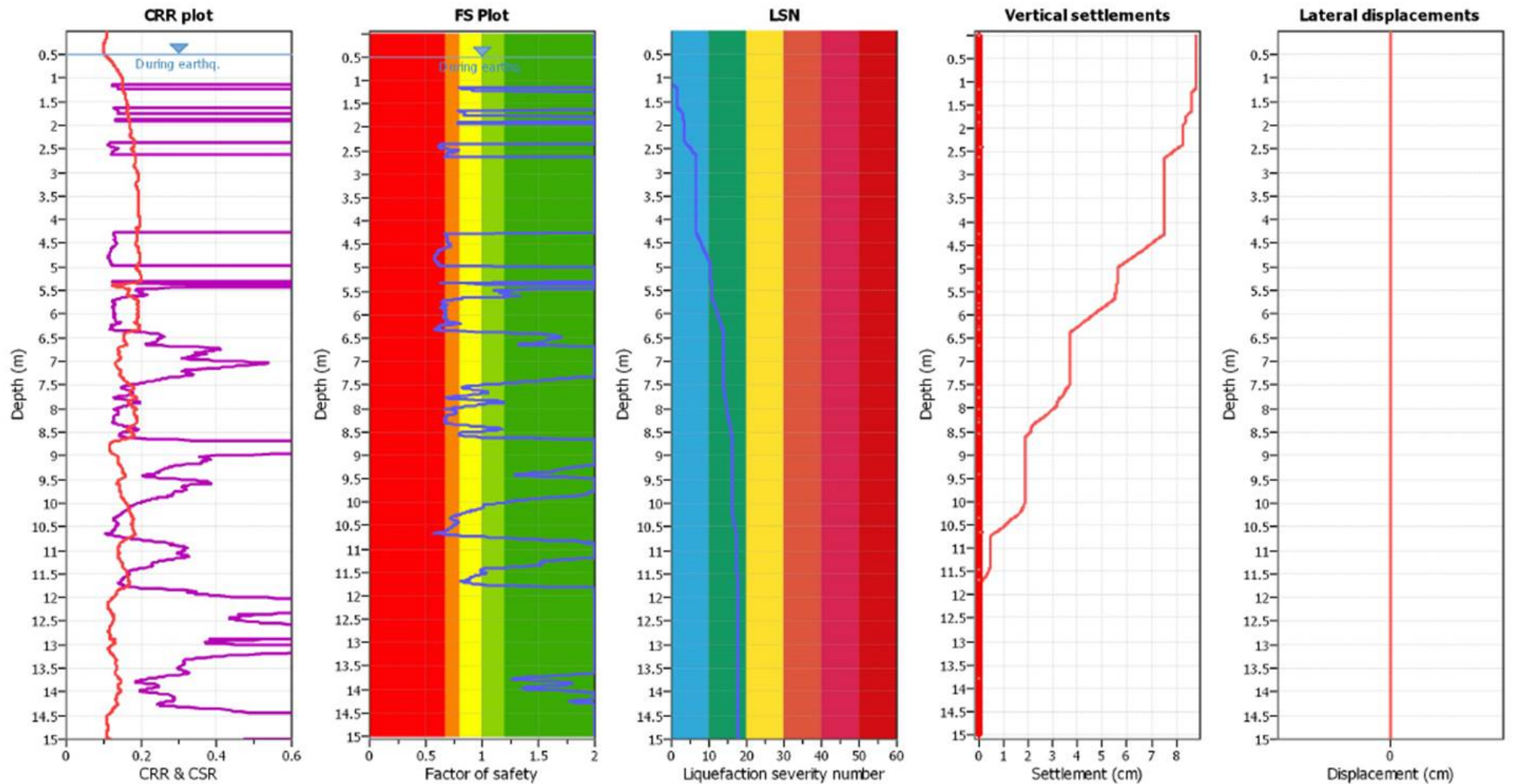
LSN color scheme

■ Severe damage
■ Major expression of liquefaction
■ Moderate to severe exp. of liquefaction
■ Moderate expression of liquefaction
■ Minor expression of liquefaction
■ Little to no expression of liquefaction

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Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
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 Earthquake magnitude M_w : 6.00
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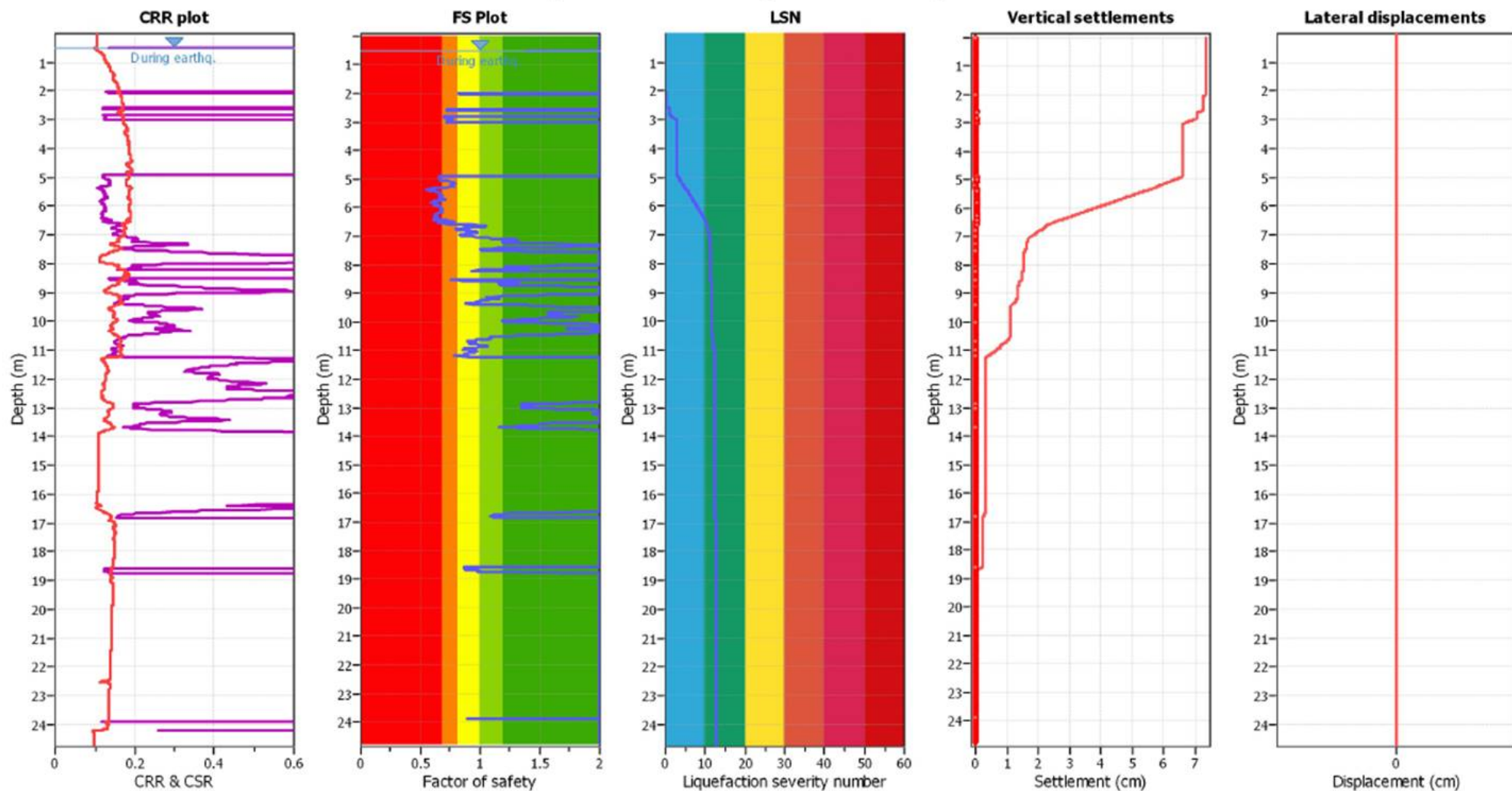
F.S. color scheme

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LSN color scheme

■ Severe damage
■ Major expression of liquefaction
■ Moderate to severe exp. of liquefaction
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Liquefaction analysis overall plots



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Analysis method: B&I (2014)
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 Points to test: Based on I_c value
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 Fill height: N/A

Fill weight: N/A
 Transition detect. applied: Yes
 K_0 applied: Yes
 Clay like behavior applied: Sands only
 Limit depth applied: No
 Limit depth: N/A

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 Unlike to liquefy
 Almost certain it will not liquefy

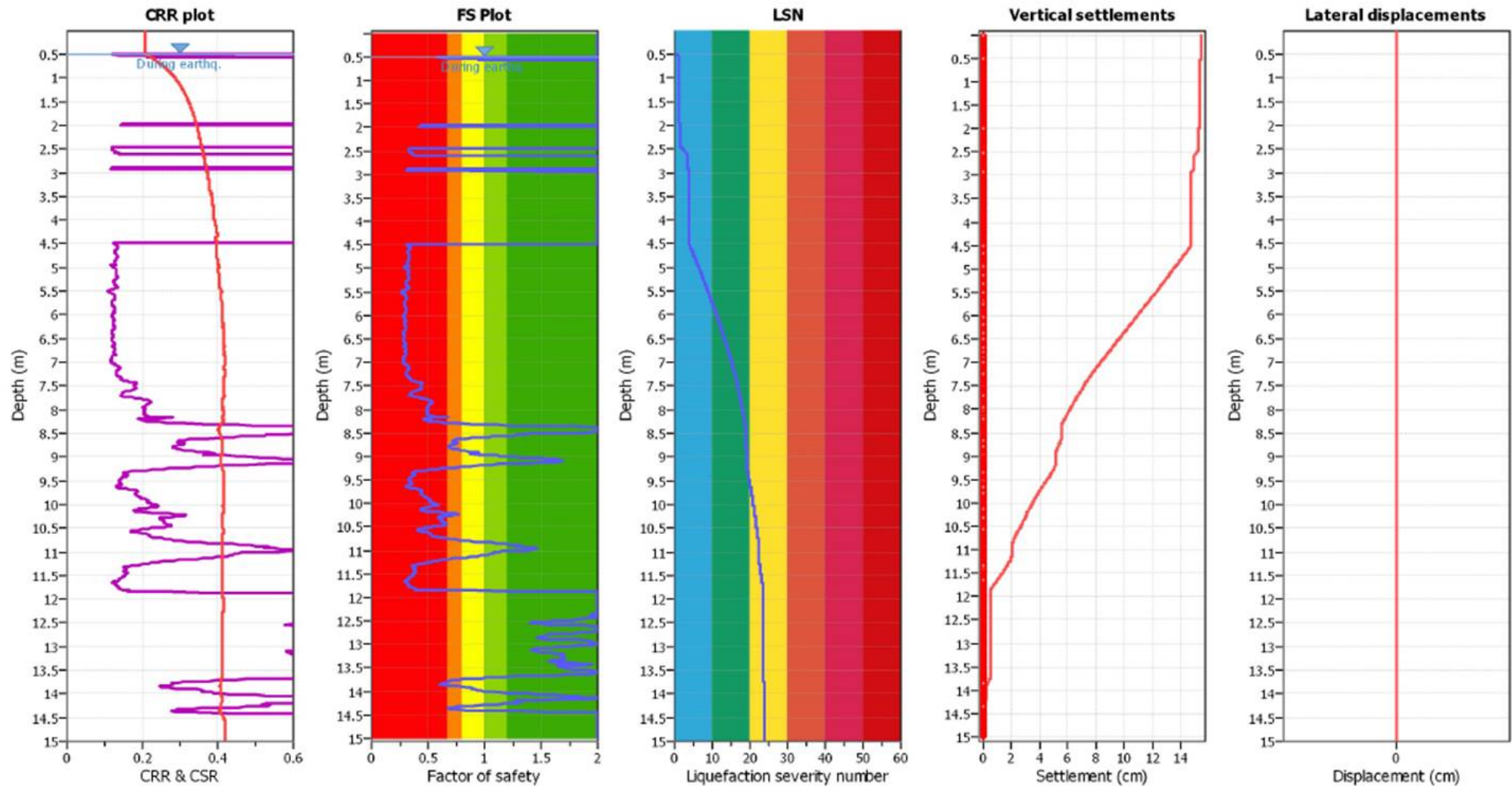
LSN color scheme

Severe damage
 Major expression of liquefaction
 Moderate to severe exp. of liquefaction
 Moderate expression of liquefaction
 Minor expression of liquefaction
 Little to no expression of liquefaction

CLiq v.1.7.6.49 - CPT Liquefaction Assessment Software - Report created on: 25/11/2016, 12:12:04 p.m.

Project file: C:\Users\Ragulan\Dropbox (Engco)\The Engineering Company Ltd\Jobs 2016\16301-16400\16363 Clip n Climb warehouse\04 - Geotechnical Report\CLiq with pour water pressure correction.clg

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _o applied:	Yes
Earthquake magnitude M _w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Green	Unlike to liquefy
Dark Green	Almost certain it will not liquefy

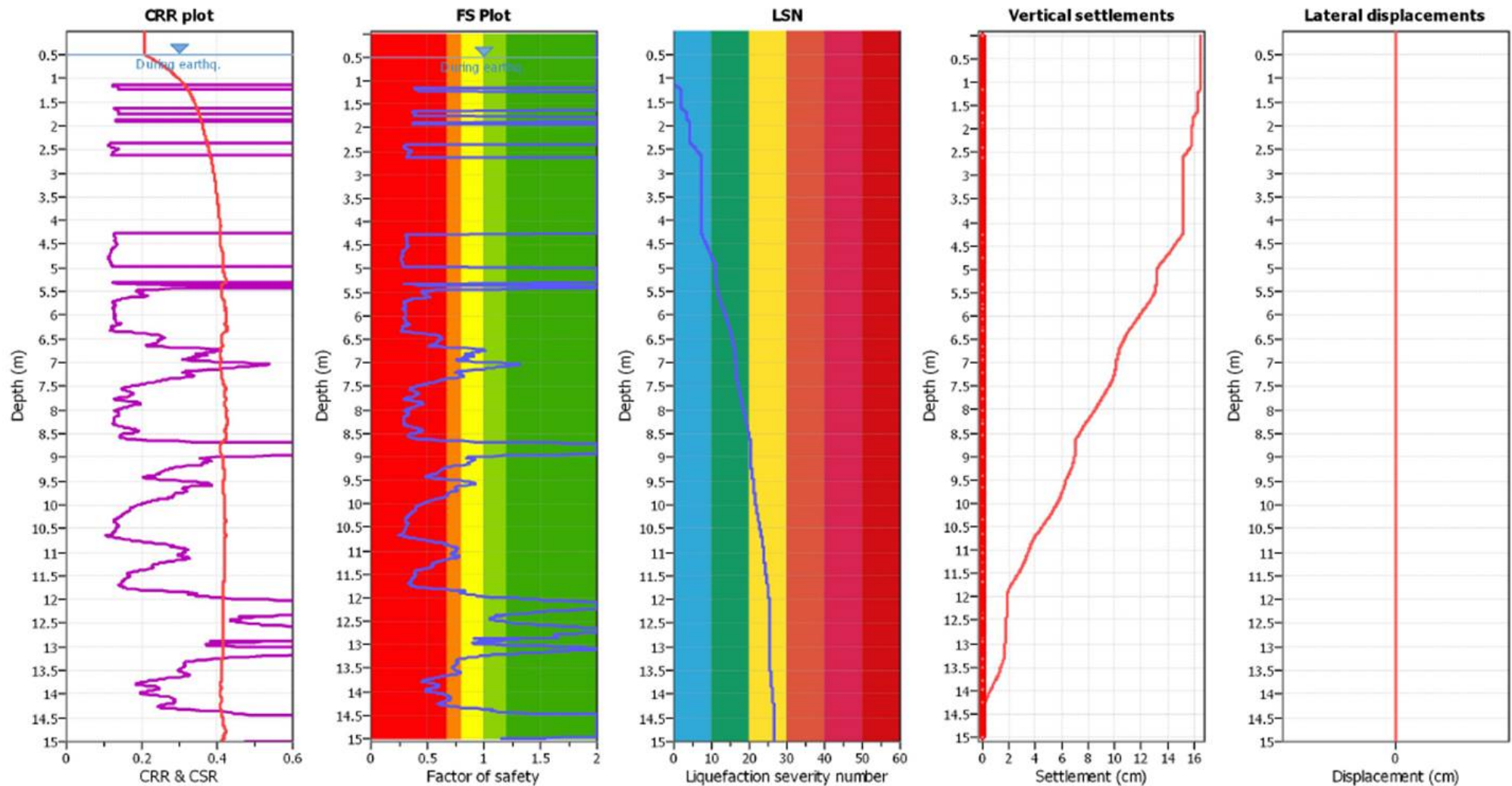
LSN color scheme

Red	Severe damage
Dark Red	Major expression of liquefaction
Orange	Moderate to severe exp. of liquefaction
Yellow	Moderate expression of liquefaction
Green	Minor expression of liquefaction
Blue	Little to no expression of liquefaction

CLiq v.1.7.6.49 - CPT Liquefaction Assessment Software - Report created on: 25/11/2016, 12:12:07 p.m.

Project file: C:\Users\Ragulan\Dropbox (Engco)\The Engineering Company Ltd\Jobs 2016\16301-16400\16363 Clip n Climb warehouse\04 - Geotechnical Report\CLiq with pour water pressure correction.clg

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
 Fines correction method: B&I (2014)
 Points to test: Based on I_c value
 Earthquake magnitude M_w : 7.50
 Peak ground acceleration: 0.35
 Depth to water table (insitu): 2.00 m

Depth to GWT (earthq.): 0.50 m
 Average results interval: 3
 I_c cut-off value: 2.60
 Unit weight calculation: Based on SBT
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect. applied: Yes
 K_o applied: Yes
 Clay like behavior applied: Sands only
 Limit depth applied: No
 Limit depth: N/A

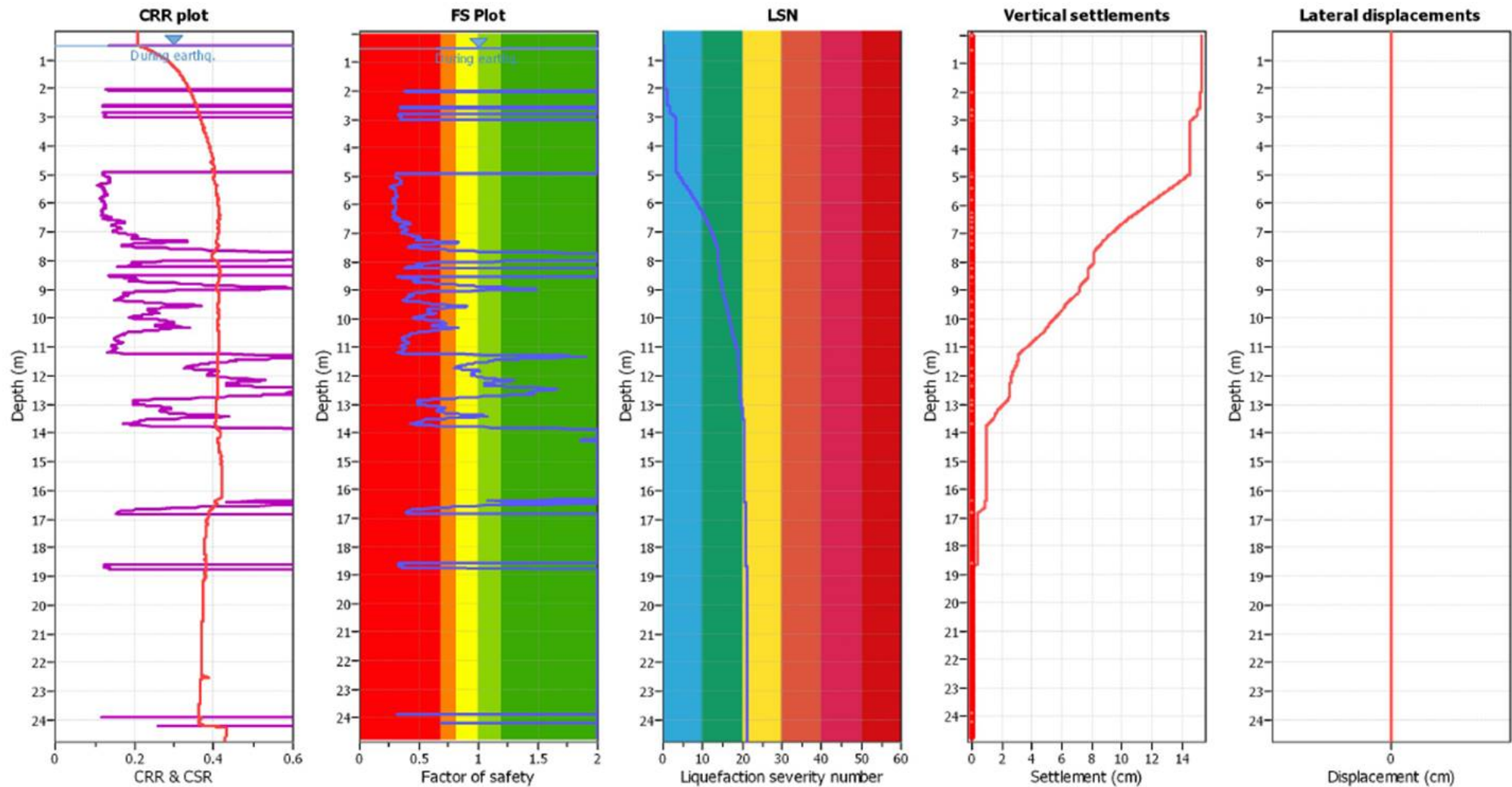
F.S. color scheme

Red: Almost certain it will liquefy
 Orange: Very likely to liquefy
 Yellow: Liquefaction and no liq. are equally likely
 Light green: Unlike to liquefy
 Dark green: Almost certain it will not liquefy

LSN color scheme

Red: Severe damage
 Dark red: Major expression of liquefaction
 Red-orange: Moderate to severe exp. of liquefaction
 Yellow: Moderate expression of liquefaction
 Green: Minor expression of liquefaction
 Blue: Little to no expression of liquefaction

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
 Fines correction method: B&I (2014)
 Points to test: Based on I_c value
 Earthquake magnitude M_w : 7.50
 Peak ground acceleration: 0.35
 Depth to water table (insitu): 2.00 m

Depth to GWT (earthq.): 0.50 m
 Average results interval: 3
 I_c cut-off value: 2.60
 Unit weight calculation: Based on SBT
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect. applied: Yes
 K_0 applied: Yes
 Clay like behavior applied: Sands only
 Limit depth applied: No
 Limit depth: N/A

F.S. color scheme

Red: Almost certain it will liquefy
 Orange: Very likely to liquefy
 Yellow: Liquefaction and no liq. are equally likely
 Green: Unlike to liquefy
 Blue: Almost certain it will not liquefy

LSN color scheme

Red: Severe damage
 Orange: Major expression of liquefaction
 Yellow: Moderate to severe exp. of liquefaction
 Green: Moderate expression of liquefaction
 Blue: Minor expression of liquefaction
 Light Blue: Little to no expression of liquefaction



ENGCO
Consulting Engineers

Appendix 3

Shallow Geotechnical Investigation Results

HAND AUGER & SCALA LOG

Job Number: 16412

Client: ENGCO
Project: 83 Byron Street

Test Label: DCP02

Site Location: 83 Byron Street, Christchurch

Test Date: 31/10/2016

Coordinates: -43.542160, 172.644481 (WGS84)

Groundwater Level: Not encountered

Operator: Logan Allan

Logger: Jozef Knottenbelt

Hole Depth: 2m

Surface Conditions: Grass

Hand Auger Geological Interpretation	Legend	Water	Depth (m)	Scala Penetrometer (Blows / 100mm)														
				2	4	6	8	10	12	14	16	18						
		Groundwater Not Encountered				7												
				2														
				2														
						6												
					4													
			0.5		3													
				2														
					4													
						7												
						6												
			1.0			8												
							11											
								15										
									18									
										20								
			1.5								18							
												20						
													19					
											16							
																	20	

Remarks

Testing carried out to New Zealand Standard 4402:1986 (Test 6.5.2.1988)

HAND AUGER & SCALA LOG

Job Number: 16412

Client: ENGCO
Project: 83 Byron Street

Test Label: DCP03

Site Location: 83 Byron Street, Christchurch

Test Date: 31/10/2016

Coordinates: -43.542241, 172.644351 (WGS84)

Groundwater Level: Not encountered

Operator: Logan Allan

Logger: Jozef Knottenbelt

Hole Depth: 2m

Surface Conditions: Gravel

Hand Auger Geological Interpretation	Legend	Water	Depth (m)	Scala Penetrometer (Blows / 100mm)														
				2	4	6	8	10	12	14	16	18						
		Groundwater Not Encountered																
						6												
												17						
							8											
			0.5		2													
						5												
						4												
						4												
						4												
			1.0				7											
						6												
								10										
									11									
									11									
			1.5							12								
										12								
											13							
												11						
													8					

Remarks

Testing carried out to New Zealand Standard 4402:1986 (Test 6.5.2.1988)

HAND AUGER & SCALA LOG

Job Number: 16412

Client: ENGCO
Project: 83 Byron Street

Test Label: HA01/SP01

Site Location: 83 Byron Street, Christchurch

Test Date: 31/10/2016

Coordinates: -43.542137, 172.644341 (WGS84)

Groundwater Level: Not encountered

Operator: Logan Allan

Logger: Jozef Knottenbelt

Hole Depth: 2m

Surface Conditions: Grass

Hand Auger Geological Interpretation	Legend	Water	Depth (m)	Scala Penetrometer (Blows / 100mm)									
				2	4	6	8	10	12	14	16	18	
Sandy Gravely SILT; with minor tiles and trace brick, dark brown/black, medium dense to very dense, damp, grey clasts(rounded)		Groundwater Not Encountered				6							
							8						
Sandy SILT; blue/grey with orange mottles, dense, damp, low plasticity													28 >>
								9					
SILT; black with orange mottles, loose, damp, moderate plasticity					3								
			0.5		3								
clayey SILT; green/blue, medium dense, damp, high plasticity						6							
						6							
clayey SILT; grey/blue with orange mottles, medium dense, damp, high plasticity						6							
						5							
clayey SILT; grey/blue with orange mottles, medium dense to dense, wet, high plasticity			1.0			6							
						6							
								10					
								9					
							7						
			1.5				7						
clayey SILT; grey/blue, medium dense, wet, high plasticity							7						
						6							
						6							
clayey SILT; grey/blue, medium dense, saturated, high plasticity,							7						

Remarks

Testing carried out to New Zealand Standard 4402:1986 (Test 6.5.2.1988)

HAND AUGER & SCALA LOG

Job Number: 16412

Client: ENGCO
Project: 83 Byron Street

Test Label: HA02/DCP04

Site Location: 83 Byron Street, Christchurch
Test Date: 31/10/2016
Coordinates: -43.542315, 172.644489 (WGS84)
Groundwater Level: Not encountered

Operator: Jozef Knottenbelt
Logger: Logan Allan
Hole Depth: 2m
Surface Conditions: Gravel

Hand Auger Geological Interpretation	Legend	Water	Depth (m)	Scala Penetrometer (Blows / 100mm)									
				2	4	6	8	10	12	14	16	18	
Sandy GRAVEL; Grey clasts brown matrix, very dense, damp, rounded clasts, well graded		Groundwater Not Encountered											
SILT; dark brown/black, medium dense, moist, plastic													19
			0.5		4								
					4								
SILT; blue/grey, medium dense, moist, high plasticity					3								
					5								
					6								
			1.0		6								
SILT; light brown, dense, moist, high plasticity					7								
					7								
					7								
					7								
			1.5					10					
					8								
					6								
SILT; light brown, dense, wet, high plasticity					6								
					6								
					6								
					6								

Remarks

Testing carried out to New Zealand Standard 4402:1986 (Test 6.5.2.1988)

Scalar prehole to 0.3m

Customer Services
P. 03 353 9007 or 0800 324 636

PO Box 345
Christchurch 8140

P. 03 365 3828
F. 03 365 3194
E. ecinfo@ecan.govt.nz

www.ecan.govt.nz

Dear Sir/Madam

Thank you for submitting your property enquiry in regards to our Listed Land Use Register (LLUR) which holds information about sites that have been used, or are currently used for activities which have the potential to have caused contamination.

The LLUR statement provided indicates the location of the land parcel(s) you enquired about and provides information regarding any LLUR sites within a radius specified in the statement of this land.

Please note that if a property is not currently entered on the LLUR, it does not mean that an activity with the potential to cause contamination has never occurred, or is not currently occurring there. The LLUR is not complete, and new sites are regularly being added as we receive information and conduct our own investigations into current and historic land uses.

The LLUR only contains information held by Environment Canterbury in relation to contaminated or potentially contaminated land; other information relevant to potential contamination may be held in other files (for example consent and enforcement files).

If your enquiry relates to a farm property, please note that many current and past activities undertaken on farms may not be listed on the LLUR. Activities such as the storage, formulation and disposal of pesticides, offal pits, foot rot troughs, animal dips and underground or above ground fuel tanks have the potential to cause contamination.

Please contact and Environment Canterbury Contaminated Sites Officer if you wish to discuss the contents of the LLUR statement, or if you require additional information. For any other information regarding this land please contact Environment Canterbury Customer Services.

Yours sincerely

Contaminated Sites Team

Property Statement from the Listed Land Use Register

Visit www.ecan.govt.nz/HAIL for more information about land uses.



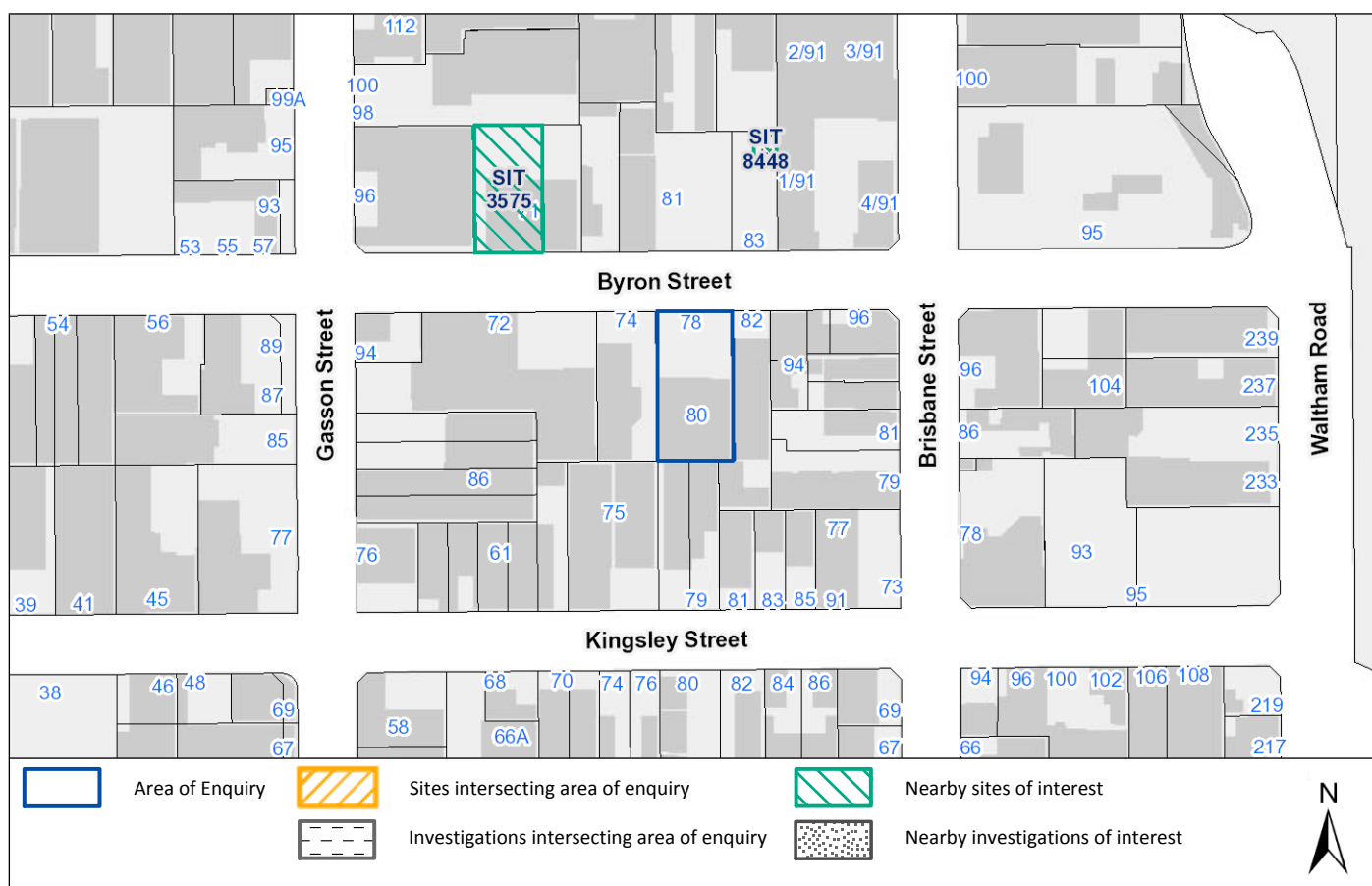
Customer Services
P. 03 353 9007 or 0800 324 636

PO Box 345
Christchurch 8140

P. 03 365 3828
F. 03 365 3194
E. ecinfo@ecan.govt.nz

www.ecan.govt.nz

Date:	28 February 2017		
Land Parcels:	Lot 1 DP 449853	Valuation No(s): 2256053900	
	Lot 1 DP 449853	Valuation No(s): 2256053900	



The information presented in this map is specific to the area within a 50m radius of property you have selected. Information on properties outside the search radius may not be shown on this map, even if the property is visible.

Summary of sites:

Site ID	Site Name	Location	HAIL Activity(s)	Category
3575	Rosiez Panel Paint & Performance	71 Byron Street, Sydenham	F4 - Motor vehicle workshops;	Not Investigated
8448	83 Byron Street	83 Byron Street, Sydenham	A17 - Storage tanks or drums for fuel, chemicals or liquid waste;	Below guideline values - Industrial/Commercial

Please note that the above table represents a summary of sites and HAILs intersecting the area of enquiry within a 50m buffer.

Information held about the sites on the Listed Land Use Register

Site 3575: Rosiez Panel Paint & Performance (Within 50m of enquiry area.)

Our Ref: ENQ158640

Produced by: LLUR Public 28/02/2017 1:27:39 p.m.

Page 1 of 3

Site Address:	71 Byron Street, Sydenham
Legal Description(s):	Lot 3 DP 19049

Site Category:	Not Investigated
Definition:	Verified HAIL has not been investigated.

Land Uses (from HAIL):	Period From	Period To	HAIL land use
	?	present	Motor vehicle workshops

Notes:

22 Jan 2008 Panel beating and spray painting workshop. Site visited by Environment Canterbury's Pollution Prevention Officer in December 2007.

Investigations:

There are no investigations associated with this site.

Site 8448: 83 Byron Street (Within 50m of enquiry area.)

Site Address:	83 Byron Street, Sydenham
Legal Description(s):	Part Lot 180 DP 2

Site Category:	Below guideline values - Industrial/Commercial
Definition:	Investigation results demonstrate that hazardous substances present at the site, but below applicable guidelines. - Industrial/Commercial

Land Uses (from HAIL):	Period From	Period To	HAIL land use
	?	2011	Storage tanks or drums for fuel, chemicals or liquid waste

Notes:

27 Jun 2011 A 1,200 L underground storage tank was removed from 83 Byron Street, Sydenham on 2 June 2011. The tank was discovered during demolition of earthquake damaged buildings. Pattle Delamore Partners Ltd was engaged to supervise the tank removal and validate the natural soils surrounding the tank pit. No ancillary pipework was encountered in the excavations. Ten cubic metres of material impacted by petroleum hydrocarbon residues was removed from the site to Texco Remediation Ltd. The environmental investigation, conducted in accordance with national guidelines, shows that the petroleum hydrocarbon impact remaining at the site is minor and unlikely to pose a significant effect on the environment.

Investigations:

10 Jun 2011 **INV 8309: Site inspection for the removal of an underground storage tank at 83 Byron Street, Sydenham, Christchurch** (Detailed Site Investigation)
Pattle Delamore Partners Ltd

Summary of investigation(s):

The investigation to remove and validate a 1,200 L underground storage tank from 63 Byron Street, Sydenham was commissioned on discovery of the tank during demolition of earthquake damaged buildings at the property. It is understood that the tank held diesel and was used for heating purposes. Its condition was described as fair, but it was noted that the tank had taken on water. The tank was housed within a concrete lined pit, in close proximity to foundations of a building located at the neighbouring property. In order to preserve the stability of the building, the concrete lining was not completely removed. No pipework was observed during the tank removal excavations. Petroleum hydrocarbon residues (odour and staining) were observed around the tank, but reportedly confined to bedding material within the concrete lined pit.

Groundwater was not observed during the tank removal to a depth of 1.7 m below ground level, but is anticipated to occur within 2 m of the surface and flow in the general easterly direction. The property is located within the confined aquifer zone and the shallow non-artesian is not abstracted for sensitive purposes in the vicinity of the removed tank. An on-site artesian well was observed within 5 m of the former tank. The native soils surrounding the concrete lining were described as clayey silts over silt to 1.7 m below ground level. The nearest surface waterway is Jacksons Creek, located 1 km from the site. The property was vacant at the time of the investigation but is zoned as Business 3 in Christchurch City Plan.

Six samples from the natural soils around and beneath the tank concrete lining and a single sample of backfill material were submitted for total petroleum hydrocarbon analysis. Approximately 10 cubic metres of petroleum hydrocarbon impacted spoil was removed to Texco Remediation Limited (Christchurch). While no pipework was encountered during the investigation, suggesting that the tank had been partially decommissioned previously, the tank pit area was adequately characterised. Additionally, given that the tank was located beneath a former building, it is assumed that the length of ancillary pipework was relatively short.

All seven samples characterising natural soil and backfill material at the former tank pit complied with the applicable petroleum hydrocarbon guidelines for commercial/industrial land use. Petroleum hydrocarbon residues were shown to remain at the site however, particularly in near-surface soils surrounding the former tank pit. Overall, while only a limited site history is presented, the investigation indicated that the minor contamination identified is unlikely to be of significant extent or severity in terms of the risk to human health or the environment. It is proposed to classify the tank pit area as Below Environmental Guidelines on the Register.

Information held about other investigations on the Listed Land Use Register

For further information from Environment Canterbury, contact Customer Services and refer to enquiry number ENQ158640.

Disclaimer: *The enclosed information is derived from Environment Canterbury's Listed Land Use Register and is made available to you under the Local Government Official Information and Meetings Act 1987 and Environment Canterbury's Contaminated Land Information Management Strategy (ECan 2009).*

The information contained in this report reflects the current records held by Environment Canterbury regarding the activities undertaken on the site, its possible contamination and based on that information, the categorisation of the site. Environment Canterbury has not verified the accuracy or completeness of this information. It is released only as a copy of Environment Canterbury's records and is not intended to provide a full, complete or totally accurate assessment of the site. It is provided on the basis that Environment Canterbury makes no warranty or representation regarding the reliability, accuracy or completeness of the information provided or the level of contamination (if any) at the relevant site or that the site is suitable or otherwise for any particular purpose. Environment Canterbury accepts no responsibility for any loss, cost, damage or expense any person may incur as a result of the use, reference to or reliance on the information contained in this report.

Any person receiving and using this information is bound by the provisions of the Privacy Act 1993.

APPENDIX C

Exploratory Hole Logs

PROJECT: Geo Investigation

CLIENT: STRUCTEX HARVARD LTD

ADDRESS: 80 Byron Street, Sydenham

LOGGED

BG

PROCESSED

BG

CHECKED

GJL

BH LOCATION: COORDS:

RL GROUND:

DEPTH (m)	SOIL DESCRIPTION	Strength/density, colour, structure, minor, MAJOR, plasticity, moisture content, other comments	LEGEND	GROUND WATER	SCALA BLOWS (PER 50 mm)
GL					5 10 15
	Asphalt				
	FILL - Medium dense grey fine to coarse sandy gravel with occasional cobbles (hardfill)				
	FILL - Soft to firm, dark grey organic silt, trace ash and orange mottles, moist				
	Firm/stiff, light grey mottled orange clayey SILT, moist				
1					
	becomes slightly clayey and wet				
	becomes heavily mottled				
	becomes firm, bluish grey and saturated				
2					
	Firm, bluish grey fine to medium sandy SILT, saturated				
3					
	End of Hand Auger (Target depth reached)				

EOH @ 3.90 m

NOTES:

Groundwater was encountered at 1.60m below ground level during the Hand Auger

ENGINEERING DESIGN CONSULTANTS LTD

CIVIL, STRUCTURAL,
ENVIRONMENTAL, GEOTECHNICAL AND
FIRE ENGINEERS

www.edc.co.nz
team@edc.co.nz

1st FLOOR, 39 CARLYLE ST, SYDENHAM
PO BOX 7354, SYDENHAM,
CHRISTCHURCH 8240

PH (03) 355 5559
FAX (09) 415 1280

1st FLOOR, UNIT 1, 100 BUSH ROAD,
ALBANY, AUCKLAND

PH (09) 451 9044

Printed: 10/03/2017 9:13:05 a.m.

PROJECT: Geo Investigation

CLIENT: STRUCTEX HARVARD LTD

ADDRESS: 80 Byron Street, Sydenham

LOGGED

BG

PROCESSED

BG

CHECKED

GJL

BH LOCATION: COORDS:

RL GROUND:

DEPTH (m)	SOIL DESCRIPTION	Strength/density, colour, structure, minor, MAJOR, plasticity, moisture content, other comments	LEGEND	GROUND WATER	SCALA BLOWS (PER 50 mm)
GL					5 10 15
	Asphalt				
	FILL - Medium dense grey fine to coarse sandy gravel with occasional cobbles (hardfill)				
	FILL - Soft, dark grey organic silt, some ash, trace fine sand and ash, wet				
	Stiff, light grey mottled orange clayey SILT, moist				
1	soil becomes greenish and has a slight hydrocarbon smell				
	becomes firm and wet				
	saturated			SWL	
2					
	becomes very clayey				
	Firm, bluish grey fine to medium sandy SILT, saturated. No hydrocarbon smell (though hard to distinguish when it finished)				
3					
	End of Hand Auger (Target depth reached)		EOH @ 3.20 m		

NOTES:

Groundwater was encountered at 1.90m below ground level during the Hand Auger
Slight hydrocarbon smell from 1.0m to 2.6m below ground level

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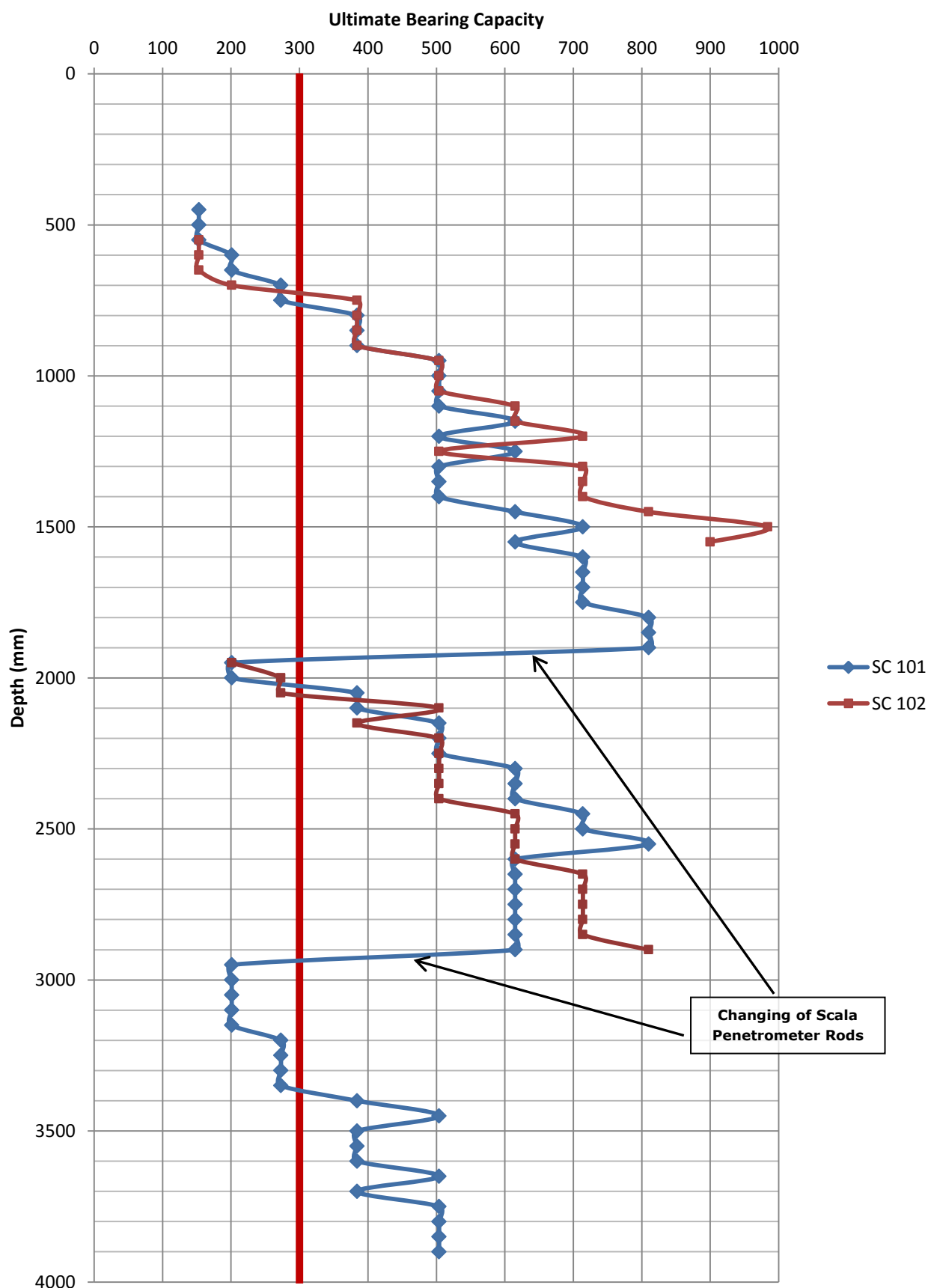
1st FLOOR, UNIT 1, 100 BUSH ROAD,
ALBANY, AUCKLAND

PH (09) 451 9044

APPENDIX D

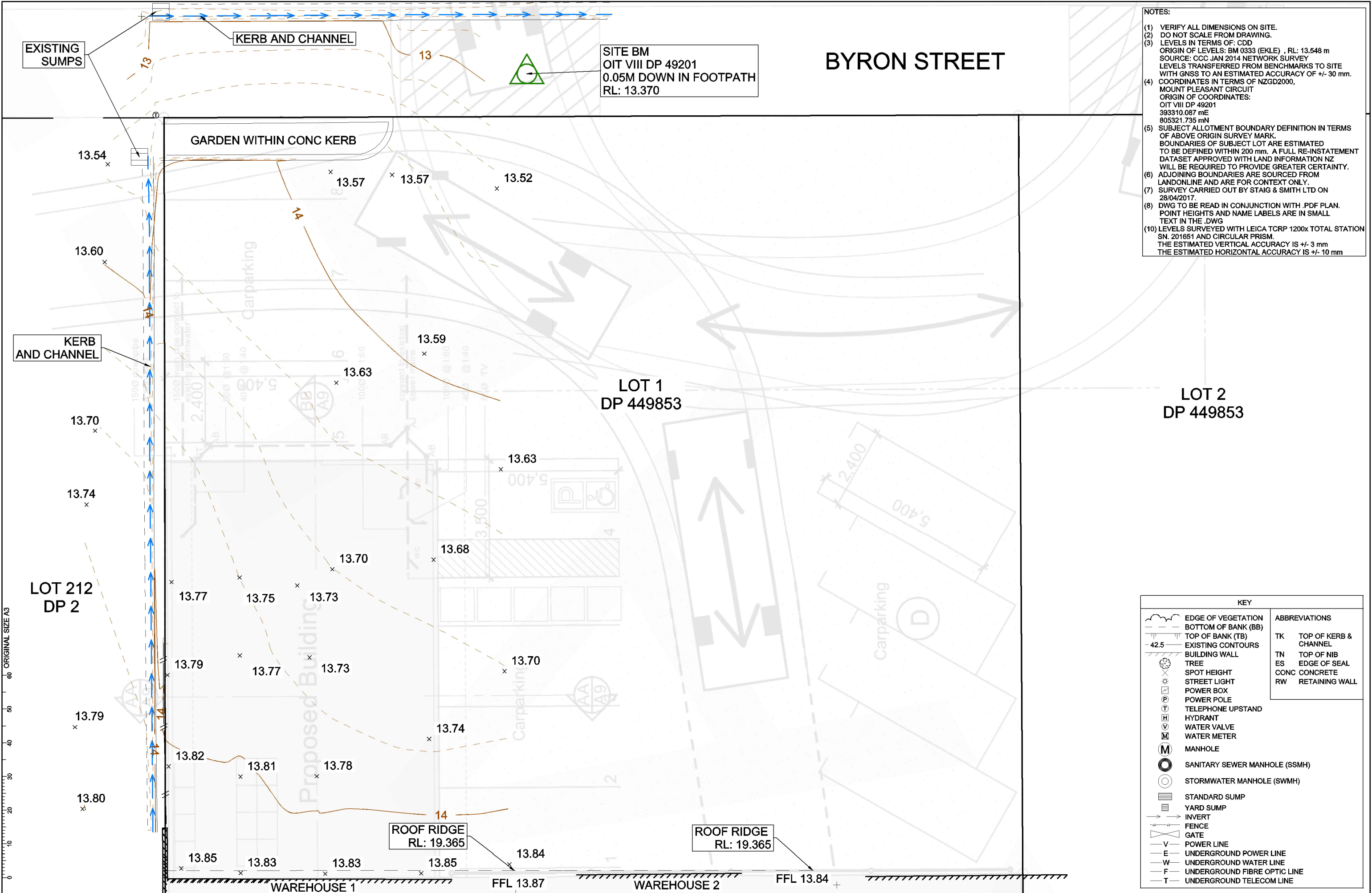
Geotechnical Ultimate Bearing Capacity Graph

Summary of Ultimate Bearing Capacity vs Depth



NOTES

1. Based on Stockwell, M.J., 1977: Determination of allowable bearing pressure under small structures. New Zealand Engineering (32:6), dated 15 June 1977, using a factor of safety of three to back calculate the UBC.



- NOTES:
- (1) VERIFY ALL DIMENSIONS ON SITE.
 - (2) DO NOT SCALE FROM DRAWING.
 - (3) LEVELS IN TERMS OF: CDD
ORIGIN OF LEVELS: BM 0333 (EKLE) , RL: 13.548 m
SOURCE: CCC JAN 2014 NETWORK SURVEY
LEVELS TRANSFERRED FROM BENCHMARKS TO SITE
WITH GNSS TO AN ESTIMATED ACCURACY OF +/- 30 mm.
 - (4) COORDINATES IN TERMS OF NZGD2000,
MOUNT PLEASANT CIRCUIT
ORIGIN OF COORDINATES:
OIT VIII DP 49201
393310.087 mE
805321.735 mN
 - (5) SUBJECT ALLOTMENT BOUNDARY DEFINITION IN TERMS
OF ABOVE ORIGIN SURVEY MARK.
BOUNDARIES OF SUBJECT LOT ARE ESTIMATED
TO BE DEFINED WITHIN 200 mm. A FULL RE-INSTATEMENT
DATASET APPROVED WITH LAND INFORMATION NZ
WILL BE REQUIRED TO PROVIDE GREATER CERTAINTY.
 - (6) ADJOINING BOUNDARIES ARE SOURCED FROM
LANDONLINE AND ARE FOR CONTEXT ONLY.
 - (7) SURVEY CARRIED OUT BY STAIG & SMITH LTD ON
28/04/2017.
 - (8) DWG TO BE READ IN CONJUNCTION WITH .PDF PLAN.
POINT HEIGHTS AND NAME LABELS ARE IN SMALL
TEXT IN THE .DWG
 - (10) LEVELS SURVEYED WITH LEICA TCPR 1200x TOTAL STATION
SN. 201651 AND CIRCULAR PRISM.
THE ESTIMATED VERTICAL ACCURACY IS +/- 3 mm
THE ESTIMATED HORIZONTAL ACCURACY IS +/- 10 mm

KEY		ABBREVIATIONS	
	EDGE OF VEGETATION	TK	TOP OF KERB & CHANNEL
	BOTTOM OF BANK (BB)	TN	TOP OF NIB
	TOP OF BANK (TB)	ES	EDGE OF SEAL
	EXISTING CONTOURS	CONC	CONCRETE
	BUILDING WALL	RW	RETAINING WALL
	TREE		
	SPOT HEIGHT		
	STREET LIGHT		
	POWER BOX		
	POWER POLE		
	TELEPHONE UPSTAND		
	HYDRANT		
	WATER VALVE		
	WATER METER		
	MANHOLE		
	SANITARY SEWER MANHOLE (SSMH)		
	STORMWATER MANHOLE (SWMH)		
	STANDARD SUMP		
	YARD SUMP		
	INVERT		
	FENCE		
	GATE		
	POWER LINE		
	UNDERGROUND POWER LINE		
	UNDERGROUND WATER LINE		
	UNDERGROUND FIBRE OPTIC LINE		
	UNDERGROUND TELECOM LINE		

BRANZ NZS 4218:2009 CALCULATION METHOD TOOL

BUILDING ELEMENTS

Roofs/ceilings: Skylights are not included here. Enter them in the skylights table below.

Roof/ceiling element	Description	Area (m ²)	Construction R-value	Heat loss
1	Roof - Dimond Top Span-DHS Purlin-R3.2 Pink Batts	103.85	3.51	29.6
2				
3				
4				
5				

Total area 103.85 m²

Total roofs/ceilings heat loss 29.6

Skylights: Skylights are at an angle of 60° or less to the horizontal. If the skylight R-value is not known, use a value of 0.15.

Skylight	Description	Area (m ²)	Construction R-value	Heat loss
1	Velux VCS 3030 solar	0.801	0.31	2.6
2	Velux VCS 2222 solar	0.478	0.31	1.5
3				
4				
5				
	From Skylight Schedule	0		0.0

Total area 1.279 m²

Total skylight heat loss 4.1

Walls: Doors are not included here. Enter them in the door table.

Wall element	Description	Area (m ²)	Construction R-value	Heat loss
1	Wall - 90mm framed timber wall-R2.4 batts office to	11.31	1.97	5.7
2	wall-140mm framed timber storeroom R 2.4 batts	12.22	2.35	5.2
3	Wall-140mm running bond masonry block timber st	44.57	1.13	39.4
4	Wall - 140mm stack bond masonry block timber str	51.66	1.13	45.7
5	Wall-140mm frame-Dimond Rib50-R2.2 batts	6.86	2.36	2.9
6	Wall - 90mm framed timber R-2.4 batts office to stc	12	1.98	6.1

Total area 138.62 m²

Total wall heat loss 105.1

Floors: Only include the ground or exterior floors. Intermediate floors not exposed to the exterior are excluded.

Floor element	Description	Area (m ²)	Construction R-value	Heat loss
1	Slab floor - 100mm thick conc.	100	1.49	67.1
2				
3				
4				
5				

Total area 100 m²

Floor heat loss 67.1

Vertical glazing: Vertical glazing only (steeper than 60°), including glazing in doors. Skylights are on the Skylight table.

If the glazing R-value is not known, use a value of 0.15

Glazing element	Description	Area (m ²)	Construction R-value	Heat loss
1	glazing windows	8	0.26	30.8
2				
3				
4				
5	glazing doors	4.38	0.26	16.8
6				
7				
8				
9				
10				
	From Glazing Schedule	0		0.0

Total area 12.38 m²

Total vertical glazing heat loss 47.6

Doors: Only the non-glazed area of doors is included. The glazed area of doors must be entered in the Glazing table.

The heat loss of doors is automatically set to 0 if the total door area is ≤ 6m² or 6% of the total wall area.

If the R-value of a door is not entered a default value of R 0.18 is automatically used.

Door element	Description	Area (m ²)	Construction R-value	Heat loss
1	Window frames	2.4	0.18	13.3
2	Door frames	2.77	0.18	15.4
3				0.0
4				0.0
5				
	From Door Schedule	0		0.0

Total area 5.17

Total door heat loss 0.0

BRANZ NZS 4218:2009 CALCULATION METHOD TOOL

PROJECT SUMMARY

Project name	Proposed Industrial Building
Address	80 Byron St, Sydenham, Christchurch
Designer	ADG
Address	47 Second Ave
Phone	578 2899
Date	Jul-17
Reference number	5996

Climate zone	3: South Island, Taupo and Ruapehu Districts, northern part of Rangitikei District, Stewart Isl						
Wall construction type	4: Mix of types 1, 2 or 3						
If mixed wall types	<table> <tr> <td></td><td>Percentage of wall area solid timber construction</td></tr> <tr> <td>0</td><td>Percentage of wall area high thermal mass construction</td></tr> <tr> <td>100</td><td>Percentage of wall area "Any wall type"</td></tr> </table>		Percentage of wall area solid timber construction	0	Percentage of wall area high thermal mass construction	100	Percentage of wall area "Any wall type"
	Percentage of wall area solid timber construction						
0	Percentage of wall area high thermal mass construction						
100	Percentage of wall area "Any wall type"						
If solid timber wall	1: External 75 mm thick solid timber and timber framed internal walls						

Summary of calculation method heat loss

Element	Area (m ²)	Proposed building heat loss (W/°C)	Reference building heat loss (W/°C)
Roofs/ceilings	103.9	29.6	31.9
Walls	138.6	105.1	71.9
Floors	100.0	67.1	76.9
Vertical glazing	12.4	47.6	180.2
Skylights	1.3	4.1	-
Doors	5.2	0.0	-
Total		253.5	360.9

Glazing percentage: 8%

Glazing <40%: Yes

Minimum R-values OK: Maybe Cannot be determined by this tool - apply Clause 4.2.1

Issues to check:

Check that the thermal mass is exposed to the interior.

Check that the high thermal mass walls have a surface density
 $\geq 215 \text{ kg/m}^2$

PASS/FAIL

PASS

Provisional - confirm all min R-values and all issues



Construction R-value Calculator

This webpage calculates the R-value of walls, roofs and suspended floors for most insulation material R-values. It uses the "iso-thermal planes" method, the same method as used in NZS4214:2006.

Some of the possible material combinations may not be suitable for actual constructions, i.e. EPS based claddings directly fixed on timber framing. Please make sure to select only appropriate material combinations.

If your construction is not listed, please send an e-mail to designnavigator@gmail.com with a description and a detail drawing (pdf) of it or use the new [Design Navigator message board](#) [1].

Please select the element type. Then choose the construction details and enter the R-value of the insulation either directly in the text box or by choosing a product from the right panel [1].

- Floors ☒
Walls ☐
Roofs ☐

Floor slab

1.49 m²K/W

Type: Floor: Slab floor

Slab floor

internal surface 0.09

Flooring : none (Example: polished surface of a concrete floor)

R-value: 0.00

Slab Insulation

Slab floor area [m²]: 100

Perimeter length [m]: 40.8

External wall thickness [mm]: 140 [1]

Soil conductivity [W/m °C]: 1.2 [1]

Underslab insulation: none

Insulation : [1]

Piles Footings: Number: [1] Penetration Diameter: [1]

Slab edge insulation: none

Insulation : [1]

Print Page



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Please select the element type. Then choose the construction details and enter the R-value of the insulation either directly in the text box or by choosing a product from the right panel.

- Floors ☐
Walls ☒
Roofs ☐

Masonry Block	1.13 m ² K/W
Type: Wall: Solid wall (concrete, masonry or other) without vented cavity, with internal insulation	
Solid wall (concrete, masonry or other) without vented cavity, with internal insulation	
external surface 0.03	
Cladding : None (facing outside air)	R-value: 0.00
Solid Masonry : Standard Blocks, 150mm, all cells filled	R-value: 0.13
Strapping : Timber batten, 45mm deep, 45mm wide @ 600mm centers	Cavity Area: 89.0%
Thermal Break : none	Insulation : 1
Strapping : none	still Airgap: none
Strapping : R-value: 0.37	R-value: 0.00
Wall Lining : Gypsum plasterboard 10mm	R-value: 0.04
internal surface 0.09	

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Construction R-value Calculator

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Please select the element type. Then choose the construction details and enter the R-value of the insulation either directly in the text box or by choosing a product from the right panel [1].

- Floors ☐
Walls ☐
Roofs ☒

Skillion Roof		3.51 m²K/W
Type: Roof: Steel framed skillion roof with insulated roofing		
Steel framed skillion roof		
external surface 0.03		
Roofing : Corrugate iron with building paper		
R-value: 0.01		
Pink®Batts® Skillion Roof R3.2 3.2		
Steel Frame & Cavity : 150/15DHS (150x75x1.45) rafters or joists @ 1200mm, battens covered with insulation		
Roof Frame Area: 6.3% Cavity Area: 93.7%		
Framing :	still Airgap :	
R-value: 0.22	10-30mm airgap (non-reflective)	
	R-value: 0.13	
Thermal Break :	Insulation :	
Timber 35mm		
R-value: 0.30		
Roof Lining : Gypsum plasterboard 10mm		
R-value: 0.04		
internal surface 0.09		

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Construction R-value Calculator

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If your construction is not listed, please send an e-mail to designnavigator@gmail.com with a description and a detail drawing (pdf) of it or use the new [Design Navigator message board](#) [1].

Please select the element type. Then choose the construction details and enter the R-value of the insulation either directly in the text box or by choosing a product from the right panel [1].

Floors ☐

Walls ☒

Roofs ☐

Timber frame vertical metal clad		2.36	m ² /K/W
Type: Wall: Timber frame (direct fixed cladding)			
timber frame (direct fixed cladding)			
external surface 0.03			
Cladding :		Metal weatherboard (corr. iron)	
		R-value: 0.08	
Air Barrier :		none	
		R-value: 0.00	
Timber Frame & Cavity :		144mm, studs @ 400mm, dwangs @ 800mm	
Wall Frame Area: 17.9%		Cavity Area: 82.1%	
Framing :		Pink®Batts® R2.4 Wall 2.4	
R-value: 1.19		still Airgap: 20-90mm airgap (non-reflective)	
		R-value: 0.16	
Wall Lining :		Gypsum plasterboard 10mm	
		R-value: 0.04	
		internal surface 0.09	

Print Page



Construction R-value Calculator

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If your construction is not listed, please send an e-mail to designnavigator@gmail.com with a description and a detail drawing (pdf) of it or use the new [Design Navigator message board](#) [1].

Please select the element type. Then choose the construction details and enter the R-value of the insulation either directly in the text box or by choosing a product from the right panel [2].

Floors ☐

Walls ☒

Roofs ☐

Timber frame storeroom		2.35 m ² K/W
Type:	Wall: Timber frame (direct fixed cladding)	
timber frame (direct fixed cladding)		
external surface 0.03		
Cladding :	Gypsum plasterboard 10mm into still air (garage, etc.)	
	R-value: 0.10	
Air Barrier :	none	
	R-value: 0.00	
Timber Frame & Cavity :	144mm, studs @ 600mm, dwangs @ 800mm	
Wall Frame Area: 14.4%	Cavity Area: 85.6%	
Framing :	Pink®Batts® R2.4 Wall 2.4	
R-value: 1.19	still Airgap: none	
	R-value: 0.00	
Wall Lining :	Gypsum plasterboard 10mm	
	R-value: 0.04	
internal surface 0.09		

Print Page



Construction R-value Calculator

This webpage calculates the R-value of walls, roofs and suspended floors for most insulation material R-values. It uses the "iso-thermal planes" method, the same method as used in NZS4214:2006.

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Please select the element type. Then choose the construction details and enter the R-value of the insulation either directly in the text box or by choosing a product from the right panel.

Floors ☐

Walls ☒

Roofs ☐

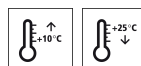
Timber frame office to Workshop		1.97 m ² K/W
Type: Wall: Timber frame (direct fixed cladding)		
timber frame (direct fixed cladding)		
external surface 0.03		
Cladding : None (facing inside air, i.e. internal bulkhead into roof space)		
R-value: 0.09		
Air Barrier : none		
R-value: 0.00		
Timber Frame & Cavity : 90mm, studs @ 400mm, dwangs @ 800mm		
Wall Frame Area: 17.9% Cavity Area: 82.1%		
Framing : R-value: 0.75	Pink®Batts® R2.4 Wall 2.4	
still Airgap: none		
R-value: 0.00		
Wall Lining : Gypsum plasterboard 10mm		
R-value: 0.04		
internal surface 0.09		

Print Page

Technical Data Sheet

StoPur WV 200 transparent

PUR sealer, water-based, matt, transparent



Characteristics

- Area of application**
- interior
 - as a transparent sealing coat on industrial flooring with low stress

- Properties**
- good stability under the effects of light
 - rapid curing at ambient room temperature

- Appearance**
- matt
 - transparent

- Information/notes**
- application on wall surface areas is also possible

Technical data

Criterion	Standard / test specification	Value/ Unit	Notes
Viscosity (at 23 °C)	EN ISO 3219	350 - 550 mPa.s	mi xture
Density (mixture 23 °C)	EN ISO 2811	1.03 - 1.09 g/cm ³	

The characteristic values stated are average values or approximate values. Due to the natural raw materials in our products, the stated values can vary slightly in the same delivery batch; this does not affect the suitability of the product for its intended use.

Substrate

Requirements

Hardened, dry and clean StoPur sealing coats or coatings

New coatings on a polyurethane basis can be sealed directly with StoPur WV 200 transparent up to a period of 72 h.

In the case of longer waiting times sand matt the old coating using an abrasive pad (green/black) before sealing it.

Substrate temperature higher than +12 °C and 3 K above dew point.

Average bond strength 1.5 N/mm²

Bond strength of the single smallest value 1.0 N/mm²

Technical Data Sheet

StoPur WV 200 transparent

Application

Application temperature Lowest application temperature: +10 °C
 Highest application temperature: +25 °C
 permitted relative air humidity: max. 80% (min. 30%)

Time for application At +12 °C: approx. 70 minutes
 At +23 °C: approx. 60 minutes

Mixing ratio Component A : component B = 100.0 : 11.1 parts by weight

Material preparation Component A and Component B are supplied in the correct mixing ratio and should be mixed in accordance with the following instructions. Stir component A, then add all of component B.
 Mix thoroughly with a slow-running paddle mixer (max. 300 rpm) until a homogeneous, streak-free compound develops. It is also vital to stir thoroughly at the sides and the bottom in order to evenly distribute the hardener. Mixing time is at least 3 minutes.
 After mixing, pour the compound into a clean container and mix again.
 Do not apply from the delivery container!

The temperature of the individual components must be at least +15 °C when mixing.
 Transfer the material into a clean container using a paint sieve and stir it once again. Eliminate any lumps that occur during mixing.

Consumption	Type of application	Approx. consumption	
	as a sealing coat for each application cycle	0.08 - 0.1	kg/m ²

Material consumption depends on the application, substrate, and consistency, among other factors. The stated consumption values are only to be used as a guide. If required, determine precise consumption values on the basis of the specific project.

Coating build-up Matt sealant on smooth coatings, colourless, transparent
 1) Substrate preparation
 2). Sealing StoPur WV 200 transparent
 3) StoDivers P 120 care treatment

Application

Sealing coat on smooth coatings, transparent, matt
 1) If necessary, substrate preparation on an old coating

2) StoPur WV 200 transparent sealing coat
 Apply StoPur WV 200 transparent using a short-pile roller (Sto-Glaze Roller Micro-Fibre, Sto-Tool Catalogue) in a criss-cross pattern.

Creating some roller seams is unavoidable. In order to minimise them, work in a

Technical Data Sheet

StoPur WV 200 transparent

criss-cross pattern.

Apply the material evenly. Using a paint grid in the application container is recommended.

Consumption: approx. 0.1 - 0.2 kg/m², depending on the substrate

3) Care treatment using StoDivers P 120

When the industrial flooring is clean and has cured, evenly apply a thin layer of care treatment. Apply the material using a pre-dampened mop. Leave the floor to dry sufficiently, approx. 20 - 30 min. Carry out the second application cycle at right angles (perpendicular) to the previous application.

In order to minimise seams, work in a criss-cross pattern. Avoid creating overlaps. Depending on the expected stress, several application cycles may be necessary. It is very important to observe the specified drying times between application cycles. Consumption: approx. 30 - 50 ml/m² per application cycle

Drying, curing, ready for next coat

Dust-dry: after approx. 3 hours (at +23 °C)

Ready for foot traffic: after approx. 12 hours (at +23 °C)

Mechanically and chemically resistant: after approx. 7 days (at +23 °C)

Cleaning the tools

Clean with water immediately after use; hardened material can only be removed mechanically.

Notes, recommendations, special information, miscellaneous

The gloss level of the dead-matt sealing coat StoPur WV 200 is increased by adding StoDivers P 120.

The layer thickness for sealing coats is normally < 0.5 mm and decreases as a result of mechanical use. This should be taken into account with regard to the required service life.

StoPur WV 200 and the StoDivers P 120 care treatment are not plasticiser resistant!

If glossy, coloured coatings are matted with StoPur WV 200 transparent, the basic colour shade will become lighter.

This should be particularly observed when matting dark and bright colour shades.

When applying StoPur WV 200 transparent it is possible that the colour shade differs from the original colour shade of the substrate coating.

Roller marks might be visible, due to applying the sealer manually.

Ensure sufficient ventilation when applying water-based coating systems. However, avoid draughts. Different layer thicknesses, too high humidity, and too low temperatures can lead to visual defects (differences in the gloss levels).

General application instructions can be found at www.stocretec.de (Products) and

Technical Data Sheet

StoPur WV 200 transparent

in the latest issue of the "Technical Data Sheets" manual, in the appendix.

Delivery			
	Article number	Designation	Container
	04446/001	StoPur WV 200 Set transparent	8.07 kg set

Storage	
Storage conditions	Store in dry and frost-free conditions; avoid direct sunlight.
Storage life	In the original container until ... (see packaging).

Designation	
Product group	Sealer

Safety

This product is subject to compulsory designation in accordance with the current EU directive.
 You will receive an EU Safety Data Sheet with your first order.
 Please observe the information regarding the handling of the product, its storage, and disposal.

Special notes	
The information in this Technical Data Sheet serves to ensure the product's intended use, or its suitability for use, and is based on our findings and experience. Users are nevertheless responsible for establishing the product's suitability and use. Applications not specifically mentioned in this Technical Data Sheet are permissible only after prior consultation. Where no approval is given, such applications are at the user's own risk. This applies in particular when the product is used in combination with other products. When a new Technical Data Sheet is published, all previous Technical Data Sheets are no longer valid. The latest version is available on the Internet.	

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 stocretec@sto.com
 www.stocretec.de

Technical Data Sheet

S-Protect WS405

Aqueous emulsion on organofunctional silanes for the water repellent impregnation of absorbent, mineral substrates

Product Description

- Milky white emulsion based on organofunctional silane systems
- A hydrophobic agent for mineral building materials with high porosity
- Flash point 72°C
- Viscosity at 20 °C: 15 mPa•s
- pH-value (20°C) 6-8

Intended Use

- suited for the water repellent impregnation of porous, mineral substrates
- penetrates deeply in porous, mineral substrates
- shows no formation of sticky silicone films
- vapour permeable protection
- reduces significantly the uptake of water
- reduces the uptake of water soluble pollutants (eg. chlorides)
- protects hair like cracks of up to 0.3mm

Application

The amount of S-Protect WS405 to be applied is dependent on the absorbance of the substrate and the desired penetration depth.

Very absorbent substrates may require up to 1 Litre/m² of S-Protect WS405

Application Method

Low pressure spray with block brush to control

Airless spray or Silane pump

Substrate**Application Rate**

Lightweight Concrete (Poren Panel & Block)

min. 250 ml/m²

Clinker Masonry

min. 240 ml/m²

Sand Limestone

min. 400 ml/m²

Mineral Plaster

min. 200 ml/m²

The substrates to be treated should be dry and clean. Acceptable surface cleaning methods include honing, chemical cleaning and water blasting. During application outside temperature and surfaces temperatures should be between +5°C and +40°C. S-Protect WS405 should not be applied during strong wind or when rain is imminent.

S-Protect WS405 is applied in a full flood coat normally in 2 coats. On vertical surfaces the solution should run down in visible descending wet curtain achieved by allowing the solution to flow against the surface of the building material without pressure. Most liquid delivery devices eg. airless pump or backpack sprayer are suitable. The material should not be atomized or applied with a brush.

The water repellent effect of S-Protect WS405 can develop within minutes depending on the substrate and weather conditions. The impregnation should be applied continuously and without a break to avoid overlapping.

A substrate which has already been treated will repeal any reapplied aqueous silane/siloxane emulsion solution. Non-absorbent sustrates such as window frames, window sills, plastic fittings, window glass, etc., should be covered before application. Surfaces which accidentally come into contact with S-Protect WS405 can be cleaned with alcohol (spirit) or aqueous chemical solution. Cleaning should be carried out as quickly as possible (within a few hours), otherwise formation of a silicone resin film can make cleaning more difficult. Silicone resin films are best removed using ethanol (or spirit). Plant life should be protected from overspray.

S-Protect WS405 reacts with the interfaces in pores and capillaries for the mineral surface and forms an invisible, water repellent interfacial compounds To determine the exact amount to be applied a sample is required as the porosities of mineral materials varies.

Before application read the Material Safety Data Sheet thoroughly for safely and toxicological data as well as for information on proper transportation, storage and use. The Material Safety Data Sheet is available upon request from Stoanz Ltd.

Packaging, Storage and Handling

S-Protect WS405 is supplied in ready-to-use 20 Litre container.

S-Protect WS405 is not resistant to frost and should be stored at temperatures between +3°C and +40°C. S-Protect WS405 has a shelf life of 12 months if stored in originally sealed containers.

REPORT

STRUCTURAL AND CIVIL ENGINEERS

78- 82 BYRON ST

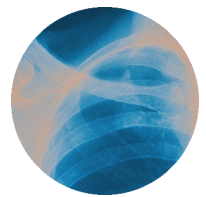
BUILDING A

PREPARED FOR

STEWART FAMILY TRUST

111702

JUNE 2014





78 BYRON ST – DETAILED SEISMIC ASSESSMENT REPORT
BUILDING A – SHEER ADVENTURE WORKSHOP

Prepared For:
STEWART FAMILY TRUST

Date: 27 June 2014
Project No: 111702
Revision No: 1

Prepared By:

David J Herman
DESIGN ENGINEER

Reviewed By:

Richard Seville
PROJECT DIRECTOR

Holmes Consulting Group LP
Christchurch Office



REPORT ISSUE REGISTER

DATE	REV. NO.	REASON FOR ISSUE
27 June 2014	1	Information



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EXECUTIVE SUMMARY

This report covers the structural damage sustained by the Sheer Adventure Workshop building at 78 Byron St, as a result of the series of earthquakes including the Darfield Earthquake that struck at 4:36am on 4th September, 2010 and the Lyttelton Earthquake that struck at 12.51 pm on the 22nd of February, 2011. The Sheer Adventure Workshop building consists of the original western warehouse structure and the eastern lean-to addition.

The lateral capacity of the building in the east-west direction prior to the earthquakes was found to be approximately 35% of current code. The capacity in the east-west direction was limited by the combined axial loading and bending capacity of the steel portal frames. The lateral capacity of the building in the north-south direction was found to be approximately 70% of current code and was limited by shear in the central ungrouted concrete block infill walls. The external wing-wall extension in the northwest corner of the original structure was found to be 15% of current code and was limited by the out-of-plane capacity of the wall at its base.

The level of shaking experienced at the site is estimated from the Geonet strong motion data recorded at monitoring sites around Christchurch and is related to the fundamental periods of the building for the Lyttelton Earthquake. Given the strong motion data available, it is likely that this earthquake produced accelerations significantly in excess of the design spectra for this building.

Preliminary and detailed observations have been made of the damage sustained as a result of the earthquakes. This report summarises the findings of these detailed observations and provides recommendations regarding the repair work required.

General damage observed consists of cracking and differential settlement of the concrete slab, diagonal cracking along the mortar joints of the concrete masonry unit block walls throughout the original western structure, and failure of a roof bracing strap.

As a result of the earthquakes the building's capacity has likely been reduced in the north-south direction due to diagonal cracking along mortar joints in some of the infill wall panels. The remaining uncracked panels provide the residual lateral capacity in the north-south direction and we estimate the remaining capacity to be greater than 33% of current code. The building's capacity in the east-west direction remains at approximately 35% of current code. The wing-wall extension in the northwest corner of the original structure remains at 15% of current code.

Repairs are recommended in the report and include repairing and repointing of the concrete blockwork and infill wall mortar joints, repair of spalled concrete at portal column bases and beam joints, removing and replacing the slab-on-grade in approximately 40% of the building, and replacing the failed roof bracing tension strap. Note that replacement of slab sections and wall repairs may require the tenants to relocate equipment and operations to the unaffected areas of the building. The northwest wing wall extension should be deconstructed. A fire engineer should be engaged to determine if the wall needs to be replaced. If so, the new wall should be designed for 100% of current loading standard.

Following the repairs recommended herein, the lateral load resisting performance of the building will be restored to its pre-earthquake condition. As noted above, this capacity is

limited by the capacity of the steel portal frames in the east-west direction (35% DBE) and the capacity of the infill walls in the north-south direction (70% DBE).

The following further investigations are recommended to confirm analysis assumptions and complete observations of areas of potential damage:

- To confirm foundation assumptions, a geotechnical report should be completed for the site.
- One location of the slab should be broken up along the internal north-south running block wall to confirm block wall foundation and steel portal frame column foundation assumptions.
- The concrete encasement around the steel portal frame column should be broken out at the slab level and the beam-column joint level at several locations to determine if any damage has occurred to the steel portal frames.

All locations should be confirmed with the engineer prior to implementation of any destructive investigations.

This report is considered a live document and will be updated throughout the course of the project with the final report issued once the repairs have been completed.



1. INTRODUCTION

Holmes Consulting Group has been engaged by the Stewart Family Trust to complete a structural review following the Canterbury Earthquakes.

The Darfield Earthquake of 4:36am on 4th September, 2010 and the Lyttelton Earthquake of 12.51 pm on 22nd of February, 2011 have subjected the building to strong ground motions which significantly exceed the full design earthquake load for buildings of this nature. Consequently it is important that a full evaluation is performed.

1.1 PURPOSE

The purpose of this study was to:

- review the impact of the earthquakes on the building
- determine the seismic capacity of the building
- map typical damage around the building
- identify those items requiring repairs or replacement
- specify concept repairs to comply with Christchurch City Council regulations

The overall objective is to ensure that the building is repaired and opened for tenants in as timely and smooth a fashion as possible.

1.2 SCOPE OF WORK

The CERA detailed engineering evaluation procedure is currently in draft form and specific requirements for re-occupation of buildings or applications for Building Consents are not yet certain. As such, this report covers the following scope:-

- Review the available structural drawings to determine the building structural systems and predict areas of likely damage.
- Inspect a sufficient amount of the building structure to be able to make a determination of the behaviour of the building in the earthquake, and to map damage to the structure.
- Repair of damage caused directly by the earthquake.
- Adoption of the new loadings standard ($Z=0.3$).
- Assessment of Critical Collapse Hazards.
- Prepare a report detailing the proposed repairs required including extent and details.

The likely extent of repairs outlined herein is based on our observations described herein and does not consider any potential changes to the minimum design load levels other than those described above. Further repairs may also be identified during the course of conducting detailed observations.

It should be noted that even after the detailed observations and analysis outlined above, it is difficult to accurately quantify the residual capacity remaining in the structure following this significant earthquake. As such, it is likely that we may never be able to categorically state that the building is as good as it was before the earthquake.

1.3 LIMITATIONS

Findings presented as a part of this project are for the sole use of the Stewart Family Trust, its insurer, and the Christchurch City Council in its evaluation of the subject property. The findings are not intended for use by other parties, and may not contain sufficient information for the purposes of other parties or other uses.

Our observations have been visual only and limited to representative samples, as described in our record of observations. Our observations have been restricted to structural aspects only. Waterproofing elements, electrical and mechanical equipment, fire protection and safety systems, service connections, water supplies and sanitary fittings have not been inspected or reviewed, and secondary elements such as windows and fittings have not generally been reviewed.

Our professional services are performed using a degree of care and skill normally exercised, under similar circumstances, by reputable consultants practicing in this field at this time. No other warranty, expressed or implied, is made as to the professional advice presented in this report.



2. STATUTORY REQUIREMENTS

2.1 BUILDING ACT

When dealing with existing buildings there are a number of relevant sections of the Building Act [1] that need to be considered in relation to the building's structure and strength.

Section 112 - Alterations to Existing Buildings

Section 112 of the Building Act requires that a building subject to an alteration continue to comply with the relevant provisions of the Building Code to at least the same extent as before the alteration.

Essentially this section means that the building may not be made any weaker than it was, as a result of any alteration.

Section 122 – Meaning of Earthquake Prone Building

Section 122 of the Building Act 2004 deems a building to be earthquake prone if its ultimate capacity (strength) would be exceeded in a “moderate earthquake” and it would be likely to collapse causing injury or death, or damage to other property.

The Building Regulations (2005) define a moderate earthquake as one that would generate loads 33% as strong as those used to design an equivalent new building.

Section 124 – Powers of Territorial Authorities

If a building is found to be earthquake prone, the territorial authority has the power under section 124 of the Building Act to require strengthening work to be carried out, or to close the building and prevent occupancy.

Section 131 – Earthquake Prone Building Policy

Section 131 of the Building Act requires all territorial authorities to adopt a specific policy on dangerous, earthquake prone, and unsanitary buildings.

2.2 BUILDING CODE

The Building Act requires all new building work to comply with the New Zealand Building Code [2] which outlines the performance standards required for new building work. The Department of Building and Housing also publishes Compliance Documents which may be used to establish compliance with the Building Code.

Following the Lyttelton Earthquake, an amendment to the Compliance Document B1 Structure was published on the 19th May, 2011. This amendment contained changes to the seismic design loads for Canterbury including:-

- 36% increase in the basic seismic design load (Z) for Christchurch (new Z=0.3)
- 85% increase in the basic seismic design load (Z) for Akaroa (new Z=0.3)
- Increased serviceability limitations for new buildings

As a result, a building constructed last year to comply with the Building Code could now have a capacity of just 73% of the new load levels.

2.3 CHRISTCHURCH CITY COUNCIL POLICY

In 2006 the Christchurch City Council (CCC) adopted their Earthquake-Prone, Dangerous and Insanitary Building Policy [3], which was subsequently amended (under urgency) following the 4th September 2010 Darfield Earthquake.

The 2010 amendment outlines a process of identifying Earthquake Prone Buildings due to commence from 1 July 2012. Owners of Earthquake Prone Buildings identified through this process would have between 15-30 years to strengthen the building to a target of 67% of current code as outlined in Section 2.3.3.

Section 2.3.3 – Taking Action on Earthquake-prone Buildings

... As noted in section 2.3.1 of this Policy, the Council will determine the level of strengthening required to reduce or remove the danger on a building-by-building basis. It will be guided by the Recommendations of the New Zealand Society of Earthquake Engineers that 67% of Full Code Levels is a reasonable target level of strengthening to reduce the risk posed by existing buildings...

The CCC's 2010 policy also includes the following section covering the repair of buildings damaged by an earthquake:

Section 2.3.6 – Buildings Damaged by an Earthquake

Buildings may suffer damage in a seismic event. Applications for a building consent for repairs will be required to ensure structural strength. The Council will follow sections 2.3.1 and 2.3.3 of this Policy in determining the level of strengthening required for each building.

If a building consent application for repairs is not made and/or the repair work is not completed within a timeframe that the Council considers reasonable the Council reserves the right to serve notice under section 124(1) of the Building Act 2004 to require the work to be done.

The judgement of a recent case before the High Court of New Zealand (CIV 2012-409-2444 [2013] NZHC 51) states that "...territorial authorities may not use section 124 notices to advance a policy of increasing building capacity to a level above 34% of the NBS. However, they are not prevented from requiring work to reduce or remove specific vulnerabilities capable of causing injury, death or property damage where the subject building is also under 34% of the NBS"

While strengthening earthquake prone buildings to levels above 34% is desirable and recommended, this judgement indicates that the Christchurch City Council does not have the authority to require earthquake prone buildings to be strengthened beyond 34% of the NBS.

2.4 CANTERBURY EARTHQUAKE RECOVERY AUTHORITY (CERA)

The Canterbury Earthquake Recovery Authority (CERA) was established on 28th March, 2011 to take responsibility for the recovery of Christchurch by means of the Canterbury Earthquake Recovery Act 2011 [4] which was passed on 18 April, 2011. Under this act, the CEO (of the Canterbury Earthquake Recovery Agency, CERA) has wide powers in respect of verifying building safety and requiring demolition or repairs. Particularly relevant sections are;

Section 38 – Works

- (4) If the chief executive gives written notice to an owner of a building, structure, or other erection on or under land that demolition work is to be carried out there, -
 - (a) the owner must give notice to the chief executive within 10 days after the chief executive's notice is given stating whether or not the owner intends to carry out the works and, if the owner intends to do so, specifying a time within which the works will be carried out; and
 - (b) if the owner fails to give notice under paragraph (a) or the chief executive is not satisfied with the time specified, or the works are not carried out in the time specified or otherwise agreed, then –
 - (i) the chief executive may commission the carrying out of the works; and
 - (ii) in the case of the demolition of a building to which section 40(1) or (2) refers, the chief executive may recover the costs of carrying out the work from the owner of the dangerous building in question; and
 - (iii) the amount recoverable becomes a charge on the land on which the work was carried out.

Section 51 – Requiring Structural Survey

The chief executive may require any owner, insurer, or mortgagee of a building that he or she considers has or may have experienced structural change in the Canterbury earthquakes to carry out a full structural survey of the building before it is re-occupied for business or accommodation by the owner, a tenant, or any member of the public.

With regard to Section 51, we understand that it is likely that CERA will require a detailed engineering evaluation to be carried out for all buildings not exempt from the Earthquake Prone Building Legislation. At this stage it is not clear whether the detailed evaluation will be required prior to re-occupation.

CERA has recently published a draft procedure for the detailed engineering evaluation. Depending on the outcome of an initial qualitative assessment for a building, a further detailed quantitative assessment may be required. In addition to repair of earthquake damage, strengthening may be required in order to achieve compliance with the performance levels outlined in this evaluation procedure.

Typically the evaluation procedure defaults to achieving the minimum standard set out by the Earthquake Prone Building legislation, which has generally been accepted as achieving an ultimate limit state capacity equivalent to at least 33% current code.

3. PRE-EARTHQUAKE BUILDING CONDITION



This section discusses the form and capacity of the building prior to the Canterbury Earthquakes. The Sheer Adventures Workshop building at 78 Byron Street was constructed in two different time periods. The main structure was constructed in the 1960's with an addition along the eastern side of the building constructed in 1988. The original structural design for the 1988 addition was completed by Buchanan and Fletcher Ltd. Designers of the 1960's section are unknown. The street facing side of the structure is shown in Figure 3-1.

The information available for the review included the structural drawings for the eastern addition. Construction documents for the original warehouse structure were not available. A geotechnical assessment has not been conducted for this site at the time of this report.



Figure 3-1: Sheer Adventure Workshop – 78 Byron St

3.1 BUILDING FORM

The Sheer Adventure Workshop overall building footprint is approximately 28 m by 26 m. The building is composed of two sections built in separate time periods. The building is located adjacent to buildings on its eastern and southern elevations. The building is structurally separate from the neighbouring buildings. There may be some small separation gap between the buildings, however existing external façade elements and internal linings prevented the

direct observation of the gap. There was originally a link (door opening) between the eastern addition and the building to the south. This has since been filled in with a fire rated concrete block wall. The block wall appears to be attached to the southern building and separated from this building. The overall building footprint is illustrated in Figure 3-2.

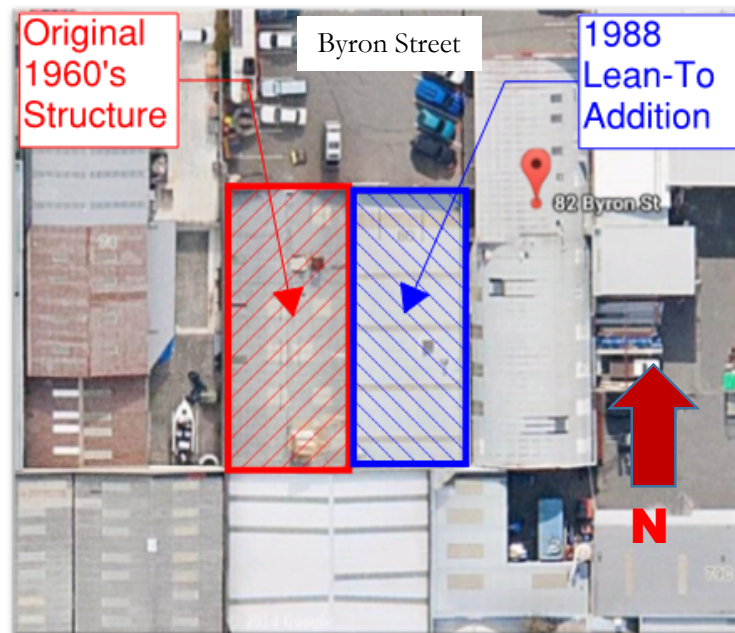


Figure 3-2: Sheer Adventure Workshop – Original Structure and Eastern Addition

The original structure, the western section, was designed and constructed in the 1960's (Figures 3-3 and 3-4). The building was likely designed to predecessor standards of the current NZ Building Code, comprising principally NZS1900:1965. The building is a single story structure, with an internal timber framed mezzanine at the north end of the building. The structure is an open warehouse with steel portal frames running across the building in the east-west direction. The portal frames are composed of I-sections with the columns encased in concrete. Infill walls around the west, south, and original 1960's eastern perimeter of the building are constructed of ungrouted concrete blockwork. There is a solid bond beam along the top of these walls that appears to be reinforced concrete. The roof is composed of diagonal sarking on timber framing with numerous skylights. There is no foundation information available to review however given the type of building and damage observed, the likely construction is concrete slab on grade with shallow pads under portal legs and shallow strip foundations under the walls.

The lean-to addition, the eastern section, was designed and constructed in 1988 (Figures 3-3 and 3-5). This addition was likely designed to the NZS4203 (1984) loadings standard. The structure consists of glulam cantilevered L-shaped frames which span in the east-west direction and are pinned to the original structure's reinforced concrete bond beam. The roof is composed of light gage metal roofing and insulation supported by timber purlins. The south, north, and east walls are composed of light timber framing. A connection doorway to the building adjacent to the south wall has been in-filled with a grout filled concrete block wall. The wall appears to be tied into the structural concrete blockwork walls of the adjacent structure, and are therefore not a part of this building. There is a short height timber framed mezzanine at the north end.

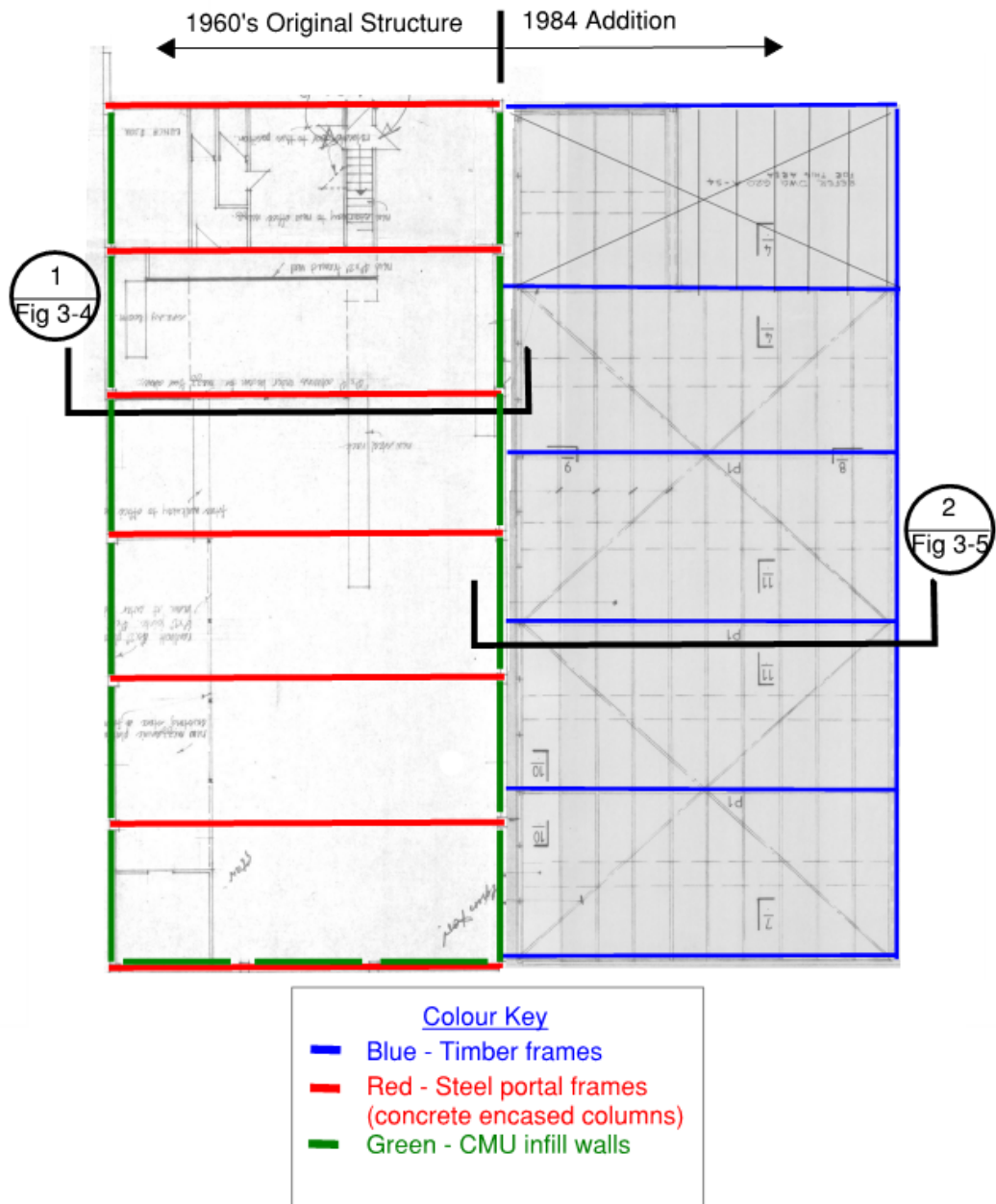


Figure 3-3: Sheer Adventure Workshop – Plan View of Building

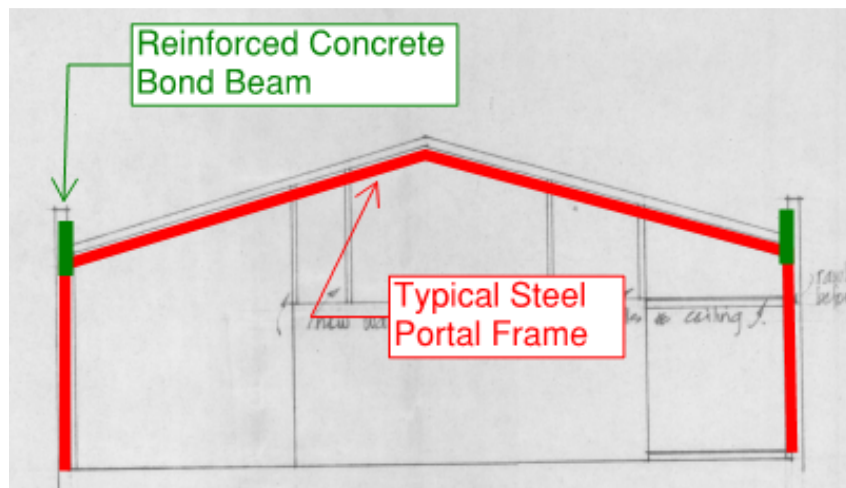


Figure 3-4: Section 1 - 1960's Original Steel Building Cross Section

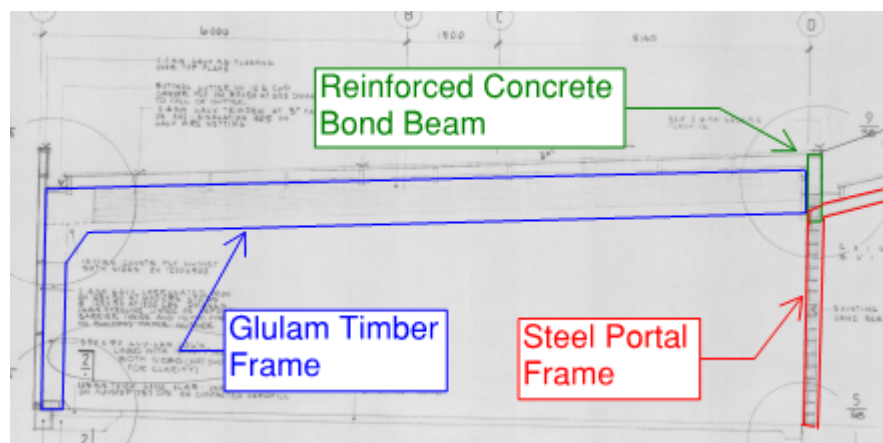


Figure 3-5: Section 2 - 1980's Eastern Addition

3.2 LATERAL LOAD RESISTING SYSTEM

In the east-west (across) direction lateral loads for the original structure at the roof level are distributed by the diagonal timber sarking and are resisted, typically, by the steel portal frames. Lateral loads at the roof level from the eastern lean-to addition are distributed to the timber glulam frames via the purlins. The lateral loads from the walls are transferred directly to the timber glulam frames. The timber glulam frames in the addition and the original steel portal frames are connected by the concrete bond beam of the original structure. The timber glulam frames and original steel portal frames are offset, as shown in Figure 3-3. Lateral loads are resisted by a combination of frame action in the glulam frame and the steel portal frames.

In the north-south direction in the original structure, lateral loads at the roof level are distributed by diagonal timber sarking to the reinforced concrete bond beam and resisted by the ungrouted concrete block infill walls between the portal frames. Lateral loads at the roof level of the lean-to addition are distributed by tension only steel strap bracing to the gib lined timber wall along the western edge of the building and to the reinforced concrete bond beam in the centre of the building. Lateral loads are resisted by the gib lined timber perimeter wall and the ungrouted concrete block infill walls below the reinforced concrete bond beam.

3.3 PRE-EARTHQUAKE BUILDING CAPACITY – DIRECT CODE COMPARISON

The original structure, the western building, was likely designed to the NZS1900:1965 loadings standard. The eastern addition, constructed in 1988, was likely designed to the NZS4203 (1984) loadings standard. Both standards have been replaced by NZS1170.5:2004 [8]. The recent amendment to the Building Code has further increased the load levels defined in NZS1170.

Based upon building occupancy, the Sheer Adventures Workshop has been considered as an Importance Level 2 (IL2) building in accordance with NZS1170.5:2004 [8]. For a building design life of 50 years, the associated return period of the Design Base Earthquake (DBE) is 500 years. Per the loadings standard for a warehouse structure as prescribed in this code (no post-disaster or special function), the risk factor for design is taken as $R=1.0$. The sub soil for the entire site has been assumed to be Soil Type D in accordance with NZS1170, which is typical of this location in Christchurch. The fundamental period of the structure was assumed to be 0.4s for out-of-plane and in-plane ungrouted concrete block walls. The fundamental period of the steel portal frame with lean-to frame addition was estimated with the Raleigh method to be approximately 1.0s.

Based upon the information available, we have assumed the following levels of ductility:

- in-plane lateral loads for frames – nominally ductile, $\mu=1.25$
- in-plane lateral loads for ungrouted concrete block walls – elastic, $\mu=1.0$
- Out-of-plane lateral loads for ungrouted concrete block walls – elastic, $\mu=1.0$

Comparisons of the load levels represented by the original loading standards to the current loading standard are plotted below for a building fundamental period of 0.4s. The seismic design loads from NZS1900:1965 are approximately 15% of current design loads. Seismic loads from NZS4203(1984) are approximately 35% of current design loads.

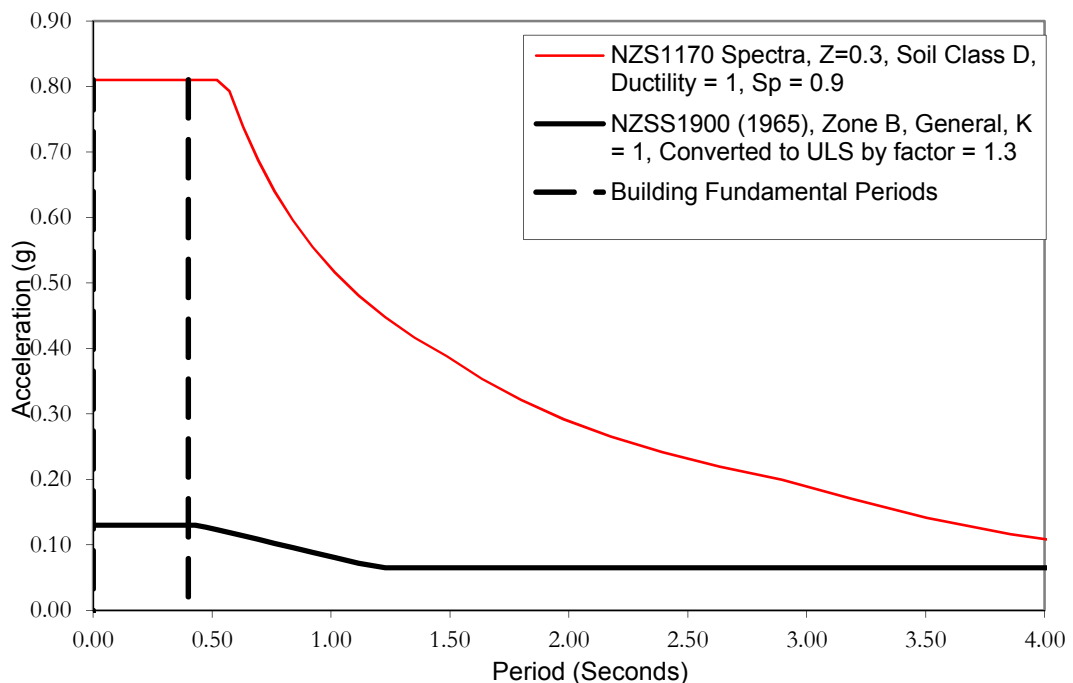


Figure 3-6: Comparison of Design Codes (NZSS1900 to NZS1170)

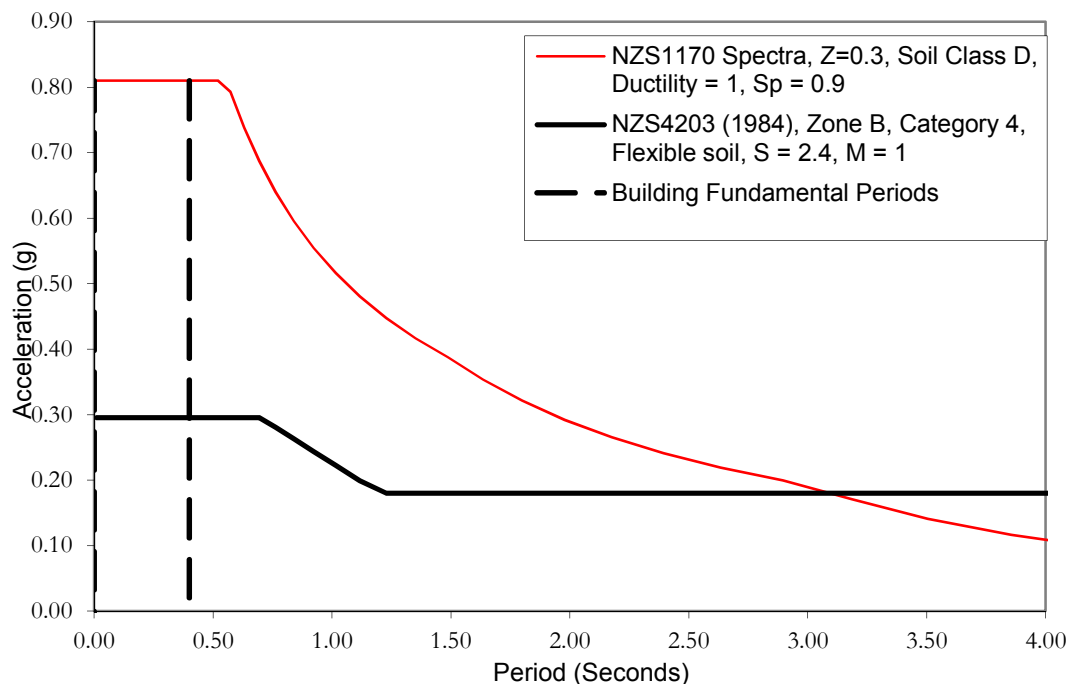


Figure 3-7: Comparison of Design Codes (NZS4203 to NZS1170)

3.4 PRE-EARTHQUAKE BUILDING CAPACITY – EQUIVALENT STATIC ANALYSIS TO NZS1170.5 (2004)

In addition to the direct code comparison provided above, an equivalent static analysis to NZS1170.5:2004 has been carried out to gain a better understanding of the buildings capacity when compared to current loading standards. The equivalent static analysis was carried out based upon the original construction documents available, incorporating on-site measurements and as-built observations.

The probable capacities have been calculated using the *New Zealand Society for Earthquake Engineering Guidelines for the Assessment of the Structural Performance of Buildings in Earthquakes* – NZSEE 2006 [13]. The guidelines allow some relaxation of the requirements for existing buildings when compared to what would be required for a new building. As a result existing buildings shown to achieve 100% of current code loading may not achieve the same level of seismic performance as a new building designed to achieve minimum compliance with the building code.

Account is also made of critical structural weaknesses. Critical structural weaknesses (CSW) are details, configurations, and building or site characteristics that could lead to increased damage levels in a building or the premature failure or collapse of all or part of a building.

To provide a comparison for each of the primary lateral components, the relative capacity of the elements have been assessed as a percentage of the demand imposed by the current loading code Design Basis Earthquake, and have been expressed as a %DBE. This includes checks for both strength and deflection requirements.

The demand on the various structural elements of the system were determined by performing a three dimensional analysis on the main framing elements. A three-dimensional model was constructed and analysed in an analysis program based on information contained on the available construction drawings and from on-site measurements. Based on the time period and

type of building construction, some fixity in the portal frame foundations was assumed in the model.

To determine the design loads imposed by the current loading standard, the building natural periods were estimated to be 0.4s in the north-south direction and approximately 1.0s in the east-west direction. The fundamental period in the east-west direction was determined using the Raleigh Method described in the loading standard. From the structure's natural period and ductility, as listed in Section 3.3, the loading demand imposed by the current standard was determined and applied to the analysis model. The demand on the various structural components was obtained from the analysis results and compared to the calculated capacities to determine the %DBE of each element.

The calculated seismic capacity in the east-west direction of the Sheer Adventures Workshop is approximately 35% DBE. The limiting elements in the structure are the east-west steel and glulam portal frames. The table below outlines the capacities of various elements in the structure.

The limiting factor in the north-south direction for the capacity of the Sheer Adventures workshop is the central ungrouted concrete block work infill walls which are at 70% DBE and limited by sliding shear of the infill walls.

Due to the flexible nature of the portal frames, large deflections are likely to occur, especially in at the western edge of the building. If the seismic gap with the adjacent building is insufficient, pounding is likely to occur.

To the north of the western concrete masonry wall of the original warehouse structure there is an extension of the concrete masonry block wall that appears to cantilever from the ground. There does not appear to be any dowel connection between the original wall and the extension. Assuming the wall is fully grouted with minimum reinforcement, the wall is at approximately 15% DBE and limited by out-of-plane loading.

Table 3-1: 78 Sheer Adventure Workshop – Seismic Assessment %DBE

Building Element	%DBE (IL2)	Comments
Ceiling Diaphragm – NS - EW	100 100	Diagonal sheathing in west side of building
Ceiling Tension Strap Bracing	95	Bracing is limited by tensile capacity
GluLam Portal Frames	35	Glulam frame is limited by combined bending and axial loading in the column
Steel Portal Frames	35	Steel portal frame is limited by combined bending and axial loading in beam element
Gib lined timber framed wall	70	Capacity limited by nail slip
Concrete Bond Beam	50	Capacity limited by out-of-plane flexural capacity due to assumed reinforcement layout.
UngROUTED concrete masonry block infill walls – in plane	70	Capacity limited by sliding shear
UngROUTED Concrete masonry block infill walls – face loading.	65	Capacity is limited by south wall block wall spanning between ground and roof
External Concrete Masonry Block wall – face loading	15	Capacity is limited by moment capacity at base of cantilevered wall



4. EARTHQUAKE EVALUATION

4.1 EARTHQUAKE SHAKING EXPERIENCED AT THE SITE

The Geonet Project, run by EQC and GNS Science, maintains the New Zealand National Seismograph Network which consists of a series of strong motion seismometers set up around New Zealand. The following image shows the location of the four closest monitoring stations to the building.

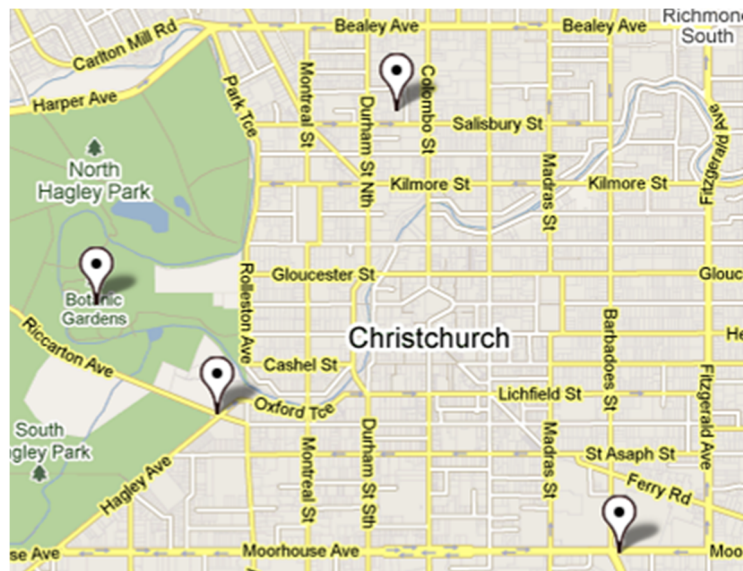


Figure 4-1: Location of Nearby Monitoring Stations

The strong motion shaking data resulting from the Darfield and the Lyttelton Earthquakes has been downloaded from these monitoring stations and processed to obtain acceleration response spectra (a response spectra essentially defines the peak response for a building subjected to the ground shaking, as a function of its fundamental period).

The accelerations recorded from the Lyttelton Earthquake are generally larger than those from the Darfield Earthquake, therefore these are presented and discussed in this section.

The following graphs plot the acceleration response spectra processed from the Geonet monitoring stations for the initial main shock of the Lyttelton Earthquake at 12:51pm on the 22nd February, as well as the elastic design spectra (NZS1170) for a new building constructed on the site. For reference the fundamental period of the building has been plotted on the graphs of the North-South and West-East directions respectively.

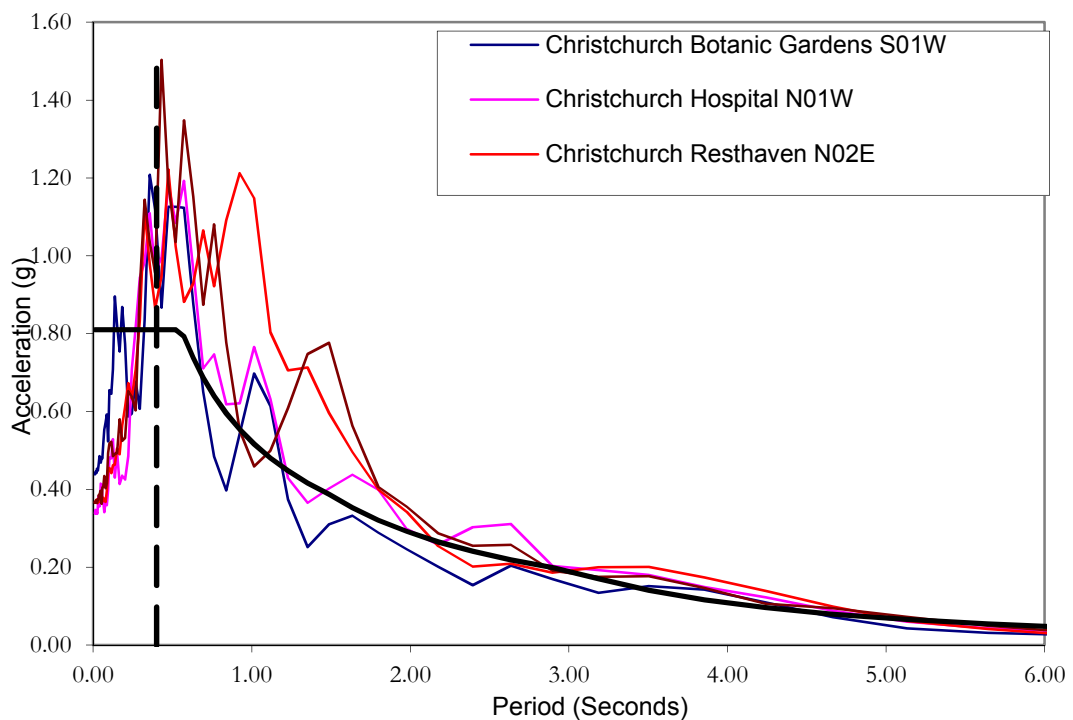


Figure 4-2: 5% Damped Spectra – North-South

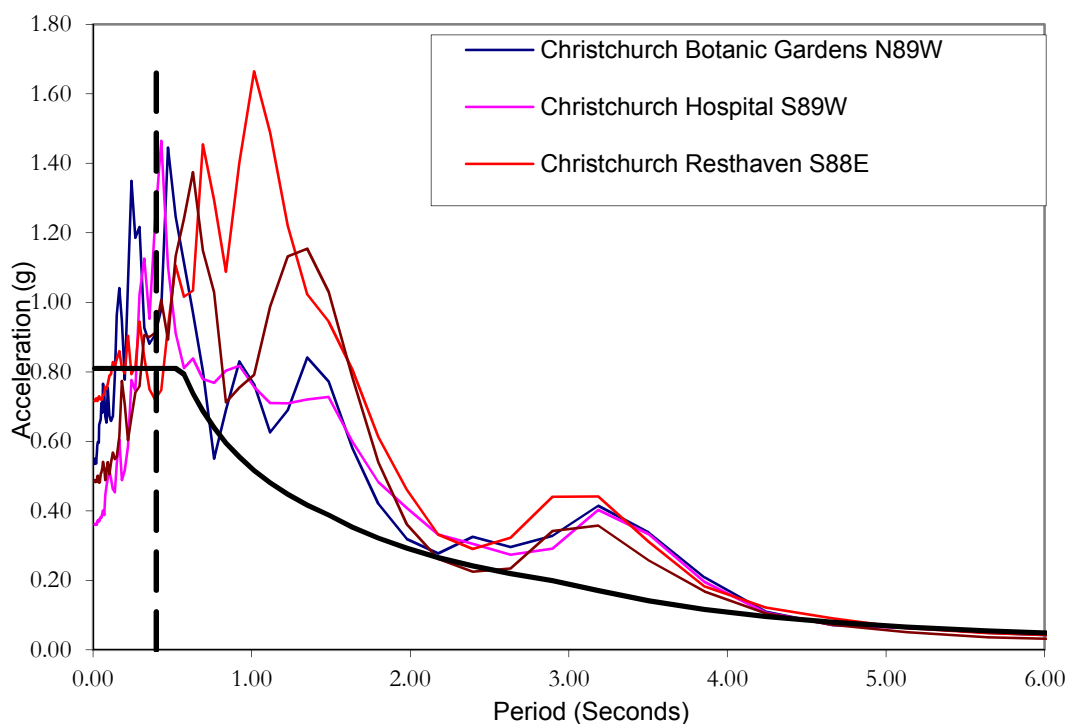


Figure 4-3: 5% Damped Spectra – East-West

It is apparent that in both directions there is significant variation in the shaking experienced at the different monitoring sites. This is due to the highly variable ground conditions around Christchurch.

The Shear Adventure Workshop building has been determined to have a fundamental period to less than 0.4 seconds (north-south) and (east-west). Based on the strong motion data downloaded, it is likely that the earthquake produced accelerations significantly in excess of the design spectra for this building.

Modern office buildings, typically designed to an importance level of 2 (IL2), are designed to resist an earthquake with a return period of 500 years at the Ultimate Limit State (ULS). The magnitude of the ground accelerations recorded in the CBD are in the order of 150% to 200% of the current design code at the time of the earthquake, and are some of the strongest ever recorded in the world. This intensity of shaking is roughly equivalent to an earthquake in Christchurch having a return period of 2500 years, deemed to be the Maximum Credible Event (MCE). At this level of shaking, modern buildings designed to the current codes in place at the time are expected to be at the point of collapse.

However it should also be noted that this earthquake was relatively short in terms of the strong shaking produced. The following plot of the earthquake record from the Christchurch Hospital monitoring station at 12:51 pm on the 22nd of February shows that the strong motion only lasted for a duration of approximately 5-10 seconds.

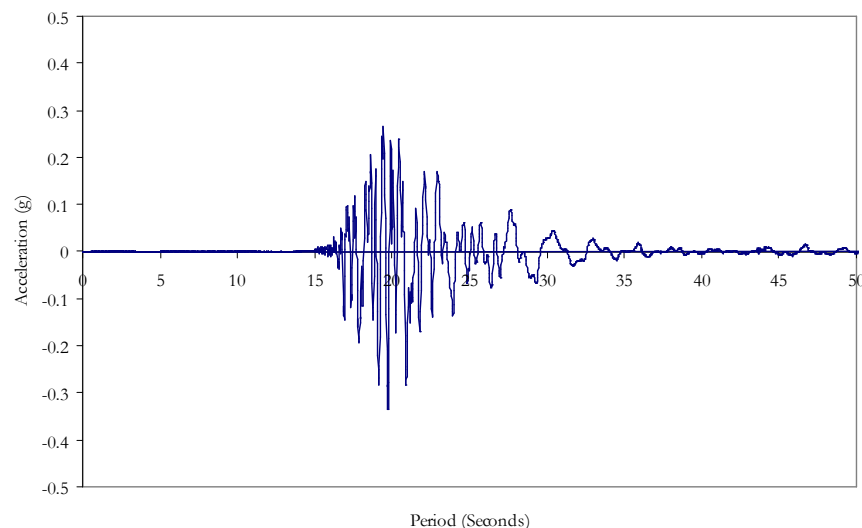


Figure 4-4: Earthquake Record from Christchurch Hospital Site

Because of this the building has only gone through a limited number of inelastic cycles. A full design earthquake for Christchurch (eg rupture of the Alpine Fault) is expected to have a significantly longer record of shaking, although the accelerations are not expected to be as strong. As an indication, rupture of the Alpine Fault is expected to contain in excess of 60 seconds of strong motion.

Due to the highly variable ground conditions around Christchurch, it is impossible to determine what the actual shaking experienced at the site was. However, based on the data described above it is likely that the shaking experienced by the building could have exceeded the current code design spectra for the building

4.2 PRELIMINARY INVESTIGATIONS

Preliminary investigations have been undertaken to ascertain areas of the building likely to be subject to damage, and therefore requiring specific attention during the detailed assessment. The areas identified for detailed inspection have been selected based on:-

- typical damage expected for buildings of this form;
- a review of the original drawings [6];
- review work undertaken to date;
- damage observed following the earthquakes.

In conjunction with a review of the structural drawings and previous damage review associated with this building the following areas were identified for potential damage:-

- Cracking of concrete block work wall mortar joints
- Distress at portal frame moment connections
- Differential settlement and lateral spreading of slab on grade
- Differential settlement and lateral spreading of walls and foundations

4.3 SUMMARY OF BUILDING DAMAGE

The following is a summary of the structural damage observed.

- In plane diagonal cracking along concrete block wall mortar joints
- Cracking along slab construction joints
- Differential settlement and lateral spreading of slab on grade
- Out of vertical walls at central block work wall and southern wall of eastern structure
- Broken tension only strap cross bracing in eastern structure

4.4 FURTHER INVESTIGATIONS REQUIRED

No geotechnical information is available for the building site. A geotechnical report should be completed to assess the ground conditions at the site.

Destructive investigations should be conducted to examine the condition of the steel portal frame beam to column connections ensure no damage occurred.

The connection between the reinforced bond beam and the steel portal frames as well as the steel portal frame foundations should be exposed and observed to confirm analysis assumptions.



5. DAMAGE OBSERVED & REPAIRS REQUIRED

5.1 TYPICAL DAMAGE OBSERVED & REPAIRS REQUIRED

Table 5-1 provides a photographic summary of the observed damage and typical repairs required. The table should be read in conjunction with Appendix A – Damage Photo Location Map and Appendix B – Record of Observations. The Repair Specification is attached in Appendix D.

Generally the aim of the repair work indicated is to restore the structure to its pre-earthquake state as far as practicable. Specifically the repair work described herein does not include the strengthening required to comply with the relevant regulations outlined in Section 2. It should be noted that more damage may be identified during the repair works and (if required) additional repair details will be specified accordingly.

The damage outlined herein does not include the necessary repair or replacement of architectural items, services, etc, or the removal of such items necessary to carry out structural observations. We recommend appropriate professionals be engaged to carry out scoping of these non-structural works.

Table 5-1: 78 Sheer Adventure Workshop - Photographic Summary of Primary Damage Observed & Repairs Required

Damaged Item	Location	Example	Recommended Repair
1. Slab on Grade			
1.1. Cracking and spreading at slab construction joints	South section of eastern structure		Chase channels each side of crack and install dowels across crack to prevent future lateral spreading of slab.
1.2. Differential settlement of slab	South section of eastern structure		Remove section of slab that has lifted. Re-level ground. Install new slab with epoxy dowels into adjacent slab sections.

Damaged Item	Location	Example	Recommended Repair
1.3. Differential settlement of slab	Southern wall at internal wall junction with slab in eastern structure.		Remove section of slab that has lifted. Re-level ground. Install new slab with epoxy dowels into adjacent slab sections.
2. Concrete Block Infill Walls			
2.1. Diagonal cracking along mortar joints in concrete block infill walls	Occurs along the west, south, and east walls of the original factory building (west structure)		Repair and repoint all mortar joint cracks from both the inside and outer faces.

Damaged Item	Location	Example	Recommended Repair
2.2. Vertical cracking in concrete block work wall	Occurs in north section of west wall		Remove and replace cracked concrete blocks. Repair and repoint cracked mortar joints.
2.3. External concrete block wing wall extension has moved creating a gap in the upper portion	External concrete wing wall at northwest corner of building		Remove wing-wall extension or strengthen for face loads. Provide temporary propping while the fire requirements are confirmed and the solution for the wall is determined.

Damaged Item	Location	Example	Recommended Repair
3. Western structure portal frames			
3.1. Cracking and spalling of concrete column to steel beam connection	Top of west portal frame column at west boundary wall		Remove concrete and observe beam to column connection to ensure no signs of distress. If no signs of distress, repair concrete encasement of column per repair specification.
3.2. Cracking and spalling of concrete column at slab level	Occurs at several locations in the western structure		Remove concrete and observe column at base to ensure no signs of distress. If no signs of distress, repair concrete encasement of column per repair specification.
4. Roof			
4.1. Broken roof tension strap	Eastern structure		Replace broken strapping. Refer to Section 5.2.

5.2 ROOF TENSION STRAP CROSS BRACING

In the eastern lean-to addition, a roof tension strap cross bracing member has failed in tension and snapped apart. This is likely due to the difference in stiffness of the eastern gib lined timber framed wall and the internal concrete blockwork infill walls. As determined in section 3, the capacity of the tension strap bracing is at 95% DBE.

The strap brace should be replaced. To improve the performance of the structure in future seismic events, the gib wall along the eastern boundary should be stiffened with additional bracing or additional strap bracing should be installed.

5.3 NORTHWEST WING WALL

In the northwest corner of the original 1960's warehouse structure, a concrete masonry block wall wing wall extension has, at some point, been added along the western boundary wall. This wall does not appear to be tied to the original wall or concrete bond beam and cantilevers from ground level. The out-of-plane capacity of the wall is 15% DBE. There are signs of lateral movement at the base of the wall and along the joint with the original wing wall end.

The wall extension may have been installed due to fire requirements. Temporarily prop the wall until the fire requirements are investigated and a strengthening solution can be determined.

5.4 DIFFERENTIAL SETTLEMENT REMEDIATION

In addition to the damage and repairs outlined in Table 5-1, differential settlement of the slab and foundations was identified onsite and in the levels survey. From the levels survey, the slab-on-grade and walls appear to have settled in the earthquake. The general pattern of settlement inside the western half of the building is settlement of the external wall foundations relative to the internal slab causing bowing in the slab. This is likely due to the heavier loads carried by the perimeter walls. The differential settlement along the wall foundations is typically less than 20mm. The differential settlement between the slab and the wall foundations is generally 35 mm or less. There is a high spot in the centre of the western half of the building.

In the eastern half of the building, settlement was generally relatively even throughout the interior with low spots at the south and north ends of the building. This is likely due to the light weight timber construction of the addition.

Slopes, throughout the building, are typically around 0.50% (1:200). In a localised area towards the south of the eastern lean-to addition, the slope is approximately 0.8% (1:130). Near this location, the slab has cracked along a construction joint. The differential settlement across the construction joint is approximately 10 mm.

5.4.1 Repair Work to Return the Building to Original Level

Based on these observations, the settlements affecting the foundations and walls may be acceptable and not require re-levelling. The bowing in the ground floor slab can be addressed by locally demolishing and replacing the existing slab-on-grade. The areas of slab to be replaced include the southern end of both the western and eastern parts of the building as well as the northern area of the eastern half of the building. Refer to Appendix C for the extent of slab replacement.

The existing slab-on-grade to be demolished should be replaced with a new 125mm slab on DPM on sand binding on 150 mm of compacted hard fill. Allow for reinforcing in the slab of 12mm diameter deformed reinforcing bars at 300mm centres each way. The demolition is to

be such that the dowels connecting the foundation beam to the slab remain in place and are cast into the new slab. Allow to epoxy inject D12 starters at 300 mm into the existing slab and foundations around the perimeter of the new slab.

Note that this option will return the structure to its pre-earthquake level and lateral capacity, but does not address the mitigation or prevention of differential settlements occurring in future seismic events. Differential settlements could reduce the lateral capacity of the structure. However, as indicated above, there has not been significant differential settlement between existing foundations in recent events. The mitigation of future differential settlement should be considered in any future strengthening scheme.



6. POST-EARTHQUAKE BUILDING CAPACITY

6.1 POST-EARTHQUAKE BUILDING CAPACITY

In its damaged state following the earthquakes, we consider the Sheer Adventures workshop to have no reduction in gravity load resistance. The overall lateral load resisting capacity of the building in the north-south direction has been affected due to the snapping of the eastern roof tension strap bracing and due to diagonal cracking along the mortar joints of the ungrouted concrete blockwork infill walls. The roof tension strap bracing that has snapped has reduced the roof bracing capacity from 95% to 75% DBE. Diagonal cracking along the mortar joints of the concrete blockwork walls has reduced the lateral load resisting capacity of the walls to approximately 35% DBE. This has been determined by considering the blockwork infill wall panels that remain uncracked as well as accounting for some contributions to capacity from the damaged walls per NZSEE 2006. Distribution via the reinforced concrete bond beam of the lateral loads to undamaged infill wall segments is likely to occur.

The overall lateral load resisting capacity of the building in the east-west direction has not been significantly reduced due to the damage observed after the earthquakes.

Following the recommended repair of the structural damage, the lateral load resisting performance of the structure will be restored. The capacity of the primary structural system in the east-west direction will be approximately 35% of DBE and in the north-south direction will be 75% DBE.

Following the recommended repair of the consequential damage the durability performance of the structure should be restored. However this should continue to be monitored throughout the life of the building to ensure that the sealants are maintained to prevent moisture penetration, and that any future cracking is repaired.



7. REFERENCES

- 1 *Building Act 2004*, New Zealand Government
- 2 *New Zealand Building Code*, New Zealand Government
- 3 *Earthquake-Prone Dangerous and Insanitary Buildings Policy 2010*, Christchurch City Council, 2010
- 4 *The Canterbury Earthquake Recovery Act 2011*
- 5 78-82 Byron Street – EQ Damage and Repair, Structex, September 2013
- 6 Temporary Warehouse 82 Byron St Christchurch, Holmes, Wood & Poole, April 1975
- 7 Survey Report for Building Survey at 78 & 82 Byron St, Christchurch, Staig & Smith, August 2013
- 8 *Structural Design Actions part 5: Earthquake Actions – New Zealand*, NZS 1170.5:2004, Standards New Zealand, 2004
- 9 *Timber Framed Buildings*, NZS 3604:2011, Standards New Zealand, 2011
- 10 *Steel Structures Standard*, NZS 3404:1997, Standards New Zealand, 1997
- 11 *Timber Structures Standard*, NZS 3603:1993, Standards New Zealand 1993
- 12 *Design of Reinforced Concrete Masonry Structures*, NZS 4230:2004, Standards New Zealand, 2004
- 13 *Assessment and Improvement of the Structural Performance of Buildings in Earthquakes*, NZSEE-2006, New Zealand Society for Earthquake engineering, 2006



APPENDIX A

Damage Map



Project Name: **78 Byron Street DEE Building A**

Project No: **111702**

Calcs By: **DJH**

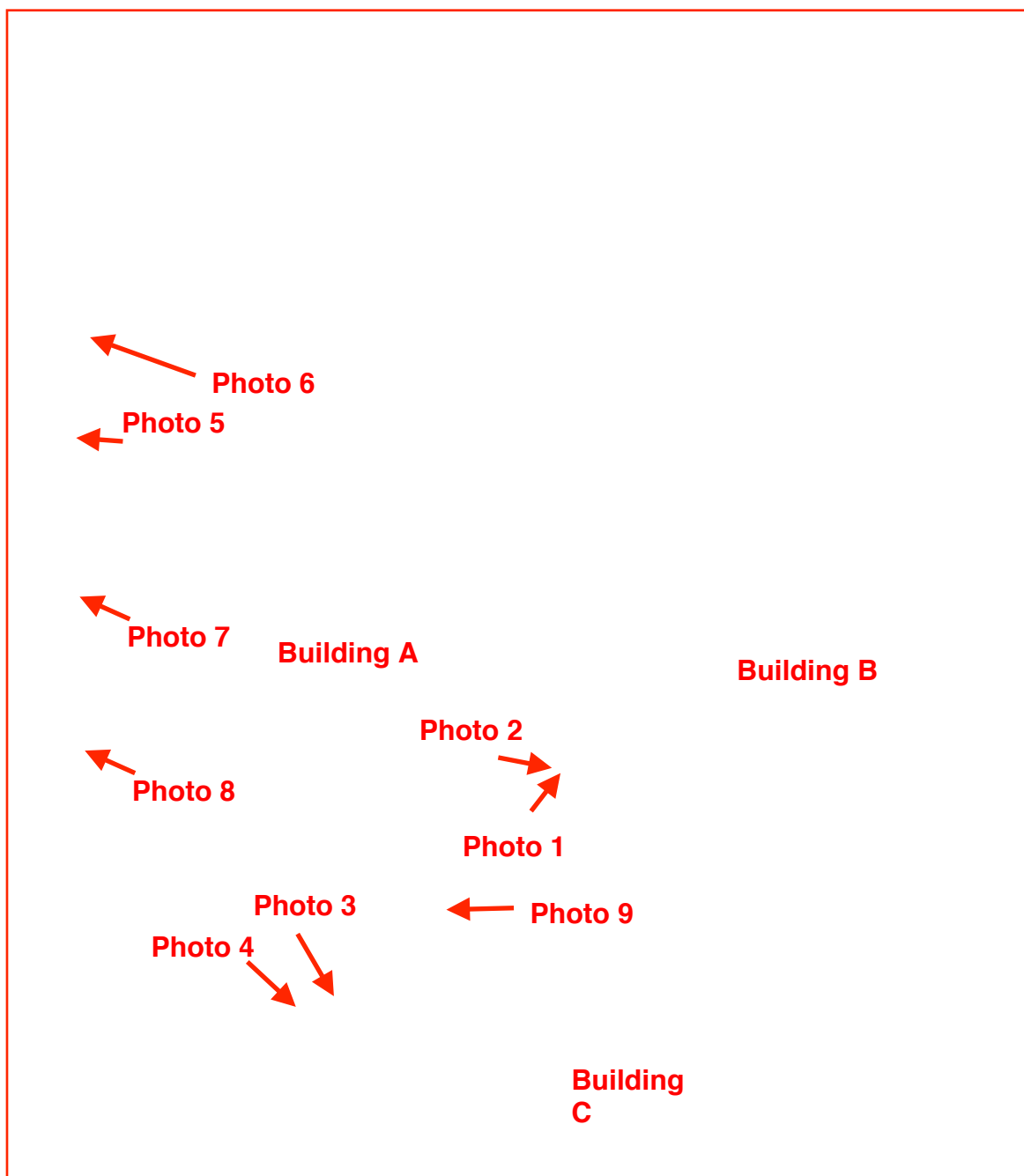
Date: **24/06/14**

Sketch No: **APA-SK01**

Page No: **1**

Revision: **1**

CALCS / SKETCHES



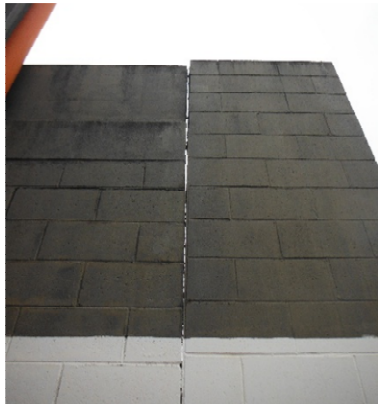


APPENDIX B

Record of Observations

Damaged Item	Location	Example	Recommended Repair
1. Slab on Grade			
1.1. Cracking and spreading at slab construction joints	South section of eastern structure See damage map photo 1.		Chase channels each side of crack and install dowels across crack to prevent future lateral spreading of slab.
1.2. Differential settlement of slab	South section of eastern structure See damage map photo 2.		Remove section of slab that has lifted. Re-level ground. Install new slab with epoxy dowels into adjacent slab sections.

Damaged Item	Location	Example	Recommended Repair
1.3. Differential settlement of slab	Southern wall at internal wall junction with slab in eastern structure. See damage map photo 3.		Remove section of slab that has lifted. Re-level ground. Install new slab with epoxy dowels into adjacent slab sections.
2. Concrete Block Infill Walls			
2.1. Diagonal cracking along mortar joints in concrete block infill walls	Occurs along the west, south, and east walls of the original factory building (west structure) See damage map photo 4.		Repair and repoint all mortar joint cracks from both the inside and outer faces.

Damaged Item	Location	Example	Recommended Repair
2.2. Vertical cracking in concrete block work wall	Occurs in north section of west wall See damage map photo 5.		Remove and replace cracked concrete blocks. Repair and repoint cracked mortar joints.
2.3. External concrete block wing wall extension has moved creating a gap in the upper portion	External concrete wing wall at northwest corner of building See damage map photo 6.		Remove wing-wall extension or strengthen for face loads. Provide temporary propping while the fire requirements are confirmed and the solution for the wall is determined.

Damaged Item	Location	Example	Recommended Repair
3. Western structure portal frames			
3.1. Cracking and spalling of concrete column to steel beam connection	Top of west portal frame column at west boundary wall See damage map photo 7.		Remove concrete and observe beam to column connection to ensure no signs of distress. If no signs of distress, repair concrete encasement of column per repair specification.
3.2. Cracking and spalling of concrete column at slab level	Occurs at several locations in the western structure See damage map photo 8.		Remove concrete and observe column at base to ensure no signs of distress. If no signs of distress, repair concrete encasement of column per repair specification.
4. Roof			
4.1. Broken roof tension strap	Eastern structure See damage map photo 9.		Replace broken strapping.



APPENDIX C

Conceptual Repair Plan



Project Name: **78 Byron Street DEE - Building A**

Project No: **111702**

Calcs By: **DJH**

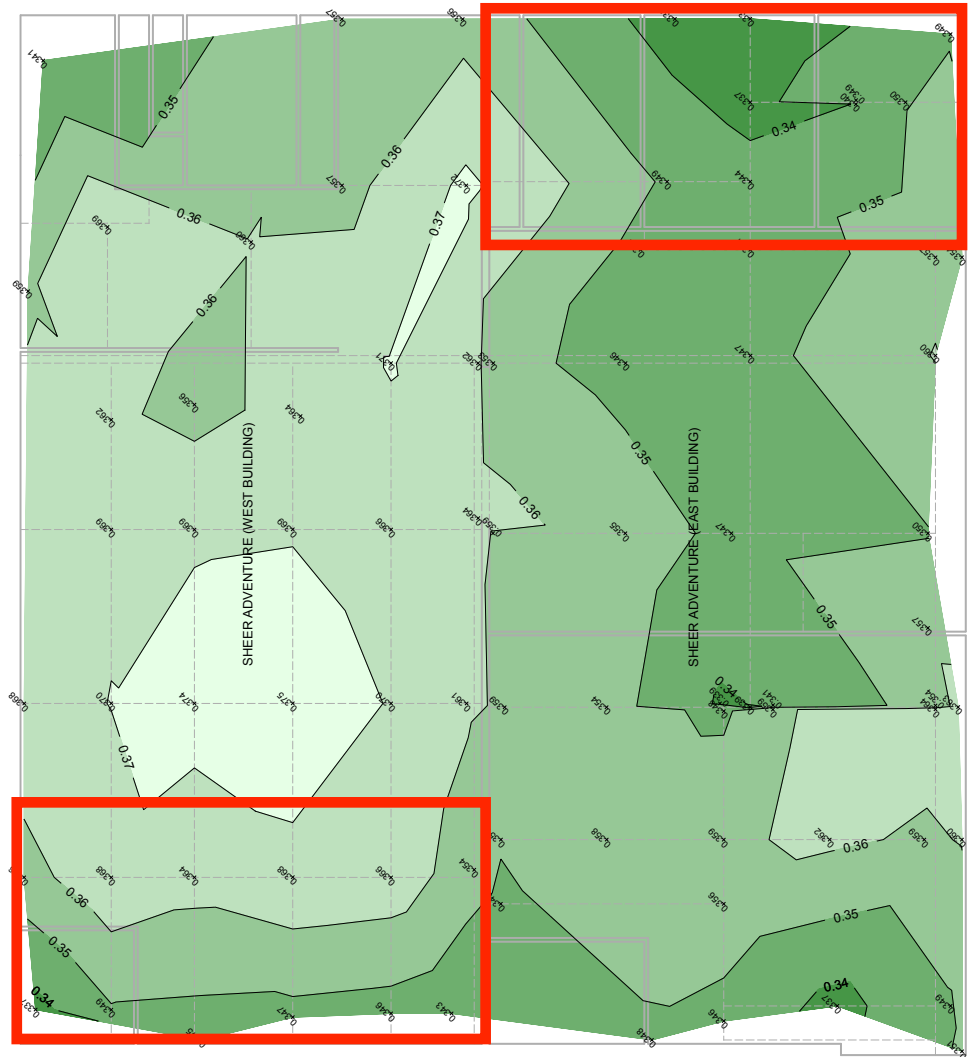
Date: **24/06/14**

Sketch No: **APC-SK01**

Page No: **1**

Revision: **1**

CALCS/SKETCHES



- Area of slab to be broken out and replaced with D12 starters epoxied into existing slab or foundations/walls to remain.



APPENDIX D

Building Alignment Survey



SURVEY REPORT FOR BUILDING SURVEY AT 78 & 82 BYRON ST, CHRISTCHURCH

Introduction

Staic and Smith Ltd were engaged to carry out a survey of the buildings at 78 & 82 Byron St. The site comprises four individual buildings; the eastern and south-eastern buildings are tenanted by Socks Pacific and the two western buildings are tenanted by Sheer Adventure.



Diagram of the buildings surveyed.

The aim of the survey was to measure the building following the recent significant earthquakes in Christchurch.

The work involved surveying the following elements:

- Floor levels and gradients
- Internal column verticality

Following the survey, a set of plans have been prepared detailing the results from the survey.

Methodology

The survey was carried out on the 28th and 29th August 2013.

Levels

Levels were surveyed with a Leica 150M Sprinter Digital Level (SN 2111297). This instrument has a measuring standard deviation of 0.6mm (electronic) and 1.2mm (optical) at 30m. Closed level loops were observed. Levels were positioned relative to the walls. In the Socks Pacific showroom the level positions were based on a grid using



the portals and concrete slabs. In the remainder of the Socks Pacific the level positions were based on a 3x3 grid on each individual concrete slab. In the Sheer Adventure buildings the level positions were based on the concrete slab edges.

Contours have been provided at 10mm (0.01m) intervals.

Assumed datums have been used for the level surveys and origin marks are shown and labelled on the plans.

Any noticeable cracks or steps in the slab were surveyed and have been shown on the plan. The thickness of the different floor coverings was measured and levels have been adjusted so that all levels are in terms of the concrete surface.

Verticality Alignment

Verticality measurements were made with a Leica TCRP 1202 Robotic Total Station (SN 227215). This instrument has measuring standard deviations of 2" for angle and 2mm+2ppm for prism distance and 3mm+2ppm for reflectorless distance.

Measurements were made directly onto the walls/columns using reflectorless EDM measurements from the total station. The top and bottom of the columns/walls were measured wherever practical.

Analysis

Socks Pacific Northern Building

The floor contours and levels indicate that the central part of the floor is generally lower than the outside of the floor, with particularly low areas seen at the central southern, central middle and central northern parts of the floor. There are noticeably high areas at the central western and central eastern parts of the floor. Note the very outer edge of the floor, which is outside the main floor slabs, drops away significantly.

The floor slope plan shows maximum slopes adjacent cracks and on the outer edge of the floor as expected. Large areas of the floor, mainly in the outer areas, have gradients of 0.5% or more.

No verticality measurements were made in this building.

Socks Pacific Southern Building

The floor contours and levels indicate that the central part of the floor is generally higher than the outside of the floor. There is a noticeably low area at the south-eastern corner of the floor.

The floor slope plan shows that the majority of the floor has gradients of 0.5% or more, particularly the southern part of the floor.

The verticality values show maximum deviations from vertical near the southeast and southwest corners of the building.

Sheer Adventure Eastern Building

The floor contours and levels indicate that the central part of the floor is generally higher than the outside of the floor, as well as low spots on the central northern and central southern edges of the floor. There is a noticeably high area near the south eastern corner of the floor.



The floor slope plan shows maximum slopes adjacent cracks as expected. Isolated areas of the floor, mainly in the outer areas, have gradients of 0.5% or more.

The verticality values show significant deviations from vertical on the eastern wall of the building. Note that this wall, including the columns, is lined so measurements have not been made directly to the structural elements.

Sheer Adventure Western Building

The floor contours and levels indicate that the central part of the floor is generally lower than the outside of the floor. The southern edge and north-western corner of the floor are noticeably lower than the rest of the floor.

The floor slope plan shows maximum slopes at the interface to the adjacent building to the east. The southern and northern areas of the floor generally have gradients of 0.5% or more.

The verticality values show significant deviations from vertical on the southern end of the eastern wall and along the southern wall.

Conclusion

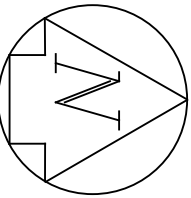
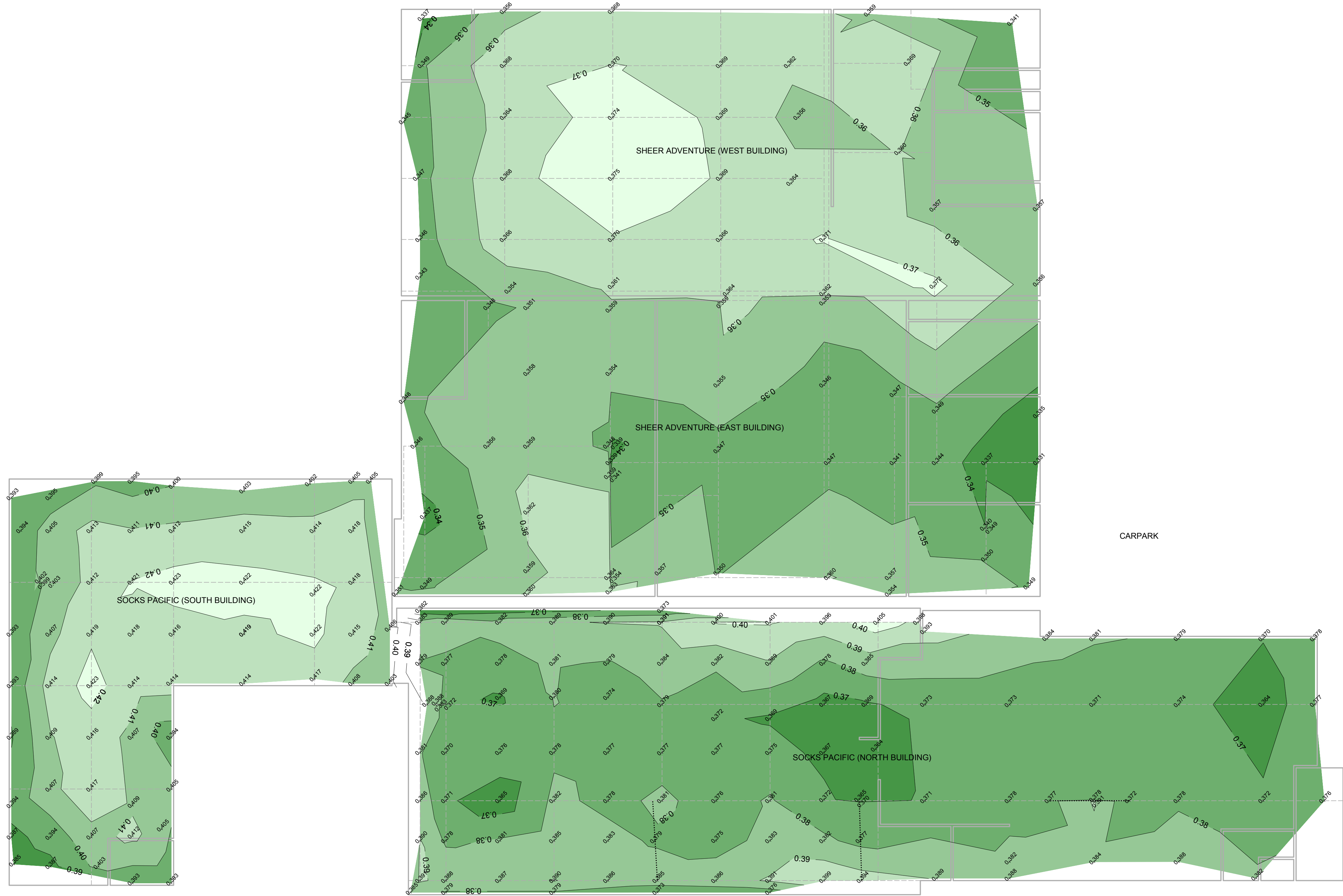
The survey was successfully carried out and plans drafted showing graphically the results of the survey. The plans show areas that deviated from level and verticality. The plans and report can be used to assist further structural analysis of the building.

Report Prepared by
STAIG AND SMITH LTD

Ephraim Jacobsen
Licensed Cadastral Surveyor

DO NOT SCALE

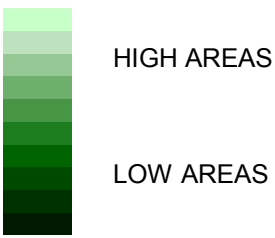
ORIGINAL SIZE A1



Notes

- (1) VERIFY ALL DIMENSIONS ON SITE.
- (2) DO NOT SCALE FROM DRAWING.
- (3) LEVELS IN TERMS OF: ASSUMED DATUM
ORIGIN OF LEVELS: SURVEY BENCHMARK NAIL 1
(IN ASPHALT ON WEST SIDE OF EASTERN ENTRANCE)
RL 0.000m
- (4) ORIENTATION IS APPROXIMATE ONLY AND IS NOT IN TERMS OF TRUE NORTH.
- (5) THE FLOOR PLAN HAS BEEN OBTAINED FROM ON-SITE MEASUREUP. THE WALL LAYOUT IS INDICATIVE ONLY AND MUST NOT BE USED FOR STRUCTURAL ANALYSIS.
- (6) LEVELS WERE TAKEN ON THE CONCRETE FLOOR SURFACE. WHERE A CARPET OR VINYL SURFACE WAS PRESENT, LEVELS WERE ADJUSTED FOR THE COVERING THICKNESS.
- (7) THE COLUMN/WALL VERTICALITY ARROWS SHOW THE DIRECTION OF THE TOP OF THE COLUMN/WALL RELATIVE TO THE BOTTOM.
- (8) THE COLUMN/WALL VERTICALITY ARROWS SHOW THE DIRECTION OF THE TOP OF THE COLUMN/WALL RELATIVE TO THE BOTTOM.
- (9) VERTICALITY DEVIATIONS ARE FOR CONCRETE WALLS, UNLESS STATED OTHERWISE.
- (10) FIELDWORK CARRIED OUT ON 28TH-29TH AUGUST 2013.

ISO CONTOUR LEGEND - INTERVAL 0.010M



KEY

- STEP/CRACK IN CONCRETE SLAB
- EDGE OF CONCRETE SLAB
- TOP OF BANK (TB)
- EXISTING CONTOURS
- BUILDING WALL
- TREE
- SPOT HEIGHT
- STREET LIGHT
- POWER BOX
- TELEPHONE UPSTAND
- HYDRANT
- WATER VALVE
- WATER METER
- MANHOLE
- SANITARY SEWER MANHOLE (SSMH)
- STORMWATER MANHOLE (SWMH)
- STANDARD SUMP
- YARD SUMP
- INVERT
- FENCE
- GATE
- POWER LINE

AMENDMENT

DATE



STAIG & SMITH LTD

12 Bealey Avenue
Christchurch

Ph: 0800 807 818
Fax: 03 548 4427

e-mail: enquiries@staigsmith.co.nz

SURVEYING-PLANNING-ENGINEERING-RESOURCE MANAGEMENT

Design:

Drawn: EDJ

Checked: SO

Approved: SO

Issue Date: 10 Sept 2013

Job Title

Structex Harvard Ltd
78 & 82 Byron St
Christchurch

Drawing Title

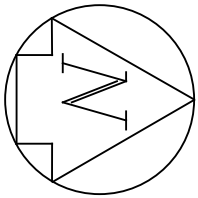
Floor Level Plan

Scale: 1:100 at A1

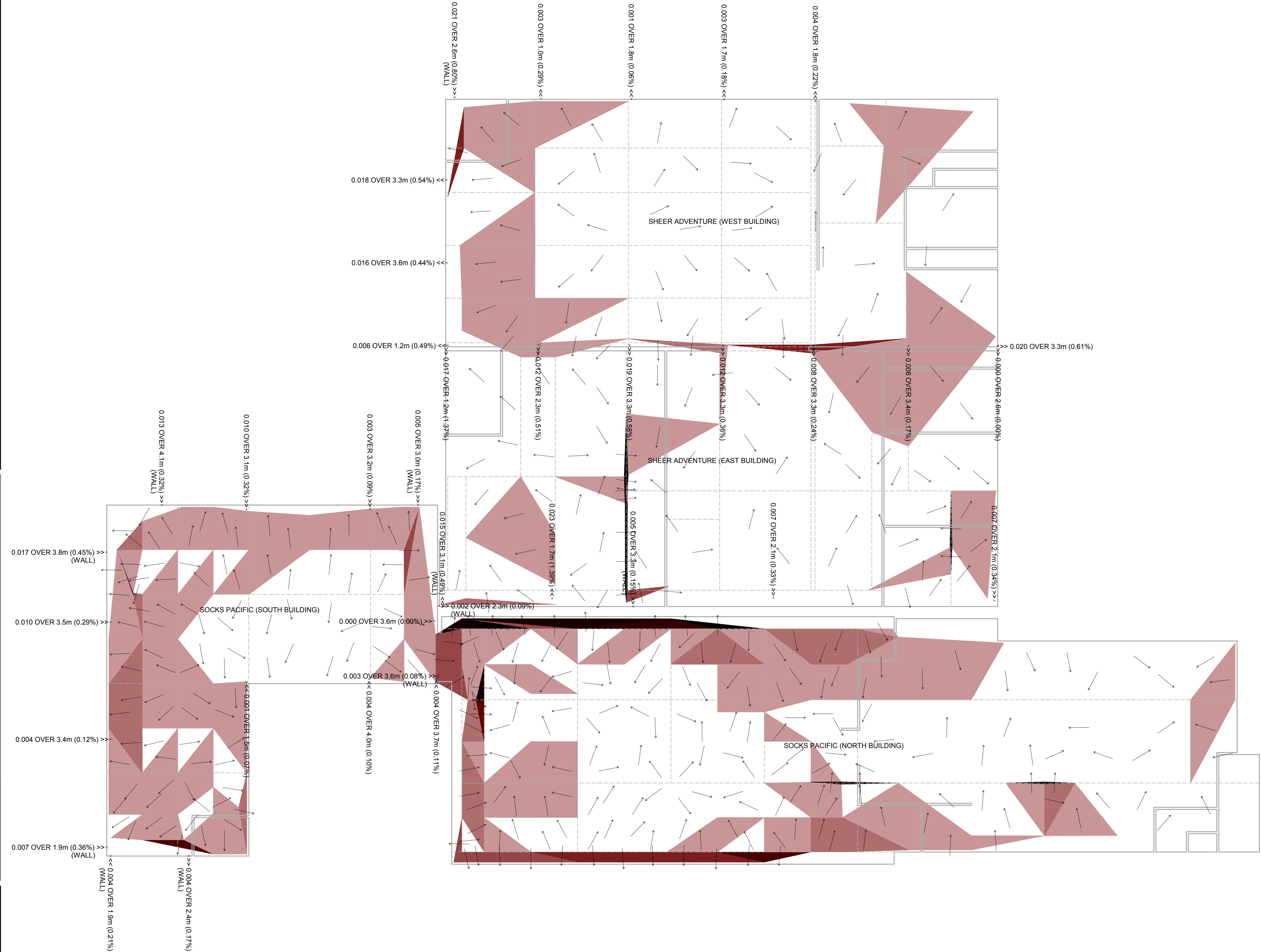
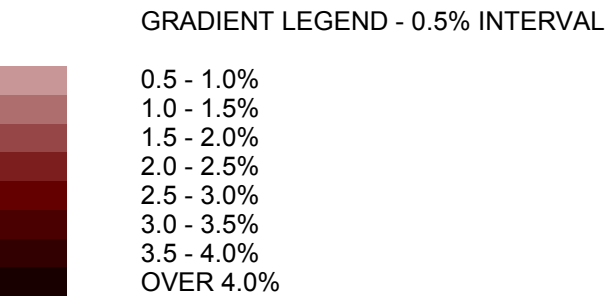
Issue. 1

Job No: 11417

Sheet 1 of 2



- Notes**
- (1) VERIFY ALL DIMENSIONS ON SITE.
 - (2) DO NOT SCALE FROM DRAWING.
 - (3) LEVELS IN TERMS OF: ASSUMED DATUM
ORIGIN OF LEVELS: SURVEY BENCHMARK NAIL 1
(IN ASPHALT ON WEST SIDE OF EASTERN ENTRANCE)
RL 0.000m
 - (4) ORIENTATION IS APPROXIMATE ONLY AND IS NOT IN TERMS OF TRUE NORTH.
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 - (6) LEVELS WERE TAKEN ON THE CONCRETE FLOOR SURFACE. WHERE A CARPET OR VINYL SURFACE WAS PRESENT, LEVELS WERE ADJUSTED FOR THE COVERING THICKNESS.
 - (7) THE COLUMN/WALL VERTICALITY ARROWS SHOW THE DIRECTION OF THE TOP OF THE COLUMN/WALL RELATIVE TO THE BOTTOM.
 - (8) VERTICALITY DEVIATIONS ARE FOR CONCRETE WALLS, UNLESS STATED OTHERWISE.
 - (9) FIELDWORK CARRIED OUT ON 28TH-29TH AUGUST 2013.



AMENDMENT DATE

STAIG & SMITH LTD

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Christchurch

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Fax: 03 548 4427
e-mail: enquiries@staigsmith.co.nz

SURVEYING-PLANNING-ENGINEERING-RESOURCE MANAGEMENT

Design:
Drawn: EDJ
Checked: SO
Approved: SO
Issue Date: 10 Sept 2013

Job Title

**Structex Harvard Ltd
78 & 82 Byron St
Christchurch**

Drawing Title

**Floor Slope and
Column Verticality Plan**

Scale: 1:100 at A1

Issue. 1

Job No: 11417

Sheet 2 of 2



APPENDIX E

Repair Specification



1. POST-EARTHQUAKE DAMAGE REPAIR

1.1 PRELIMINARY

Refer to the Preliminary and General Clauses of this Specification and to the General Conditions of Contract which are equally binding on all trades. This section of the Specification shall be read in conjunction with all other sections.

1.2 SCOPE

This Section consists of:-

1. Damage surveys.
2. Repair of cracks in reinforced concrete and blockwork.
3. Repair of concrete spalling.
4. Repair of cracks in unreinforced masonry.
5. Grouting of reinforcing bars and anchors into unreinforced masonry.

1.3 RELATED DOCUMENTS

In this section of the Specification reference is made to the latest revisions of the following documents:

The New Zealand Building Code		(BIA)
NZS 3103:1991	Specification for sands for mortars and plasters	(SCNZ)
NZS 3104:2003	Specification for Concrete Production	(SCNZ)
NZS 3109:1997	Specification for Concrete Construction	(SCNZ)
NZS 3112.4:1986	Methods of test for concrete Tests relating to grout	(SCNZ)
NZS 3121:1986	Specification for water and aggregate for concrete	(SANZ)
NZS 4210:2001	Code of Practice for Masonry Construction: Materials and Workmanship	(SANZ)
BS EN 459-1:2010	Building Limes Part 1: Definitions, Specifications and Conformity Criteria	(BS EN)
BS EN 1052-3:2002	Determination of Initial Shear Strength	(BS EN)
BS EN 459-2:2010	Building Limes Part 2: Test Methods	(BS EN)
NZSEE	Assessment & Improvement of the Structural Performance of Buildings in Earthquakes.	(NZSEE)

ASTM C 109-08	Standard Test Methods for Compressive Strength of Hydraulic Cement Mortars.	(ASTM)
ASTM C 1314-10	Standard Test Methods for Compressive Strength of Masonry Prisms.	(ASTM)
ASTM E488-90	Standard Test Methods for Strength of Anchors In Concrete and Masonry Elements.	(ASTM)

1.4 QUALITY ASSURANCE

1.4.1 General

It is the Contractor's responsibility to ensure that all work associated with this part of the contract is performed in accordance with the plans and specifications.

The Contractor's quality assurance procedures should encompass, but are not limited to, the following items:

1. Photographic record of damage observed
2. Recording of repairs completed
3. Daily recording of materials used
4. Mixing of epoxy/mortar/grout
5. Substrate surface preparation
6. Application of repair systems
7. Anchor hole location and embedment depth
8. Anchor and reinforcing steel placement
9. Testing frequency and reporting

The Contractor shall advise the Engineer in writing of the name of a suitably qualified and experienced representative to be responsible for ensuring that quality assurance procedures are being followed, prior to commencement on site.

Masonry shall be erected only under the direction of a Registered Mason specialising in the laying of masonry units. Before work commences on site, the Contractor shall advise the Engineer, in writing, the name of the Registered Mason who will be responsible for the masonry construction.

From time to time the Engineer may elect to audit the quality records. They shall be kept up to date and be made available for audit by the Engineer at all times during the construction of this project.

If so instructed, the Contractor shall forward copies of all or part of the records to the Engineer.

1.4.2 Inspection

The Engineer will review construction. Prior to grouting of anchor holes, the Engineer or his representative shall be notified and a reasonable opportunity given him to inspect prepared anchor holes.

Where necessary, the Engineer's instructions shall be carried out before grouting commences.

1.4.3 Producer Statement – Construction (PS3)

When the works are sufficiently complete that they are ready for application to the Territorial Authority for a Code Compliance Certificate, or otherwise at key handover dates for particular sections of the works, the nominated representative responsible for the quality assurance procedures for the Damage Repair will be required to certify to the main Contractor that all Damage Repair work has been carried out in full accordance with all Contract Documents and Contract Instructions in the form of a Producer Statement - Construction. This statement will be required to be completed prior to the issue of the Producer Statement – Construction Review by the Engineer for the whole or sections of the works as appropriate.

No Practical Completion Certificate shall be issued until such time as all the Producer Statements for the relevant section of the works have been received.

1.5 TESTING

The Contractor shall provide evidence of material compliance with the required testing as defined in this section of the Specification.

1.5.1 Mortar for Reinforced Concrete Blockwork

The Contractor shall provide evidence of testing for the following:

1. Mortar Compression Strength

Allow to test mortar compressive strength in accordance with NZS 4210:2001. Each test shall consist of a minimum of 3 specimens. Testing frequency shall be as follows:

- (i) Test to be carried out for every 450 sq.m of wall constructed (measured on one face only) to be tested at an age of 28 days.

2. Masonry to Mortar Bond Strength

Allow to test masonry to mortar bond strength in accordance with NZS 4210:2001. Each test shall consist of a minimum of 3 specimens. Testing frequency shall be as follows:

- (i) Test to be carried out for every 450 sq.m of wall constructed (measured on one face only) to be tested at an age of 7 days.

1.5.2 Unreinforced Masonry with Lime Mortar

The Contractor shall provide evidence of testing for the following:

1. Lime Chemical Requirements

Prior to the commencement of work allow to test the carbon dioxide content of the lime in accordance with Section 5.5 or 5.4 of BS EN 459-2:2010.

2. Soundness of Slaked Lime

Prior to the commencement of work allow to test soundness of slaked lime in accordance with Section 6.4.4 of BS EN 459-2:2010. Each test shall consist of a minimum of 3 specimens.

3. Mortar Compression Strength

Allow to test mortar compressive strength in accordance with ASTM C 109-08 (2008) except that the samples shall be left to cure at a temperature of 24 ± 8 deg C and a relative humidity of less than 80%. Each test shall consist of a minimum of 3 specimens. Testing frequency shall be as follows:

- (ii) Specimens prepared for testing prior to the commencement of works, to be tested at an age of 7, 28, 90, 180 and 360 days (total 15 specimens to be prepared).
- (iii) Specimens prepared for every 50 sq.m of wall constructed (measured on one face only) to be tested at an age of 7 and 28 days.

4. Masonry Compression Strength

Prior to the commencement of work allow to test masonry compressive strength in accordance with ASTM C 1314-10 (2010) except that the samples shall be left to cure at a temperature of 24 ± 8 deg C and a relative humidity of less than 80%. Each test shall consist of a minimum of 3 specimens. Testing frequency shall be as follows:

- (i) Specimens prepared for testing prior to the commencement of works, to be tested at an age of 7, 28, 90, 180 and 360 days (total 15 specimens to be prepared).

5. Masonry Bed-Joint Shear Strength

Prior to the commencement of work allow to test initial masonry shear strength in accordance with BS EN 1052-3:2002. Each test shall consist of a minimum of 9 specimens as detailed in BS EN 1052-3:2002. Testing frequency shall be as follows:

- (i) Specimens prepared for testing prior to the commencement of works, to be tested at an age of 28, 90, 180 and 360 days (total 12 specimens to be prepared).

Variation of Materials

If the repair works consist of structural elements with more than one type of masonry unit (i.e. red brick and Halswell Stone) the testing detailed above for masonry compressive strength and bed-joint shear strength shall be repeated for each masonry unit type.

Further tests shall be carried out if, and immediately when, the supply of the constituent materials varies during construction with at least three specimens per test. Tests shall also be conducted when requested by the Engineer.

The results of all tests shall be submitted upon request to the Engineer for review.

1.5.3 Unreinforced Masonry with Cement-Lime Mortar

The Contractor shall provide evidence of testing for the following:

1. Mortar Compression Strength

Allow to test mortar compressive strength in accordance with Appendix 2.A of NZS 4210. Each test shall consist of a minimum of 3 specimens. Testing frequency shall be as follows:

- (i) Specimens prepared for testing prior to the commencement of works, to be tested at an age of 7, 28 and 90 days (total 9 specimens to be prepared).
- (ii) Specimens prepared for every 50 sq.m of wall constructed (measured on one face only) to be tested at an age of 7 and 28 days (6 specimens to be prepared for every 50 sq.m).

2. Masonry Bed-Joint Shear Strength

Prior to the commencement of work allow to test initial masonry shear strength in accordance with BS EN 1052-3:2002. Each test shall consist of a minimum of 9 specimens. Testing frequency shall be as follows:

- (i) Specimens prepared for testing prior to the commencement of works, to be tested at an age of 28 and 90 days (total 18 specimens to be prepared).

Variation of Materials

If the repair works consist of structural elements with more than one type of masonry unit (i.e. red brick and Halswell Stone) the testing detailed above for masonry compressive strength and bed-joint shear strength shall be repeated for each masonry unit type.

Further tests shall be carried out if, and immediately when, the supply of the constituent materials varies during construction with at least three specimens per test. Tests shall also be conducted when requested by the Engineer.

The results of all tests shall be submitted upon request to the Engineer for review.

1.6 SAFETY

The Contractor shall conform fully both on and off site with the provisions of the New Zealand Building Code in all matters related to construction safety, in particular with approved documents F1 (Hazardous Agents on Site), F2 (Hazardous Building Materials), F4 (Safety from Falling) and F5 (Construction and Demolition Hazards).

1.7 MATERIALS AND WORKMANSHIP

1.7.1 Materials

The Contractor shall adhere to all requirements of NZS 3104, NZS 3109 and NZS 4210, except where specified otherwise herein or instructed otherwise by the Engineer. A copy of this standard shall be kept on the site and relevant parts read with the following Clauses of this Specification.

Materials to be used in conjunction with brick or stone masonry shall be selected to minimise the effects of efflorescence.

The Engineer may approve equivalent products that satisfy all of the requirements and show equality to the systems specified herein. Approval for the equivalent system shall be sought prior to submission of tender, refer also to the Submittals section below

1.7.2 Workmanship

All work shall be carried out by licensed applicators of the material manufacturer's.

Undertake all preparatory work necessary prior to application of the specified system to ensure proper bond and clean, true surfaces in the finished work.

All materials shall be mixed and applied in accordance with best trade practice and applied by skilled applicators to the manufacturer's recommendations.

All adjoining work shall be adequately protected during mixing and application and utmost care shall be taken not to damage surrounding fixtures and fittings. All damage consequent upon this operation shall be completely made good.

Remove debris at regular intervals and leave the completed work free from defects of all kinds.

1.7.3 Completion

Clean all adjoining surfaces and fittings of any paint contamination. Replace all hardware without damage to it or the adjoining surface. Take away from the site all painting materials, equipment and rubbish leaving the surrounding area clean, tidy and undamaged.

1.8 DAMAGE SURVEYS

We have undertaken an initial assessment that has identified general forms of damage and repairs required. We have not been able to expose all critical elements for observation, nor have we conducted a detailed survey identifying each individual crack. At the request of the engineer the Contractor shall expose areas of the structure, in order to enable detailed observations to be made of critical areas.

The Drawings provide specific details of the primary structural repairs required. Repairs of more minor damage (such as cracking and spalling of concrete) shall be undertaken by the Contractor in accordance with this Specification, under the direction of the Engineer.

1.8.1 Crack Damage

The Contractor shall identify cracks to be repaired following the methodologies outlined in the following sections of this Specification. Following preparation but prior to epoxy injection or grouting, the Contractor shall contact the Engineer to arrange an inspection of the area to be repaired.

Cracks are to be repaired in various elements as identified in site reports or on structural drawings.

Records should be kept of repaired cracks and should include details of:-

1. Location
2. Crack width
3. Crack length
4. Volume of material (epoxy/grout) used

1.8.2 Spalling Damage

The Contractor shall identify areas of spalled concrete to be repaired following the methodologies outlined in the following sections of this Specification. Following preparation but prior to application of the repair mortar, the Contractor shall contact the Engineer to arrange an inspection of the area to be repaired.

Spalled concrete is to be repaired in various elements as identified in site reports or on structural drawings.

Records should be kept of repaired spalling and should include details of:-

1. Location
2. Approximate spalled area
3. Volume of material (repair mortar) used

1.8.3 Verticality Survey

At the request of the Engineer, the Contractor shall undertake a verticality survey of the target building. The verticality survey shall ascertain whether there is any residual displacement or twist of the building. The Contractor shall submit their proposed methodology to the Engineer for approval prior to undertaking the survey.

1.9 REPAIR OF CRACKS IN REINFORCED CONCRETE AND BLOCKWORK

The following sections of the Specification detail the procedures to be followed when repairing cracks in reinforced concrete and reinforced concrete blockwork.

Cracks less than 0.2mm wide are considered to be superficial and do not require specific structural repair.

1.9.1 Repair of Hairline Cracks (< 2mm)

Where possible at the direction of the Engineer, cracks between 0.2mm and 2mm shall be repaired by injection of epoxy resin.

Where access to seal around the element being repaired is possible, repair the crack using a low viscosity epoxy resin such as Sikadur Injectokit – LV or Sikadur 52.

Where access is not possible to prevent grout loss, repair the crack with a thixotropic epoxy resin such as Sikadur Injectokit – TH.

Seal and prepare the surface being repaired and inject the epoxy resin in accordance with the manufacturers instructions.

Alternative products of equivalent properties may be acceptable but must be submitted to the Engineer for approval at the time of tender.

1.9.2 Repair of Large Cracks (< 5mm)

Where possible at the direction of the Engineer, cracks between 2mm and 5mm shall be repaired by injection of Sikadur 52.

Seal and prepare the surface being repaired and inject the epoxy resin in accordance with the manufacturers instructions.

Alternative products of equivalent properties may be acceptable but must be submitted to the Engineer for approval at the time of tender.

1.9.3 Repair of Very Large Cracks (> 5mm)

Advise the Engineer of any cracks larger than 5mm in width.

If the Engineer does not require any specific repair detail, cracks larger than 5mm shall be repaired by injection of Sikadur 42 / Sika Grout 212.

Seal and prepare the surface being repaired and inject the epoxy resin / cementitious grout in accordance with the manufacturers instructions.

Alternative products of equivalent properties may be acceptable but must be submitted to the Engineer for approval at the time of tender.

1.9.4 Repair of Reinforced Concrete Blockwork Mortar Joints

Repair mortar shall conform to NZS 4210, clause 2.2. Mortar shall have a 28 day compressive strength of at least 12.5 MPa. The 7 day masonry to mortar bond strength shall not be less than 200kPa. Sand shall comply with NZS 3103 with chloride levels not exceeding 0.04% by dry weight of sand. Appearance of new mortar shall match the existing. The contractor shall submit to the Engineer a mix design for the mortar prior to commencing work.

Damaged mortar beds shall be raked out to a minimum depth of 25 mm and re-pointed. Pointing shall be undertaken to match existing.

The Contractor shall carry out material testing as required in Section 1.5.

1.10 REPAIR OF CONCRETE SPALLING

The following sections of the Specification detail the procedures to be followed when repairing spalled concrete.

1.10.1 Repair of Shallow Spalling (<40mm thick)

At the direction of the Engineer break back to sound concrete. The depth of breakout on the edge of any repair area shall be a minimum of 10 mm and feather edges will not be accepted. To achieve this, the perimeter of the area to be repaired shall first be cut to a depth of 10 mm using a suitable tool.

Clean any exposed reinforcing using a wire brush. Prepare the exposed concrete surface and reinforcing in accordance with the manufacturers instructions, applying a primer such as Sika Monotop Primer as required.

Build up the required concrete profile using a high strength repair mortar, such as Sika Monotop Structural Mortar, and finish in accordance with the manufacturers instructions.

Alternative products of equivalent properties may be acceptable but must be submitted to the Engineer for approval at the time of tender.

1.10.2 Repair of Moderate Spalling (<80mm thick)

At the direction of the Engineer break back to sound concrete. The depth of breakout on the edge of any repair area shall be a minimum of 10 mm and feather edges will not be accepted. To achieve this, the perimeter of the area to be repaired shall first be cut to a depth of 10 mm using a suitable tool.

Clean any exposed reinforcing using a wire brush. Prepare the exposed concrete surface and reinforcing in accordance with the manufacturers instructions, applying a primer such as Sika Monotop Primer as required.

Build up the required concrete profile using a high build repair mortar, such as Sika Monotop High Build Mortar, and finish in accordance with the manufacturers instructions.

Alternative products of equivalent properties may be acceptable but must be submitted to the Engineer for approval at the time of tender.

1.10.3 Repair of Deep Spalling (>80mm thick)

At the direction of the Engineer break back to sound concrete. The depth of breakout on the edge of any repair area shall be a minimum of 10 mm and feather edges will not be accepted. To achieve this, the perimeter of the area to be repaired shall first be cut to a depth of 10 mm using a suitable tool.

Clean any exposed reinforcing using a wire brush. Prepare the exposed concrete surface and reinforcing in accordance with the manufacturers instructions.

Box and pour to the required concrete profile using a flowable repair mortar, such as Sika Monotop Microconcrete, and finish in accordance with the manufacturers instructions.

Alternative products of equivalent properties may be acceptable but must be submitted to the Engineer for approval at the time of tender.

1.11 REPAIR OF CRACKS IN UNREINFORCED MASONRY

The following sections of the Specification detail the procedures to be followed when repairing cracks in unreinforced masonry. The Contractor shall adhere to all requirements of NZS 4210, except where specified otherwise herein or instructed otherwise by the Engineer.

1.11.1 Unreinforced Masonry with Lime Mortar

At the direction of the Engineer, replace or repair cracked masonry units. New brick or stone masonry units shall be selected to match colour, density and texture of the existing.

Repair mortar shall be lime mortar to match the existing. Lime mortar shall be composed of aged slacked lime (lime putty), sand and water. The prescribed ratio of lime to sand shall be 1:3. Alternate mix designs may be used with the approval of the Engineer. Repair mortar should be batch mixed.

Lime used shall meet the requirements of BS 890:1995 and shall be slaked for a minimum of 3 months. Acceptable suppliers include:

1. Historic Building Conservation
18 Soper Road
Wingatui
Dunedin
03 489 0930

Alternate suppliers may be used with the approval of the Engineer.

Sand shall be Class A sand as defined in NZS 3103 with chloride levels not exceeding 0.04% by dry weight of sand.

Alkaline resistant mineral oxides can be added to enable colour matching. Dosage rates of mineral oxides shall limited such that they do not cause a reduction in mortar strength.

No cement products, modern additives or plasticisers are to be added to the mix unless approved by the Engineer.

The contractor shall submit to the Engineer a mix design for lime mortar prior to commencing work.

Masonry repairs shall be cured in accordance with NZS 4210, Sections 2.18 and 2.19.

The Contractor shall carry out material testing as required in Section 1.5.

1.11.2 Unreinforced Masonry with Cement-Lime Mortar

Repair of unreinforced masonry with cement-lime mortar shall be undertaken in accordance with NZS 4210.

At the direction of the Engineer, replace or repair cracked masonry units. New brick or stone masonry units shall be selected to match existing. Damaged mortar beds shall be raked out to a minimum depth of 25 mm and re-pointed. Pointing shall be undertaken to match existing.

Repair mortar shall be cement-lime mortar to match the existing. Mortar shall be composed of Portland cement, hydrated lime, sand and water, and shall be Durability Class M2 mortar as defined in Table 2.1 of NZS 4210.

Mortar shall have a 28 day compressive strength of at least 5 MPa. The 28 day masonry to mortar bond strength shall not be less than 200kPa.

Building lime shall comply with BS EN 459-1:20101 and shall be slaked with water to form hydrated lime before use in mortar. Sand shall be Class A sand as defined in NZS 3103 with chloride levels not exceeding 0.04% by dry weight of sand.

Repair mortar should be batch mixed. Hydrated lime shall not be omitted from the mix unless approved by the Engineer. Alkaline resistant mineral oxides can be added in accordance with NZS 4210 to enable colour matching.

The contractor shall submit to the Engineer a mix design for the mortar prior to commencing work.

Masonry repairs shall be cured in accordance with NZS 4210, Sections 2.18 and 2.19.

The Contractor shall carry out material testing as required in Section 1.5.

1.12 GROUT INJECTION OF CRACKS AND OPEN JOINTS IN UNREINFORCED MASONRY

The following sections of the Specification detail the procedures to be followed when repairing cracks in unreinforced masonry.

At the direction of the Engineer, replace or repair cracked masonry units. New brick or stone masonry units shall be selected to match colour, density and texture of the existing.

1.12.1 Materials

Grout shall be Centricrete MV or approved alternative.

Repair mortar shall be as specified in Section 1.10.

1.12.2 Methodology

Rake open joint to adequate depth to remove any loose mortar, but no less than 25 mm.

Flush joint, surfaces and cracks with clean water. Loose bricks shall be removed and reset with mortar

Injection holes are to be drilled at header joints or cracked brick, through to the inner wythe in each course. Bleed tubes shall be provided as required to ensure that any trapped air can escape. Flush bleed holes with water. Pressure inject grout to bond cracks in accordance with the manufacturers recommendations.

Re-point holes and open joints. Pointing shall be undertaken to match existing.

1.13 GROUTING OF BARS INTO UNREINFORCED MASONRY

The following sections of the Specification detail the procedures to be followed when grouting threaded rod and reinforcing bars into unreinforced masonry.

1.13.1 Shallow Embedment (< 750mm)

Grout shall be either non-shrink cement or epoxy based and shall be prepared in accordance with the manufacturers specifications. Acceptable products include:

1. Hilti HY150
2. Hilti CM 651
3. Sika Sikadur 52
4. Sika Grout 212
5. Ramset Epcon C6 (brick masonry only)
6. Ramset Premier Grout MP

The Contractor shall submit details of the proposed grout and grouting procedure to the Engineer for approval prior to the start of construction.

Anchor hole diameters are detailed in Table 1.

Table 1 Hole Diameters

Anchor Size (mm)	Hole Diameter (mm)	
	Hilti HY150 / Sikadur 52 / Epcon C6	Hilti CM 651 / Sika Grout 212/ Premier Grout MP
10	12	20
12	14	24
16	18	32
20	22	40
25	27	50

Holes shall be drilled using hammer drills and must be dry prior to filling with grout.

All holes shall be cleaned out using a stiff bristled wire bottlebrush and a compressed air source (with no oil bottle in the line) so that all dust and debris are removed from the side of the hole.

When this has been completed the Contractor is to notify the Engineer for inspection of the holes prior to placement of bars and grout.

The holes shall be partially filled with grout prior to inserting the reinforcing bar. Holes shall be filled from the bottom up (rather than pouring from the top). When a wall cavity is encountered, use a proprietary mesh anchor sleeve to bridge the cavity.

Bars shall be placed in the holes, given one turn to expel air voids and shall be fully supported (if necessary) and left undisturbed for at least 24 hours. After 24 hours horizontal bars installed at 15 degree slope can be bent horizontal.

After the bars have been placed in position, ensure that the grout fills the hole to the surface of the substrate. Top up holes if necessary.

The grouts shall be used strictly in accordance with the manufacturer's instructions.

When it is intended that the anchor be concealed in the completed state the bar shall be recessed a minimum of 35 mm beyond the exposed face of the masonry. Close the hole by mixing dust salvaged from the drill hole with a weakly cementitious mortar (eg Sika 212) and plug the hole to match existing.

1.13.2 Deep Embedment (> 750mm Vertical)

This section of the Specification details the procedure to be followed when grouting vertical bars into masonry walls. Grout shall be either non-shrink cement or epoxy based and shall be prepared in accordance with the manufactures specifications. Acceptable products for grouting include:

1. Hilti RE500
2. Sika Sikadur 52
3. Sika Grout 212
4. Ramset Epcon C6
5. Ramset Premier Grout MP

The Contractor shall submit details of the proposed grout and grouting procedure to the Engineer for approval prior to the start of construction.

Anchor hole diameters are detailed in Table 2.

Table 2 Hole Diameters

Anchor Size (mm)	Hole Diameter (mm)	
	Hilti RE500 / Sikadur 52/ Epcon C6	Sika Grout 212/ Premier Grout MP
10	12	20
12	14	24
16	18	32
20	22	40
25	27	50

Holes may be drilled using hammer or core drills and must be dry prior to filling with grout.

If the brick wall is suspected to contain cavities that might cause significant grout loss the hole can be filled with expandable builders filler and re-drilled at 2mm oversize to remove the filler from the walls of the hole.

All holes shall be cleaned out using a stiff bristled wire bottlebrush and a compressed air source (with no oil bottle in the line) so that all dust and debris are removed from the side of the hole.

When this has been completed the Contractor is to notify the Engineer for inspection of the holes prior to placement of bars and grout.

The holes shall be partially filled with grout prior to inserting the reinforcing bar. Holes shall be filled from the bottom up (rather than pouring from the top). Grouting shall be conducted with a maximum lift height of 1.5m.

Bars shall be placed in the holes, given one turn to expel air voids and shall be fully supported (if necessary) and left undisturbed for at least 24 hours.

After the bars have been placed in position, ensure that the grout fills the hole to the surface of the substrate. Top up holes if necessary.

The grouts shall be used strictly in accordance with the manufacturer's instructions.

1.13.3 Control Tests – Grouted Anchors & Reinforcing Bars

Shallow embedment anchors installed in accordance with Section 1.11.1 above shall be tested in accordance with the following:

Torque Testing

One quarter of all new tension anchor bolts and reinforcing bars embedded in unreinforced masonry walls shall be tested using a torque calibrated wrench to the following minimum torques,

12mm diameter anchors or bars	54Nm
16mm diameter anchors or bars	68Nm
20mm diameter anchors or bars	100Nm

No slippage shall occur under the above torques.

Direct Tension Testing

A minimum of five direct tension tests shall be undertaken for each anchor size specified on the Structural Drawings. The load testing shall be undertaken as follows:

The masonry wall should support the test apparatus. The distance between the anchor and the test apparatus support should not be less than the wall thickness.

The tension test load reported should be the load recorded at 3 mm relative movement of the anchor and the adjacent masonry surface. For the testing of existing anchors, a preload of 1.5 kN shall be applied prior to establishing a datum for recording elongation.

Reports

Results of all tests shall be reported. The report shall include the test results as related to anchor size and type, location, embedment depth, wall thickness and joist orientation.

1.14 GROUTING OF TIES INTO UNREINFORCED MASONRY PIERS

The following sections of the Specification detail the procedures to be followed when grouting galvanised threaded rod into unreinforced masonry piers.

Grout shall be Sika 212 or approved alternative. Anchor hole diameters are detailed in Table 3. When steel plate washers are required a rebate shall be formed at each end to ensure at least 35 mm cover is provided to the end of the threaded rod.

Table 3 Hole Diameters

Anchor Size (mm)	Hole Diameter (mm)
10	20
12	24
16	32
20	40
25	50

All holes shall be cleaned out using clean water so that all dust and debris are removed from the side of the hole.

When this has been completed the Contractor is to notify the Engineer for inspection of the holes prior to placement of bars and grout.

Injection holes are drilled through to the anchor hole. Bleed tubes shall be provided as required to ensure that any trapped air can escape. Flush bleed holes with water. Insert threaded rod into hole. Install plate washers with high strength grout behind. Attempt to close cracks in the unreinforced masonry piers by tightening the nuts.

When all threaded rods have been installed and tightened pressure inject grout the anchor holes in accordance with the manufacturers recommendations.

When it is intended that the threaded rod be concealed in the completed state the threaded rod, plate washer and nut shall be recessed a minimum of 35 mm beyond the exposed face of the masonry. Close the hole by mixing dust salvaged from the drill hole with a weakly cementitious mortar (eg Sika 212) and plug the hole to match existing.

1.15 RECONSTRUCTION OF UNREINFORCED MASONRY WALLS

The following sections of the Specification detail the procedures to be followed when rebuilding whole or parts of unreinforced masonry walls. The Contractor shall adhere to all requirements of NZS 4210, except where specified otherwise herein or instructed otherwise by the Engineer.

1.15.1 Unreinforced Masonry with Lime Mortar

At the direction of the Engineer, demolish and rebuild unreinforced masonry walls. New brick or stone masonry units shall be selected to match colour, density and texture of the existing.

Mortar shall be lime mortar to match the existing. Lime mortar shall be composed of aged slacked lime (lime putty), sand and water. The prescribed ratio of lime to sand shall be 1:3.

Alternate mix designs may be used with the approval of the Engineer. Repair mortar should be batch mixed.

Lime used shall meet the requirements of BS EN 459-2:2010 for air lime and shall be slaked for a minimum of 3 months. Acceptable suppliers include:

1. Historic Building Conservation
18 Soper Road
Wingatui
Dunedin
03 489 0930

Alternate suppliers may be used with the approval of the Engineer.

Sand shall be Class A sand as defined in NZS 3103 with chloride levels not exceeding 0.04% by dry weight of sand.

Alkaline resistant mineral oxides can be added to enable colour matching. Dosage rates of mineral oxides shall be limited such that they do not cause a reduction in mortar strength.

No cement products, modern additives or plasticisers are to be added to the mix unless approved by the Engineer.

The contractor shall submit to the Engineer a mix design for lime mortar prior to commencing work.

Masonry repairs shall be cured in accordance with NZS 4210, Sections 2.18 and 2.19.

If the wall is a veneer, install Type B Heavy Duty (EH) veneer ties at 600mm c/s horizontally, 400mm vertically each way unless noted otherwise.

The Contractor shall carry out material testing as required in Section 1.5.

1.15.2 Unreinforced Masonry with Cement-Lime Mortar

Reconstruction of unreinforced masonry walls with cement-lime mortar shall be undertaken in accordance with NZS 4210.

At the direction of the Engineer, demolish and rebuild unreinforced masonry walls, replacing or repairing cracked masonry units. New brick or stone masonry units shall be selected to match existing.

Mortar shall be cement-lime mortar to match the existing. Mortar shall be composed of Portland cement, hydrated lime, sand and water, and shall be Durability Class M2 mortar as defined in Table 2.1 of NZS 4210.

Repair mortar should be batch mixed. Hydrated lime shall not be omitted from the mix unless approved by the Engineer.

Building lime shall comply with BS EN 459-1:2010 and shall be slaked with water to form hydrated lime before use in mortar.

Sand shall be Class A sand as defined in NZS 3103 with chloride levels not exceeding 0.04% by dry weight of sand.

Alkaline resistant mineral oxides can be added in accordance with NZS 4210 to enable colour matching.

The contractor shall submit to the Engineer a mix design for the mortar prior to commencing work.

Masonry repairs shall be cured in accordance with NZS 4210, Sections 2.18 and 2.19.

If the wall is a veneer, install Type B Heavy Duty (EH) veneer ties at 600mm crs horizontally, 400mm vertically each way unless noted otherwise.

The Contractor shall carry out material testing as required in Section 1.5.

1.16 COORDINATION

The Contractor shall coordinate all associated trades so as to ensure the correct finished relationship, both as to dimensions, details, and finishes, between concrete repair work and all other trades, in particular finishing trades who will be working in the same areas.

1.17 SUBMITTALS

The Contractor shall supply the following documentation for review, at least 10 days prior to installation of the system:

A complete list of proposed materials for the system, including the following areas and clearly identifying any proposed variances from this specification:

1. Repair product
2. Primer / filler
3. Fire resistant coating
4. Protective coating

The individual component materials proposed for the system must be confirmed by the manufacturers to be mutually compatible.

The manufacturer must be able to demonstrate compliance with the Materials section of this specification above.

The manufacturer must also be able to provide supporting evidence of adequate testing of the performance of the proposed system, to the satisfaction of the Engineer.

A complete methodology shall be provided for the system, addressing the following areas and clearly identifying any proposed variances from this specification:

1. Substrate surface preparation
2. Mixing of epoxy / grout
3. Application method
4. Curing method
5. Testing of samples

From: Nigel Walsh info@mecserve.co.nz
Subject: RE: Attention Nigel Ventilation commissioning PS1 & PS4
Date: 25 July 2017 3:37 pm
To: Adrian adrian@architecturaldesigngroup.co.nz

Hi Adrian

Yes we are able to submit a PS1 and PS4 for this project.

We would estimate a cost of \$450.00 to \$550.00 +GST

Regards



From: Adrian [<mailto:adrian@architecturaldesigngroup.co.nz>]
Sent: Monday, July 24, 2017 9:09 AM
To: info@mecserve.co.nz
Subject: Attention Nigel Ventilation commissioning PS1 & PS4

Hi Nigel,

My name is Adrian, I am a architectural technician for ADG here in Tauranga, further to our conversation on the phone today. I have received an RFI from Christchurch City Council (see below) for a project we are working on in Byron Street, Sydenham, Christchurch.

Specialist Review : Mechanical Ventilation (Nick Waddington - 7/4/17)

SER - 001 The specialist services reviewer of this application requires the following additional information:

Please provide PS1 (Design) and associated design details, showing Compliance with Clauses G4 and H1.3.6 of the New Zealand Building Code. Also, a schedule of inspections to be

undertaken by the engineer with confirmation that 'as built' drawings and a PS4 will be provided on successful commissioning of the ventilation systems. Response received 12/7/17

does not address RFI.

I have attached related consent drawings for your use in calculating volumes etc the ablution rooms are quite small and have no window.

The meeting room and other office that have sky lights are 24 and 22% for natural ventilation

Basically I will need conformation for Council that you are able to issue a PS1 and a schedule of inspection, as built drawings and PS4 when commissioning is completed. Ventilation units Specification attached to this email also.

Our client would like some idea of costs before proceeding if possible.

Thanks

Regards,
Adrian

Consenting & Compliance Group

Producer statement design (PS1)

To be completed by the design professional who has been engaged to provide a PS1

Author name:

Nigel Walsh

Author company:

Mecserve Ltd

Site address:

80 Byron Street

Legal description:

Engaged by:

Architectural Design Group

To provide design services in respect of: ☒ part ☐ all

(describe work)

.Design for toilet extraction for disabled toilet and standard toilet. Meeting rooms and other office natural ventilation.

NZBC clauses:

(select as applicable)

- | | | | | | | | | | | | |
|--|--|-----------------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|
| ☐ B1 | ☒ B2 | ☐ C1 | ☐ C2 | ☐ C3 | ☐ C4 | ☐ C5 | ☐ C6 | ☐ D1 | ☐ D2 | ☐ E1 | ☐ E2 |
| ☐ E3 | ☐ F1 | ☐ F2 | ☐ F3 | ☐ F4 | ☐ F5 | ☐ F6 | ☐ F7 | ☐ F8 | ☐ G1 | ☐ G2 | ☐ G3 |
| ☒ G4 | ☐ G5 | ☐ G6 | ☐ G7 | ☐ G8 | ☐ G9 | ☐ G10 | ☐ G11 | ☐ G12 | ☐ G13 | ☐ G14 | ☐ G15 |
| ☐ H1 | | | | | | | | | | | |

NB: All statements must include B2

The design has been prepared in accordance with:

☒ Approved documents issued by the Ministry of Business, Innovation and Employment (verification method / acceptable solution)

G4 and H1.3.6 of the New Zealand building code.

☐ Alternative solution (attach schedule if required)

The proposed building work covered by this producer statement design is described on the drawings referenced below, together with the specifications and other documents set out in the schedule attached to this statement:

Drawing title:

Proposed Additions
80 Byron Street
Christchurch
For Clip and Climb

Drawing numbers:

A4 A6

The producer statement is subject to:

(i) Site verification of the following design assumptions:

The size of the toilets and offices does not increase in cubic mtrs. Increase in maximum occupancy and intended use.

(ii) All proprietary products meeting their performance specification requirements

I believe on reasonable grounds that the proposed building work, will comply with the relevant provisions of the Building Code if constructed in accordance with the drawings, specifications and other documents provided or listed with this statement.

I understand that the Council may rely on this producer statement for the purposes of establishing compliance with the relevant provisions of the Building Act 2004, Building Regulations and Building Code. I confirm that I hold a current policy of professional indemnity insurance to the value required by the Council.

Construction monitoring is: ☐ Not required ☒ Required

If required, please list below:

Site visit and inspection before lining or ceilings installed.

(Agreement must be attached)

Signature:



Date:

26/7/17

☐ ACENZ

☐ IPENZ

☐ CPENG

☐ NZIA

☒ Other (specify):

IRACE 1127

(Membership number)

Practice Area:

Canterbury Westland

Address:

60 Aikmans Road Christchurch

Postcode:

8014

Phone:

03 3554840

Fax:

03 3664221

Mobile:

0274335593

Email:

info@mecserve.co.nz

Comments:

Toilet fans are two of WhisperVent 100 @ 60 Pa 50L/sec (175 cubes) Office ventilation from skylights.

MEMO

To: Architectural Design Group - Adrian
CC: John Targett – Clip n Climb International
From: Robert Warner
File Ref: CC16175 E
Date: 18.07.17
Re: EQ strengthening & Proposed Office, 80 Byron Street, Christchurch –
 Emergency Lighting

Dear Sir,

We have reviewed the emergency lighting requirements for the above job and enclose the following documents:

1. PDF generated sketch drawing, referenced CC16175-EL.01, indicating the locations of emergency luminaires and emergency switching. Complete with accompanying Document Transfer sheet, applicable Legend and separately attached, drawing notes specification sheets, indicating the typical emergency luminaires and emergency switching Lighting control diagram.
2. Specification clauses to be inserted within your specification that specify the installation methods, connection details, test log books, maintenance etc. of the emergency lighting installation. Please Note: Luminaire Schedule has been detailed on the layout drawing and is the minimum expectation specified emergency exit luminaires and fittings.
3. PS1 – Design Producer Statement and Fire Coordination Statement which must be attached/enclosed in final Consent submission package
4. PS3 – Construction Producer Statement and Emergency lighting Test sheet for the installation Contractor's use as appropriate

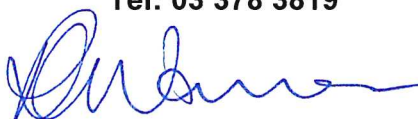
Note: Emergency lighting design and luminaires as shown on the drawings meets the minimum requirement for emergency lighting under the relevant NZ Building Codes. The client may wish to provide further emergency lighting above and beyond this minimum requirement.

If you have any further questions or queries regarding this project, please contact us.

Kind regards,

Robert Warner
Cosgroves

Tel: 03 378 3819



PRODUCER STATEMENT – PS1 – DESIGN

(Guidance notes on the use of this form are printed on page 2)

ISSUED BY:.....COSGROVES LIMITED.....
 (Design Firm)

TO:.....CLIP n CLIMB INTERNATIONAL c/- ARCHITECTURAL DESIGN GROUP.....
 (Owner/Developer)

TO BE SUPPLIED TO:...CHRISTCHURCH CITY COUNCIL.....
 (Building Consent Authority)

IN RESPECT OF:.....EMERGENCY LIGHTING & EXIT SIGNAGE DESIGN & DOCUMENTS.....
 (Description of Building Work)

AT:... EQ STRENGTHENING & PROPOSED OFFICE, 80 BYRON STREET, CHRISTCHURCH.....
 (Address)

.....**LOT**... 1... **DP**449853..... **SO**

We have been engaged by the owner/developer referred to above to provide EMERGENCY LIGHTING & EXIT SIGNAGE DESIGN AND DOCUMENTATION....services in respect of the requirements of
 (Extent of Engagement)

Clause(s)F6 & F8 (Part).....of the Building Code for

All ☒ or Part only ☐ (as specified in the attachment to this statement), of the proposed building work.

The design carried out by us has been prepared in accordance with:

☒ Compliance Documents issued by the Ministry of Business, Innovation & Employment...NZBC F6/AS1 & F8/AS1 (Part).....or

(verification method / acceptable solution)

☐ Alternative solution as per the attached schedule.....

The proposed building work covered by this producer statement is described on the drawings titled EQ STRENGTHENING & PROPOSED OFFICE, 78 BYRON ST., CHRISTCHURCH – EMERGENCY LIGHTING LAYOUT

.....and numberedCC16175-EL.01

together with the specification, and other documents set out in the schedule attached to this statement.

On behalf of the Design Firm, and subject to:

(i) Site verification of the following design assumptionsNONE.....

(ii) All proprietary products meeting their performance specification requirements;

I **believe on reasonable grounds** that a) the building, if constructed in accordance with the drawings, specifications, and other documents provided or listed in the attached schedule, will comply with the relevant provisions of the Building Code and that b), the persons who have undertaken the design have the necessary competency to do so. I also recommend the following level of construction monitoring/observation:

☐ CM1 ☒ CM2 ☐ CM3 ☐ CM4 ☐ CM5 (Engineering Categories) Or ☐ as per agreement with owner/developer (Architectural)

I, **STEPHEN PAGE** am:
 (Name of Design Professional)

☒ CPEng 216143 #

☐ Reg Arch #

I am a Member of : ☒ IPENZ ☐ NZIA and hold the following qualifications: B.E. (ELEC) The Design Firm issuing this statement holds a current policy of Professional Indemnity Insurance no less than \$200,000*.

The Design Firm is a member of ACENZ: ☒

SIGNED BY ...STEPHEN PAGE..... **ON BEHALF OF** ...COSGROVES LIMITED...
 (Design Firm)

Date.. 18th JULY 2017 (signature).....

Note: This statement shall only be relied upon by the Building Consent Authority named above. Liability under this statement accrues to the Design Firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the Building Consent Authority in relation to this building work, whether in contract, tort or otherwise (including negligence), is limited to the sum of \$200,000.*

This form is to accompany **Form 2 of the Building (Forms) Regulations 2004** for the application of a Building Consent.

THIS FORM AND ITS CONDITIONS ARE COPYRIGHT TO ACENZ, IPENZ AND NZIA

Fire Design Coordination Statement for Electrical Services
(in accordance with IPENZ Practice Note 22)



PROJECT: EQ Strengthening & Proposed Office – 80 Byron Street, Christchurch
JOB NO: CC16175 E

STATEMENT OF COORDINATION:

This Design Coordination Statement is to be provided to the Building Consent Authority, and is intended to accompany the documents submitted in the building consent application.

The Fire Report, rev B, prepared by Cosgroves Ltd, for New Tyre Workshop, 7 Shirley Road, Christchurch, issued 07.11.16 has been reviewed by Cosgroves Ltd – Electrical Engineer.

We believe on reasonable grounds that the relevant elements of the associated Report detailed above have been incorporated into our design of the electrical services systems proposed, as described on COSGROVES' drawings titled EQ Strengthening & Proposed Office, 78 Byron Street, Christchurch –*Emergency Lighting Layout, referenced CC16175-EL.01 Issue A and dated 18.07.17*, together with the specification issued by Cosgroves Ltd.

SIGNED BY:  **ON BEHALF OF:** Cosgroves Ltd

NAME: Robert Warner

POSITION: Senior Electrical Engineer

DATE: 18th July 2017

DOCUMENT TRANSFER ELECTRICAL SERVICES

PROJECT: EQ Strengthening & Proposed Office
80 Byron Street, Christchurch
Emergency Lighting

FILE No: CC16175 E

DATE: 18th July 2017

SHEET: 1 of 1

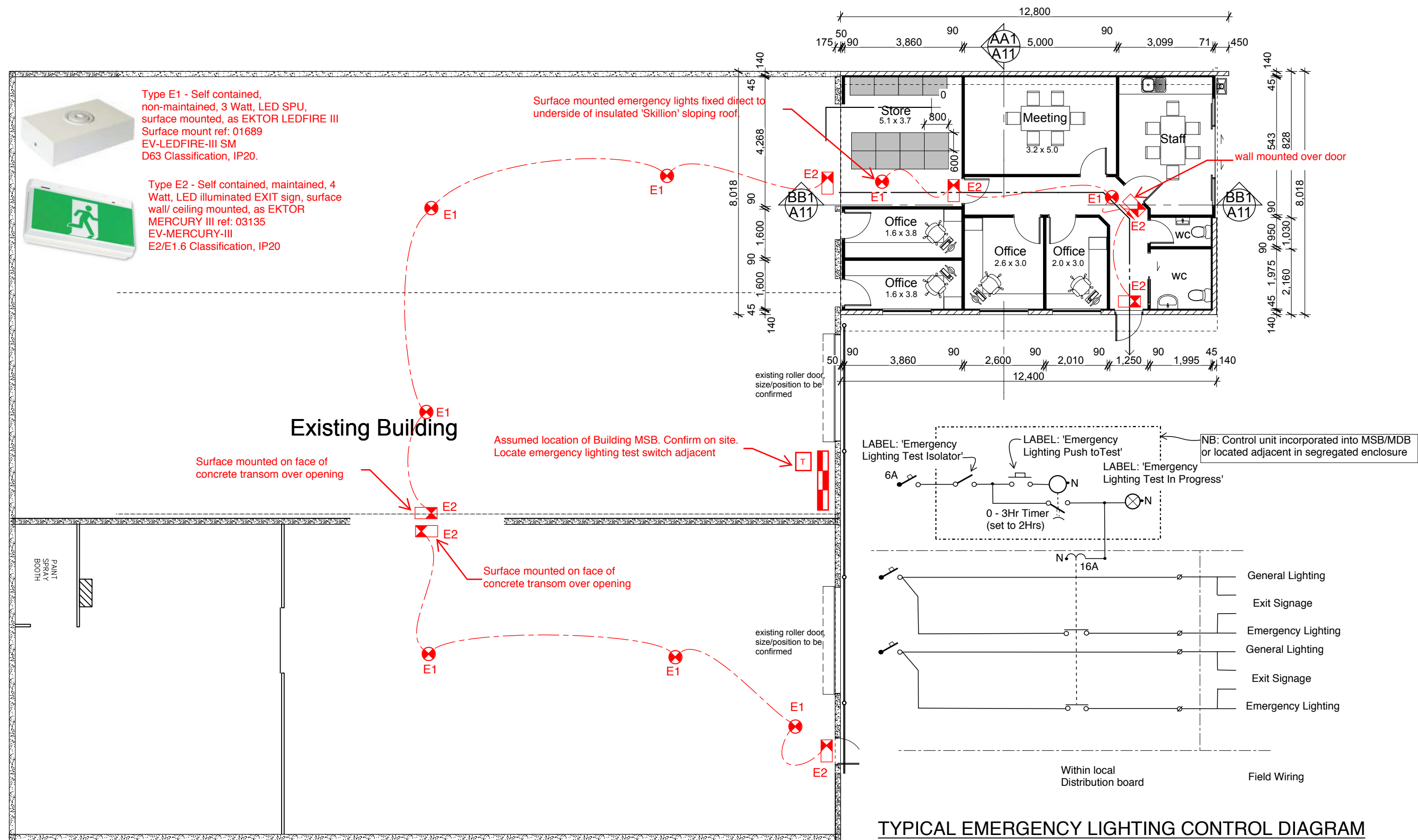
Day	18					
Month	07					
Year	17					
Issued by	rlw					

Drawing	Sheet	Description	Revision					
CC16175-EL.01	A3	Emergency Lighting Layout	A					

Other Documents Enclosed	Issue					
PS1 – Design Producer Statement	0					
Specifications Sheet	0					
PS3 – Construction (pro forma)	0					
Emergency Lighting Test & Log Sheet (pro forma)	0					
Schedule of Notes	0					
Fire Coordination Statement	0					

Distribution	Attention	No of Copies Distributed					
Clip n Climb International	John Targett	1 x PDF					
Architectural Design Group	Adrian	1 x PDF					

Reason for Issue						
P Preliminary	R Revision					
N Consent	I Information	N/I				
Q As Requested	C Construction	Q				
T Tender	S Schedule					



Symbol	Description
	New emergency luminaire (surface/recessed)
	New illuminated EXIT sign (Directional as required)
	Main switchboard -MSB
	Emergency lighting test point at MSB
	emergency circuiting line

NOTES:
This drawing to be read in conjunction with the separately attached 'Notes' & 'Specifications' sheets

CHECK ALL INFORMATION ON SITE PRIOR TO COMMENCING WORK. READ IN CONJUNCTION WITH THE SPECIFICATION AND OTHER RELEVANT DRAWINGS AND DOCUMENTS			 cosgroves First Floor, 99 Tuam St. PO Box 842 Christchurch, New Zealand. Ph. (03) 377 8800 Email: admin@cosgroves.com	PROJECT EQ STRENGTHENING & PROPOSED OFFICE, 80 BYRON STREET, CHRISTCHURCH	SHEET TITLE: EMERGENCY LIGHTING LAYOUT	CONSENT		
		DESIGNED: RLW				DATE: 18.07.17	ISSUE: A	
		DRAWN: RLW				SCALE: NTS		
A		CONSENT ISSUE						
		18.07.17						
ISSUE	AMENDMENT	DATE						

Emergency Lighting Notes - To be read in conjunction with the Layout Drawing referenced CC16175-EL.01 and the Specification clauses.

1. New illuminated Exit signs shall be located centrally over exit ways, and be mounted no less than 2m AFL and no more than 2.7m AFL in full compliance with the manufacturers technical specifications attached.
2. The Electrical Contractor shall supply and install emergency self-contained battery luminaires and circuit cables to comply with the requirements of NZBC F6 (including AS2293 parts 1 and 3: 2005), NZBC G9 (in part), AS/NZS 60598.2.22: 2005 and AS/NZS 2293.2: 1995. The system shall comprise a single point system utilising Maintained (M), non-maintained (NM) or sustained (S) as defined in AS2293:2005 parts 1 and 3 and AS/NZS 60598.2.22: 2005.
3. All emergency fittings to be controlled via an installed common test & maintenance switch facility (refer to Specification and AS/NZS 2293 for further information). Test and maintenance switch should be located adjacent or incorporated into the front panel of the MSB,
4. Post installation, the installing Contractor shall measure the illuminance levels achieved in accordance with Appendix B of AS/NZS 1680.1 **or**, verify the installation has been installed in accordance with the minimum spacing's recommended in the manufacturers' spacing's tables, & ensure the additional luminaires are incorporated into a site specific Test Log Book & Maintenance Schedule.
5. Locations and selection of Emergency luminaires and Illuminated Exit signs are designed in accordance with manufacturers' recommended mounting heights and spacing's to meet the requirements of AS/NZS 2293: and NZBC Clause F6/AS1 and F8/AS1 (in part). Any major deviations from the locations indicated must be in compliance with stated manufacturers spacing at the relevant mounting heights. Any deviations from the manufacturers' units specified must be provided with alternative justification to satisfy the requirements of F6/AS1 & F8/AS1 (in part). The final locations incorporating any minor deviations shall be confirmed on site to suit the prevailing site conditions.
6. Luminaires shall connect to the existing emergency lighting test facility.
7. Emergency Luminaires shall be controlled in connection with the monitoring of the existing relevant local lighting circuit MCB's.

CC16175 E - EMERGENCY LIGHTING – SPECIFICATION CLAUSES

The Electrical Contractor shall supply and install emergency self-contained battery luminaires and circuit cables to comply with the requirements of NZBC F6 (including AS2293 parts 1 and 3: 2005), NZBC G9 (in part), AS/NZS 60598.2.22:2005 and AS/NZS 2293.2:1995. The system shall comprise a single point system utilising non-maintained (NM) and (M) Maintained as defined in AS/NZS 2293.

Illuminated exit signs shall be fitted to all doors leading to the exit ways and shall be installed as shown on the drawings. Final coordination shall be carried out on site to suit the prevailing site conditions.

Emergency luminaires shall be supplied from the live side of the essential lighting circuit supplying general lighting in the area concerned. Emergency luminaries shall only be looped together where indicated. Provide all relays and automatic resetting test switch/timer controls associated with the group test facility as required by the Standards. All test initiation devices and indicators shall be panel mounted on the door of the associated controls cabinet, provide all necessary labelling. Provide manual cancel facility at same location in order that batteries are not unduly discharged.

Self Contained Maintained Luminaires: Self Contained Maintained units shall comprise single lamp luminaires or signs, the principle of operation shall be that under normal conditions the lamp shall be illuminated via the mains and in the event of a power failure or under test conditions via its integral battery system.

Self Contained Non-Maintained Luminaires: Self Contained Non Maintained units shall comprise single lamp luminaires or signs, the principle of operation shall be that under normal conditions the lamp shall be either extinguished or illuminated in conjunction with the general lighting (as specified) and in the event of a power failure or under test conditions via its integral battery system.

Emergency lights shall be rated for two-hour duration. Batteries shall be sealed non-venting high temperature Lithium Iron Phosphate type, suitable for operating lamp at its rated output for 2 hours. Lead acid or Nickel Cadmium or Nickel Hydride type batteries will not be accepted. Battery life shall be at least 3 years when operating under normal conditions at an ambient temperature of 25 degrees Celsius and subjected to charging and discharging at 6 monthly intervals.

All Emergency lights shall be an approved classified type, as required by AS/NZS 2293, and certificates for each luminaire (stating compliance with AS/NZS 2293) shall be provided on request.

All emergency lights shall have a Red LED indicator and local test switch, as specified within AS/NZS 2293. Provide protection of the inverter system against damage in the event of failure, removal or replacement of lamp, while in normal operation. All exit fittings shall be complete with 'Exit' labels and arrows as necessary to indicate the direction of exit

Individual lighting MCB's which are associated with the Emergency Lighting System shall be fitted with an engraved label (red on white) with lettering:

INTERRUPTING SUPPLY WILL DISCHARGE
EMERGENCY LIGHTING BATTERIES.

The test facility shall be similarly labelled:

EMERGENCY LIGHTING TEST

An operating and maintenance manual in a durable A4 hard-bound cover shall be provided for the emergency lighting installation, in addition to the test procedures and maintenance procedures this document shall incorporate test record sheets for each emergency luminaire and a copy of the lighting drawings cross referencing the emergency luminaires indicated on the drawings with the test record sheets.

The operating and maintenance manual shall be kept on the premises at all times, or at such other locations as may be approved by the inspecting authority.

The system shall be fully tested on completion.

Emergency Lighting Test Record Sheet

Single Point System

Building Owner: Address: Building Description:	Installation Engineer / Inspector: Installation Date: Telephone: Area Description:
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[illegible]

[illegible]

From: Nick Chen nick.chen@cosgroves.com
Subject: RE: BCN/2017/2013- Processing - RFI update (FIR-0xx only) V3 - Fire
Date: 13 July 2017 2:38 pm
To: Adrian adrian@architecturaldesigngroup.co.nz

Hi Adrian,

Could you please send a copy of your latest architectural drawing set and structural design documentation for coordination? Council may request a coordination statement prepared in accordance with IPENZ Practice Note 22. But we will see how it goes first with the below response.

Below is my suggested response to NZFS.

- 1.1 Please refer attached photo for the opening between two spaces and there is no sliding door.
- 1.2 a: The external fire rated wall is of concrete construction and the structural engineer's design calculation should provide information on achieving the required fire rating and meet with post-fire structural stability requirements.

b: The coordination of the fire safety requirements between the fire design and architectural & structural engineer has occurred.

Kind Regards

Nick Chen
BE(Hon), ME(Fire), CPEng, MIPENZ
Senior Fire Engineer
Cosgroves Ltd
03 377 8600
027 520 9292

From: Adrian [<mailto:adrian@architecturaldesigngroup.co.nz>]
Sent: Thursday, 13 July 2017 9:11 AM
To: Nick Chen <nick.chen@cosgroves.com>
Subject: Fwd: BCN/2017/2013- Processing - RFI update (FIR-0xx only) V3 - Fire

Hi Nick,

it would appear that the Christchurch City Council are not prepared to accept your interpretation of the Fire Code can you deal with these Requests for Information and get back to me on who is handling the emergency lighting and installation.

I will handle FIR 031, I was under the impression that there was only the one lock that needed to be noted as i would of thought that all new hardware would be to the requirements in the fire report, but i will put a hardware schedule together send it to them

Regards,
Adrian





The Lock Shop

powered by

BOND SECURITY GROUP



BRAVA EV SERIES COMMERCIAL LEVER SET (DDA COMPLIANT)

\$115.00

FUNCTION

Entrance

▼

KEYING

Keyed to Differ

▼

BRAVA Metro EV6000 series commercial grade entrance leverset with *clutching* levers.

 BCA AS1428.1 -2009 compliant lever set.

 Successfully tested up to 4 hours (depending on type of doorset) on fire door assemblies in accordance with Australian Standard AS 1905.1- 2005, Part 1: Fire Resistant Doorsets.

Entrance function

- Outside key locks and unlocks exterior lever.
- Inside lever free at all times, snib inside locks and unlocks outside lever.

Passage function

- Both outside and inside levers are always free.

Storeroom function

- Outside lever unlocked by key, lever retracts the latch.
-  Outside lever *can not* be left unlocked, key retained.
- Inside lever free at all times.



Classroom function

- Outside key locks and unlocks outside lever
- Inside lever free at all times

Glass Door function

- Outside key locks and unlocks both levers.
- Inside key locks and unlocks both levers.

Privacy function

- Outside opened by lever when free. Can be opened in an emergency situation with a coin or screw driver.
- Inside opened by lever at all times, external lever locked with turn snib from inside

Institution function

- Key from either side retracts latch only.
- Levers on both sides clutching at all times.

Specifications

Door thickness	35 mm - 51 mm
Backset	70 mm
max. Lever / knob projection	74 mm
<i>distance may not include turnsnib</i>	
Strike	28 mm x 70 mm x 2 mm
Latch	70 mm (12.7 mm throw)
Latch face plate	57 mm x 25 mm
Cylinder	LW5 profile
Door handing	Non-handed levers
Rose	85 mm

The Lock Shop



powered by
BOND SECURITY GROUP



AUSTRAL YARRA VIEW - CURVE
\$95.00

COLOUR

Silver ▼

KEYING

Keyed to Differ ▼

An all-metal lock for sliding glass doors. Contemporary design to suit wide range of doors and households.

- **Twin counteracting beaks** engage an all-metal catch plate.
- **Self-adjusting catch plate** automatically compensates for building movement and door carriage wear.
- **A range of outer pull designs** are available for various applications.
- **Anti-slam plunger** prevents the door being shut with beaks extended, avoiding damage to beaks and catch plate.
- Fits Industry-standard three-hole door cutouts (three 9mm diameter holes).
- Fits wide range of door stile thicknesses from 21.3mm to 46.4mm.
- Suits left-closing and right-closing doors (lock is not handed).
- **Australian** design and manufacture.
- Available in many colours - contact us if you require another option.

****PLEASE NOTE - SOME FINISHES ARE MADE TO ORDER AND CAN HAVE UP TO A 10 DAY LEAD TIME. PLEASE CONTACT US FOR MORE INFORMATION.****

Home | Door Knobs and Levers | Entrance Sets | Austral Lock



CL100 LaviLock™



The **CL100 LaviLock** is a disabled access lockset designed with ease of use and longevity of service in mind. The brass and stainless steel working components ensure reliability as well as resisting the outdoor environment they are often installed into.*

Easy to read **"Vacant / In Use"** lettering and 'fail safe' Exit Free functionality ensure the lock complies with disabled egress requirements when fitted to a 910mm wide cavity sliding door.

The LaviLock is supplied as a complete set including:

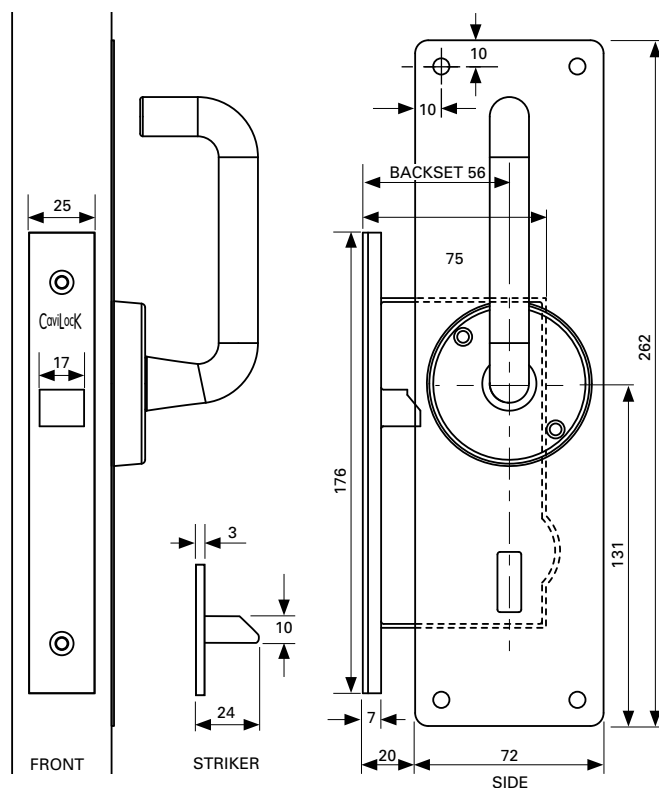


- ▮ Lever Handles
- ▮ Stainless Steel Indication Plates
- ▮ Slide Locking Buttons including Emergency Release
- ▮ CL100 Mortice Lock Case

IMPORTANT; To be Council compliant, the Lever/Lever option must be used for disabled toilets and the door needs to be a minimum of 910mm to allow minimum clear walk through of 760mm.

*If LaviLock is to be installed into areas where there is exposure to corrosive environments, e.g. high chlorine or salt concentration, contact CS for an appropriate solution.

Dimensions



Handles & locks for sliding doors

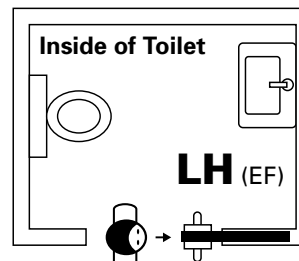


↑ 'Vacant/In Use' indicator plate on outside door face with Emergency Release.

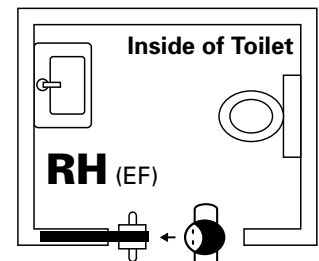


↑ Easy to use 'Unlock/Lock' lever on inside door face.

Handing



When standing looking into the cavity pocket, if the locking snib is on your **left hand** side then the LaviLock is a Left Hand lock.



When standing looking into the cavity pocket, if the locking snib is on your **right hand** side then the LaviLock is a Right Hand lock.

EF = Exit Free - Even when in locked position the handle on the **inside** remains unlocked.

Finish Options

▮ Satin Chrome

- CL100B3008 (RH)
- CL100B3010 (LH)

▮ Polished Brass

- CL100B3009 (RH)
- CL100B3011 (LH)

For other configurations, including Exit Free options, please refer to the CL100 brochure (available from the CaviLock section on our website).

Drawings & pictures are not to scale. All dimensions in millimetres.

info@csfordoors.co.nz
www.csfordoors.co.nz

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Miro

Urbo

Icon

Hardware

Miro Hardware



Wedgeless fastener



Wedgeless venting fastener



Window fastener



Interior handle



Sliding door handle small



Sliding door Handle large



Lever door handle



Surface mount sliding door handle



Bi-fold operator

Window fastener



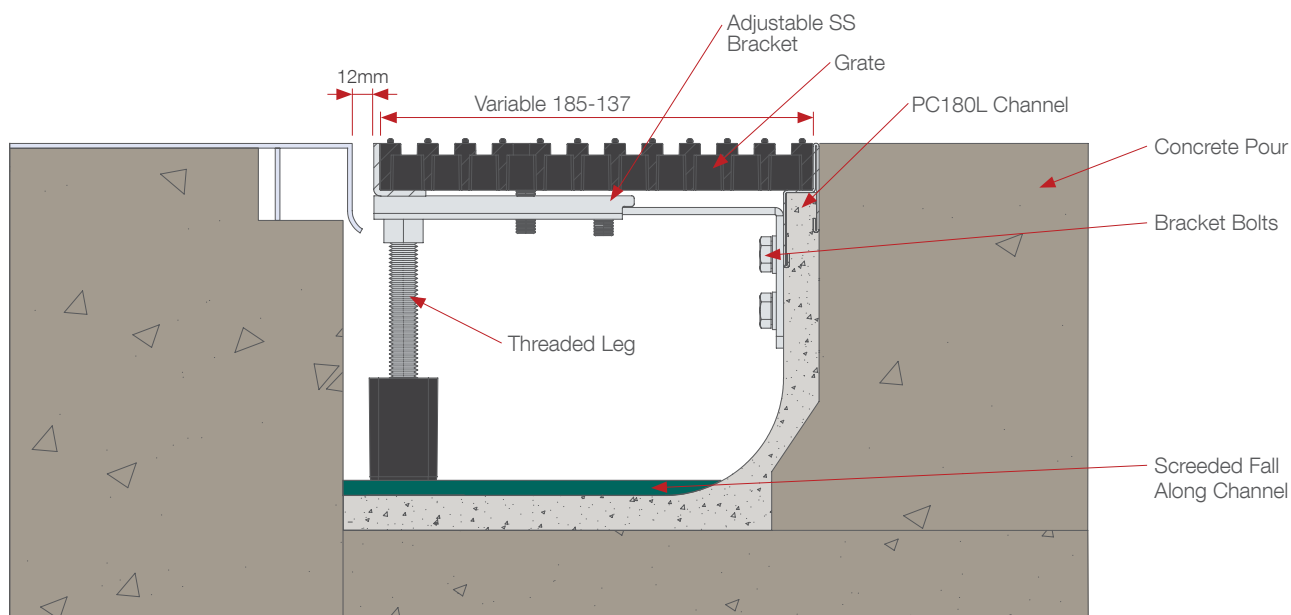
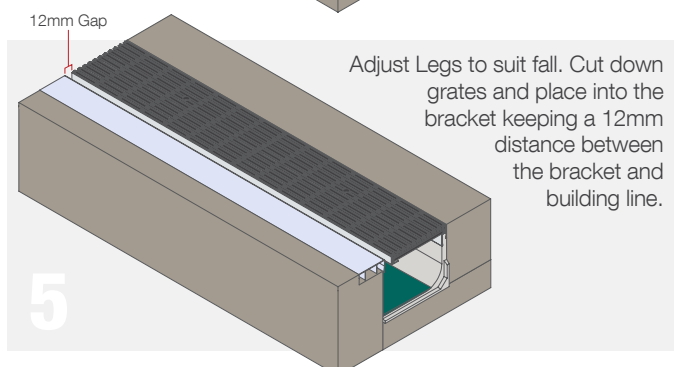
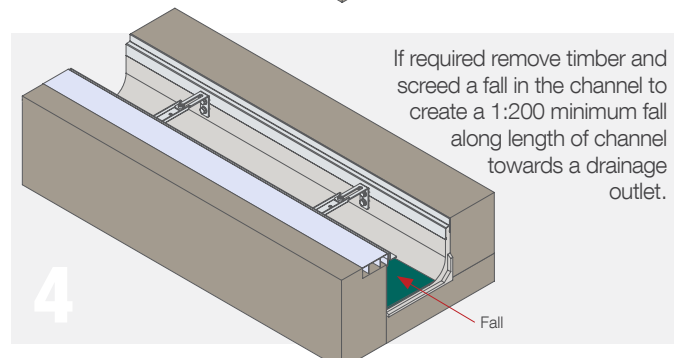
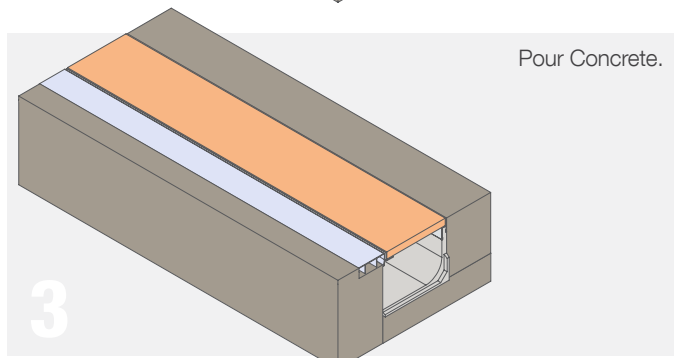
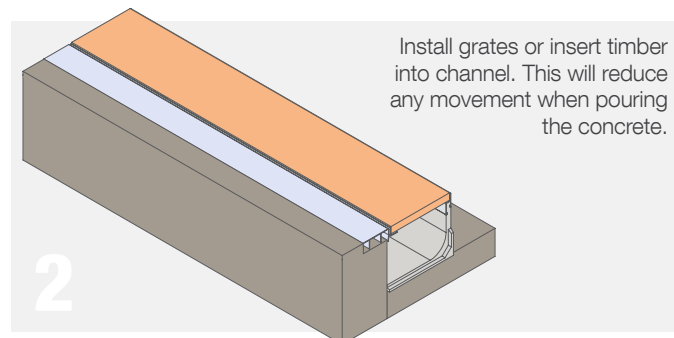
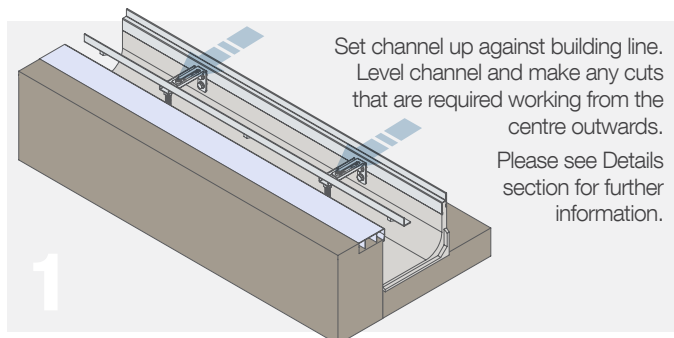
Suitable for APL Architectural Series and Smartwood joinery. A separate colour-matching wedge is fitted to the frame or transom. Matt silver finish shown.

PERIMETER DRAIN INSTALL GUIDE

*An Effective Solution
For Level Threshold
Installations*

*Modern
systems
for modern
buildings.*

Perimeter Drain Install Steps



Perimeter Drain Install Details

When installing this channel it is important to provide sufficient bracket fixing points to create sufficient load support and look aesthetically pleasing.

We recommend following the steps below to get the best possible result.

Channel Construction

[Stand back from the building and visualise the job in 'runs']

Work out the length of each run, this will allow you to work out how many lengths of channel you will require, based on the notes below.

- > At least two fixing points are required per channel
 - > This means that the shortest channel length is 530mm so that two fixing points are maintained per channel length (Fig 1)
- > If more than 200mm is to be cut off a channel length then equal amounts should be cut from each end of the channel.
- > In order to achieve minimum channel length it may be required to cut more than one channel in a run.
- > It will look aesthetically better to have the cut channels at each end of the run, I.E. work from the centre out.
- > Installing small lengths with one or no fixings will require custom brackets to be made.

Fig 1

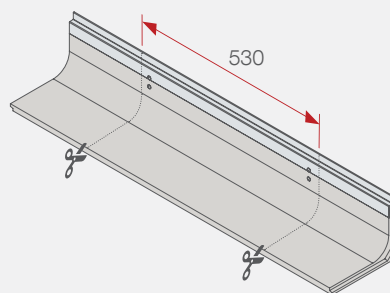
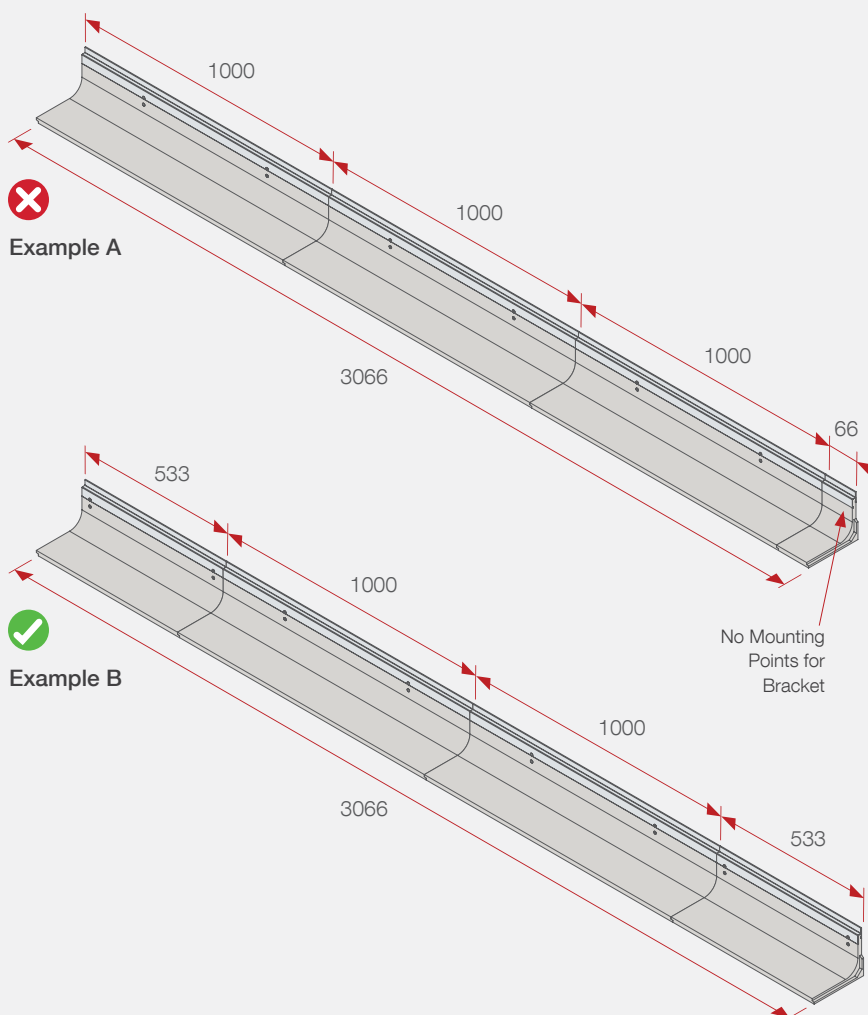


Fig 2

To illustrate the above we have created a scenario where a 3066mm channel is required.

Example A- 3x 1m lengths have been used and a 66mm section cut, however this leaves no mounting points on it and a custom bracket will require fabricating.

Example B- 2x 1m lengths have been used and the remaining distance has been made up by cutting down two equal length sections on either end. This allows for the installation of standard brackets while achieving minimal cuts and uniform finish.



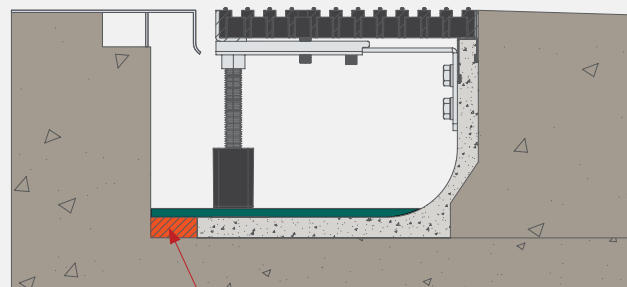
Following the Building Line

To ensure a constant reveal between channel and joinery/building.

The channel edge must be set parallel to the joinery/building line. This may require the channel to 'run out' on the foundation of the building in order to achieve a parallel reveal.

It is almost impossible to create a tapered grate that will look aesthetically correct. (Fig 3)

Cross Section Of Example B



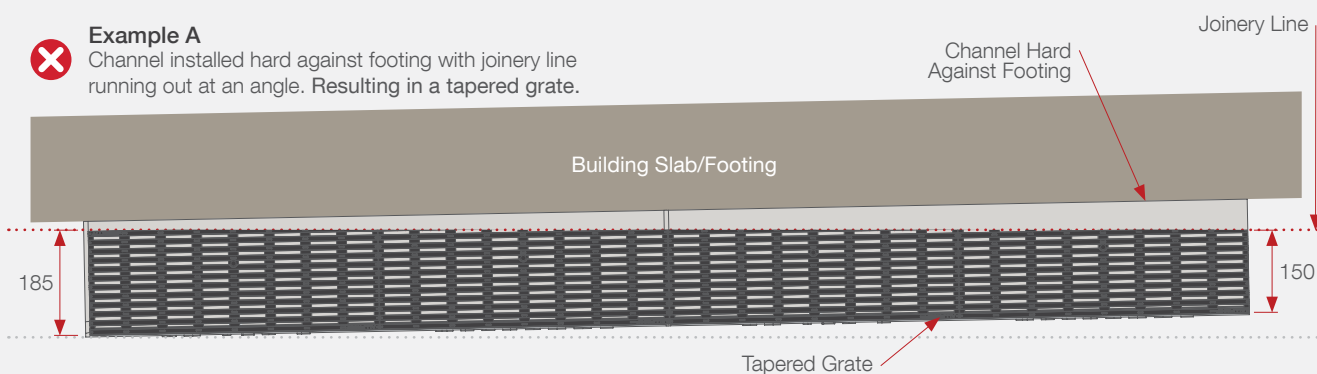
Epoxy Mortar

Fig 3



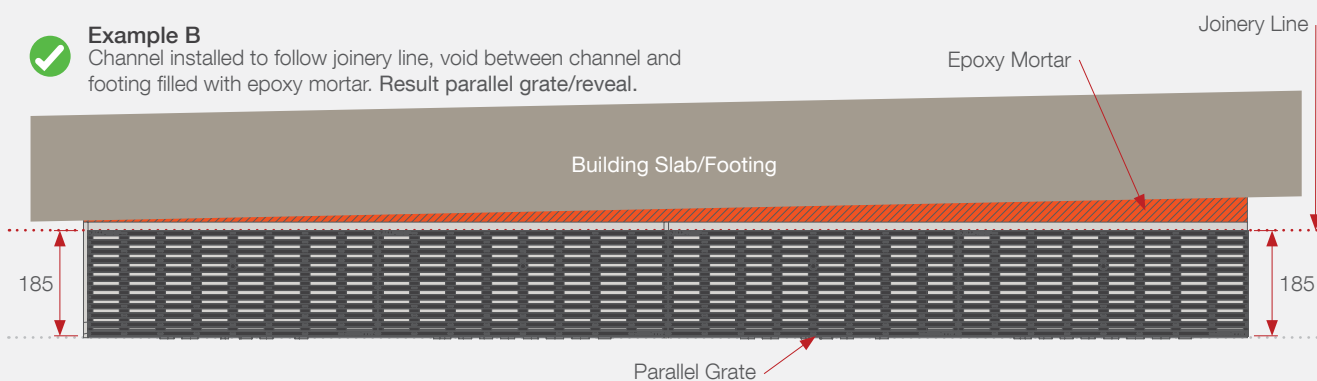
Example A

Channel installed hard against footing with joinery line running out at an angle. Resulting in a tapered grate.



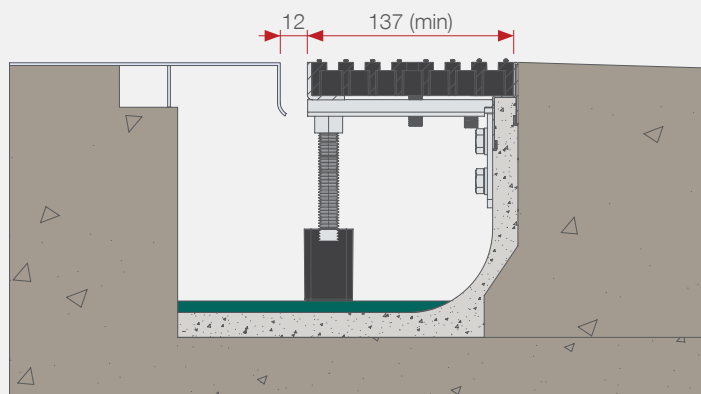
Example B

Channel installed to follow joinery line, void between channel and footing filled with epoxy mortar. Result parallel grate/reveal.



Note that any reveal of less than 137mm will require a custom bracket to be fabricated by Allproof. (Fig 4)

Fig 4



Corners

90 degree internal and external corner pieces are available to purchase. If this doesn't work for your situation you can mitre cut straight lengths to suit the required angle.

Outlets

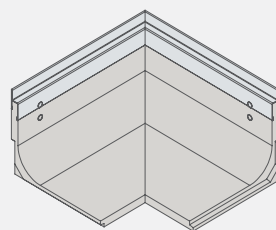
Outlets should be brought up into the base of the channel as this will work best hydraulically. The base or the channel features drillout locations to suit 100mm pipe.

A diamond core is the best tool to drill outlets in polymer concrete

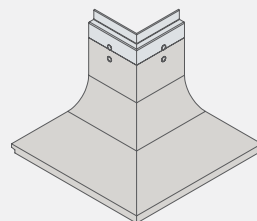
These outlets should then lead to a separate sump/sediment catchment pit.

Consult your drain layer/plumber for local regulatory information.

Corners



90° External Corner



90° Internal Corner

Cutting Channels

When cutting channels the most important thing to be aware of is the stainless edge is the only main visual point.

A 'back cut' in the channel can help to make the stainless edge meet well, the gap in the two channels can then be filled with an epoxy mortar to reform the shape of the channel.

A diamond blade on a grinder is the best tool for this. We recommend wearing appropriate PPE including face mask, eye protection and gloves when cutting channels and grates.

Installation of brackets and grates.

Grates are set up to follow the number of channels previously installed. I.e. one bracket per channel.

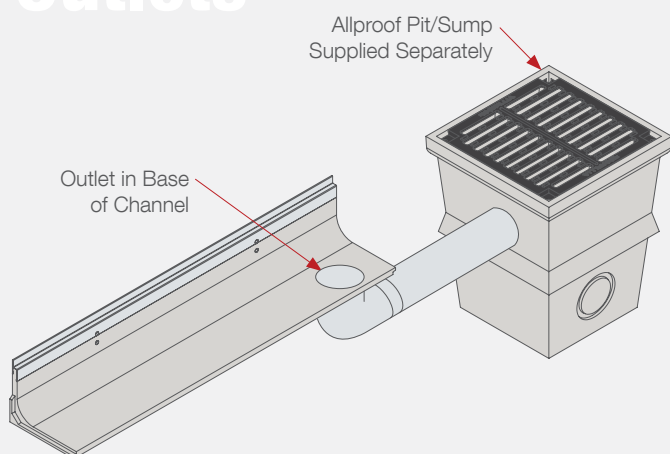
Changes in building line can be accommodated by cutting the bracket to adjust the grate width and achieve the required 12mm clearance to building line. (Fig 4)

Use a new, iron free, cutting wheel to cut the bracket. Any burn marks can be cleaned off with a dry soft abrasive pad.

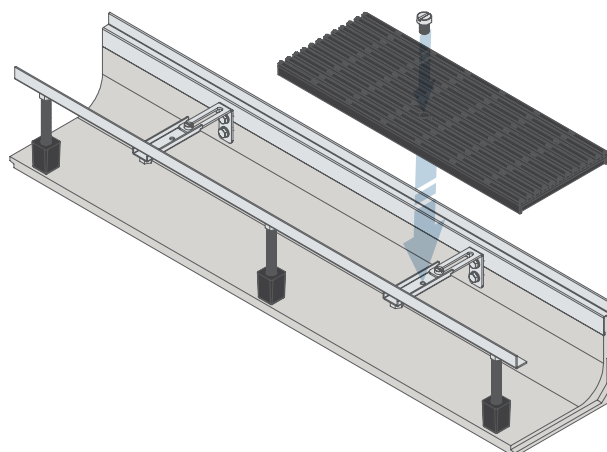
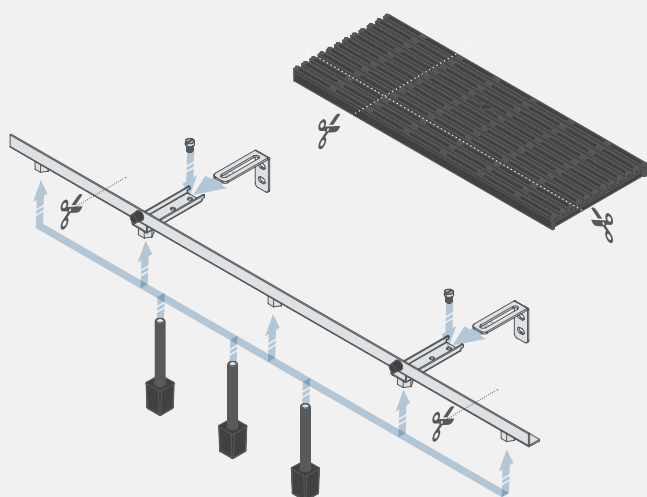
GFN grates can be cut on site using a handsaw or jig saw. Any cuts can be cleaned up with sandpaper.

NOTE: only use hand driven tools for fixing of brackets and grates. Power or impact drivers can strip threads.

Outlets



Cutting Grates & Brackets



2 August 2017

Tania McGrath Building Consent Officer

Christchurch City Council ,

Christchurch.

Building Consent: BCN/2017/201380 Byron Street, Sydenham

Addition to Factory – New Offices, Meeting and Store Room

RFI Items

B1 - 016

8. The drawings indicate that the opening in the existing wall will be significantly extended. Please provide details of the support for this opening and evidence that the bracing of the existing building can be maintained with this new opening.

14/07/17 - Unable to locate information within engineering calculations as indicated - please direct me to where this information is located.

Refer to Sheets A6 & engineering calculations supplied

(Resolved)

D1 – 074

- 1 Please provide finished floor level between the existing and new floors sufficient to demonstrate compliance with the requirement of D1 in relation to isolated steps.

Refer to Sheets A2, A8, A11 cross section B-B, A16 Detail 18 & A22 Detail 25 of consent drawings.

13/07/17 - Thank you for the revised detail, however the dimensions provide are not within the scope of D1/AS1 4.1.1 and figure 11 ie risers of less than 150mm (less than 23 degree pitch) are not acceptable - Please review as appropriate. For this to be reviewed as an alternative solution sufficient information to demonstrate compliance with D1 will be required.

Refer to Sheets A2, A8, A11 cross section A-A & B-B, A16 Detail 18 & A22 Detail 25 of consent drawings.

E2-100

- 1 Please provide cladding details for all junctions sufficient to demonstrate compliance with requirements of E2. This should include but is not limited to the vertical metal cladding to block wall both vertical junction and internal corner and internal corner for existing metal cladding to new block wall.

13/07/17 - Thank you for the additional details. Please review detail 23 Sheet A22. It appears the existing metal wall cladding is shown as continuous within the seismic gap required. Also Detail 24 same sheet indicates the presence of blocking within this seismic gap. Please remove from details to ensure full depth of seismic separation is maintained.

Refer to Sheets A22 Details 23, 24 of the consent drawings.

13/07/17 - NEW - please provide a detail for the junction between existing block wall and new blockwall located on the boundary - this detail should reflect the requirement for seismic separation that has been indicated throughout consent documents. Note detail 7 will need to be revised to reflect this requirement and to remove the metal cladding indicated within the seismic gap.

Engineers Explanation:

While we have nominated a seismic gap of 50mm between the existing and proposed office, the design features report is not intended to provide a detailed commentary of how this is expressed at every element at the interface of the two buildings. On this boundary wall (shown in detail 28 sheet A22) the existing and new walls are able to move independently out of plane under face load as there is no active connection between them – this is no different with a 10mm gap than with a 50mm gap – so they are seismically separate in that direction of shaking. Under in-plane loads the existing wall (stiff concrete block masonry) and the new wall (also stiff concrete block masonry) are not expected to drift enough over the relatively low height of the wall at ultimate design level loads enough to cause connection or pounding of the two buildings. Because of this, while the separation between the buildings at this wall line is less than the nominated seismic gap of 50mm, it does not impair the effectiveness of this gap or result in undue damage, therefore the intent of the seismic gap is not compromised and the two buildings will still behave independently under seismic shaking. With this 10mm gap along the boundary wall the gap area is less than 0.1m².

Specialist Review: Geotechnical (Margaret Stoffel)

GEO – 001

- a) Please provide Engco geotechnical report for 83 Byron St.

Refer to revised Engco report supplied within these documents

GEO - 001A f) The geotechnical letter also recommends that where it is not possible to extend the gravel layer beyond the building footprint on the South & West sides of the building because the site boundary does not provide adequate space, a new slab section must be designed. Please address this issue.

ADDED 13/7/17: Response refers to structural calculations; this does not answer the question. Please indicate where this information is found.

Engineers Explanation: refer also to Engineers Calculations in Supporting Documents

Our previous response stated: On the south side the new slab has been tied into the existing slab as recommended (refer sheet A9). This was the recommendation in the geotechnical report which states “a Chartered Structural Engineer should design the new section of slab to suitably tie into the existing slab and cantilever along the western side.” This tie in is intended to provide support to the floor slab in the event of any ground slumping at this boundary.

As regards the western boundary our previous response stated: On the western side of the foundation the recommendation in the geotechnical report is for the slab to be able to cantilever in the case of loss of support from settlement of the hardfill. The hardfill is to be 300mm deep, and so a cantilever length of 300mm has been allowed for. The 300mm thick slab thickening with H12 @400crs is able to cantilever this distance easily. Refer attached calculations. The additional page of calculations that was attached to that response shows that the load on the western edge of the slab comes from the wall only as the roof support is on the north and south and internal walls, and that under the assessed ULS load the slab as detailed in the drawings is able to cantilever a length greater than 400mm. Please be clearer on what information you are looking for to resolve this response.

Specialist Review : Mechanical Ventilation (Nick Waddington - 7/4/17)

SER - 001The specialist services reviewer of this application requires the following additional information:

Please provide PS1 (Design) and associated design details, showing Compliance with Clauses G4 and H1.3.6 of the New Zealand Building Code. Also, a schedule of inspections to be undertaken by the engineer with confirmation that 'as built' drawings and a PS4 will be provided on successful commissioning of the ventilation systems. Response received 12/7/17 does not address RFI

Refer to Mecserve Heating Ventilation Engineers PS1 supplied within these documents

Yours sincerely

Adrian Ellis