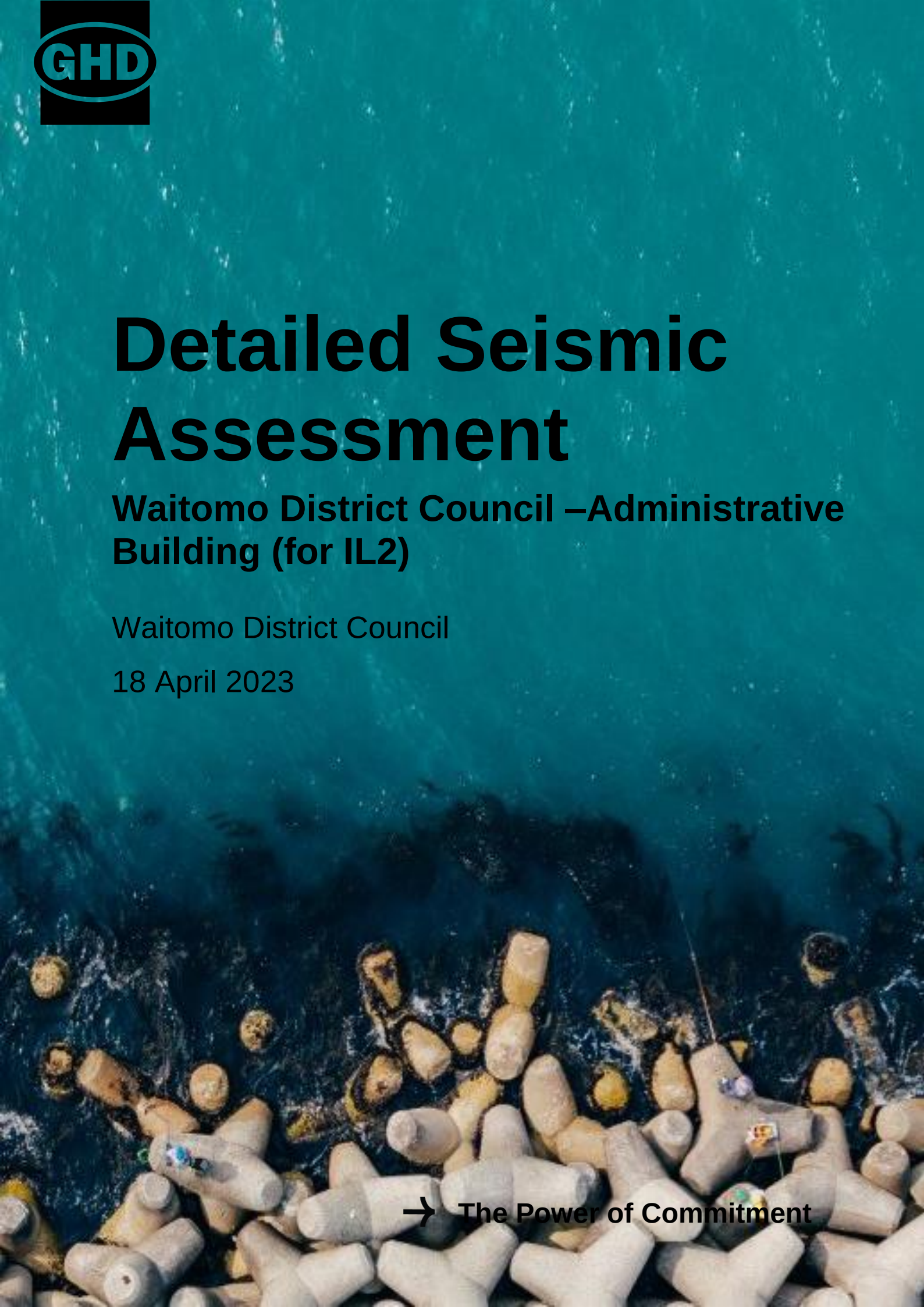
Detailed Seismic Assessment

Waitomo District Council –Administrative Building (for IL2)

Waitomo District Council

18 April 2023



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Executive summary

The client - Waitomo District Council (WDC) - engaged GHD to undertake a Detailed Seismic Assessment of the existing administrative building located at 15 Queen Street, Te Kuiti, Waitomo, to better understand the likely seismic performance of the building against seismic events.

The Detailed Seismic Assessment (DSA) focuses on life safety issues, paying special attention to the structural load paths of the building, the capacities of the structural elements, the likely inelastic mechanisms, the global building response to earthquake shaking and the earthquake rating for the building. The detailed procedures for the assessment are intended to provide a more reliable and consistent outcome than is available from the Initial Seismic Assessment (ISA). The focus of the DSA is to achieve an understanding of the likely behaviour of the building in earthquakes by quantifying the strength and deformation capacities of the various structural elements, by checking the building's structural integrity against the loads/deformations (demands) that would be used for the design of a similar building on the same site.

The results of the Detailed Seismic Assessment of the existing building indicated a building score of **15%NBS(IL2) Grade E**. Grade E buildings represent a risk to occupant's equivalent to more than 25 times that expected for an equivalent new building, indicating a high-risk exposure to life-safety issues. The building score is below the 67%NBS threshold for Earthquake Risk buildings and also below 34%NBS threshold for Earthquake Prone Buildings.

The Critical Structural Weaknesses (CSWs) controlling the building's score are the timber braced walls in the Ground floor, closely followed by the timber braced walls in the First floor. Also, in line with Part C2G of the MBIE Assessment Guidelines, the timber walls and diaphragm are identified as Severe Structural Weaknesses (SSW) because their failure could lead to the collapse of the building.

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.2 and the assumptions and qualifications contained throughout this report.

Contents

Table index

Figure index

Appendix index

1. Introduction

1.1 Background

GHD has been engaged by the Waitomo District Council (WDC) to carry out a Detailed Seismic Assessment (DSA) of the existing administrative building located at 15 Queen Street, Te Kuiti, Waitomo as an Importance Level 2 **(IL2)** structure.

The purpose of this assessment is to provide the client the expected structural performance of the existing building relative to the current Building Code requirements in terms of the percentage New Building Standard (%NBS).

The structure to be assessed is shown in orange in Figure 1.1.

Figure 1.1: Aerial view of the building (Source: http://maps.waitomo.govt.nz)

1.2 Scope and deliverables

The agreed scope of works of the DSA comprises the following:

1. Obtain property file folder held at the Waitomo District Council and perform a desktop review.
2. Perform an external and internal visual inspection of the structure.
3. Perform detailed assessment of the building.
4. Prepare the DSA report advising the outcome of the assessment.

The deliverables include:

1. A DSA report considering the structure as an IL2 structure for client's review and comment.
2. High-level Concept strengthening plans.

The report also includes the existing building plans (Refer Appendix A) and the geotechnical report (Refer Appendix C).

1.3 Assumptions and limitations

Assumptions:

1. In this report it was assumed that the building was built following the documentation presented in section 2.1 with the alterations – if any – observed during the site inspection as noted in section 2.2.
2. A part of the structural drawings was not available in the documentation, and so some assumptions related to connections were made.
3. The thickness of the particle board at first floor level is assumed to be 15 mm as the information was not in the available plan set. These boards are assumed to be grade F4 with a built-in safety factor of 2 due to the uncertainty and criticality of these elements.

Limitations:

1. *This report has been prepared by GHD for Waitomo District Council and may only be used and relied on by Waitomo District Council for the purpose agreed between GHD and Waitomo District Council as set out in section 1.2 of this report.*
2. *GHD otherwise disclaims responsibility to any person other than Waitomo District Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.*
3. *The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.*
4. *The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.*
5. *The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.*
6. *GHD has prepared this report on the basis of information provided by others which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.*

2. Building investigation

2.1 Available documents

A desktop review of the information provided by the Client and the property file folder was completed for the building. The useful documents and a short description are provided in Table 2.1.

Table 2.1: Available documents

Year	Author	Description
1985	Ministry of works and Development	Part set of the original structural drawings numbered 201, 202, 205 to 209, 210, 211
1985	Ministry of works and Development	Original Architectural drawings numbered 101 to 105
2017	Mark T Mitchell Ltd	Soil investigation, Geotechnical assessment for site subsoil class and Liquefaction potential

2.2 Site inspection

A visual internal and external site inspection was carried out on 1 May 2019. During the site inspection all areas were generally accessible and recorded by GHD where appropriate.

During the site inspection, GHD found the following alterations with respect to the original as-built drawings:

- Removal of bracing walls at gridline 2 between gridlines A and D at the reception area of the ground floor. In addition, the supporting steel column on Grid B was also removed. It appears from bulkhead framing that the beam has been retrofitted for a deeper longer spanning member during the column removal, however this could not be confirmed on site.
- At the upper floor, timber framed walls with a second layer of GIB panel have been added in the office room located in the front area bounded between gridlines 2~3 and A~B.
- A segment of bracing panel at the intersection of gridlines E and 1 was shortened.

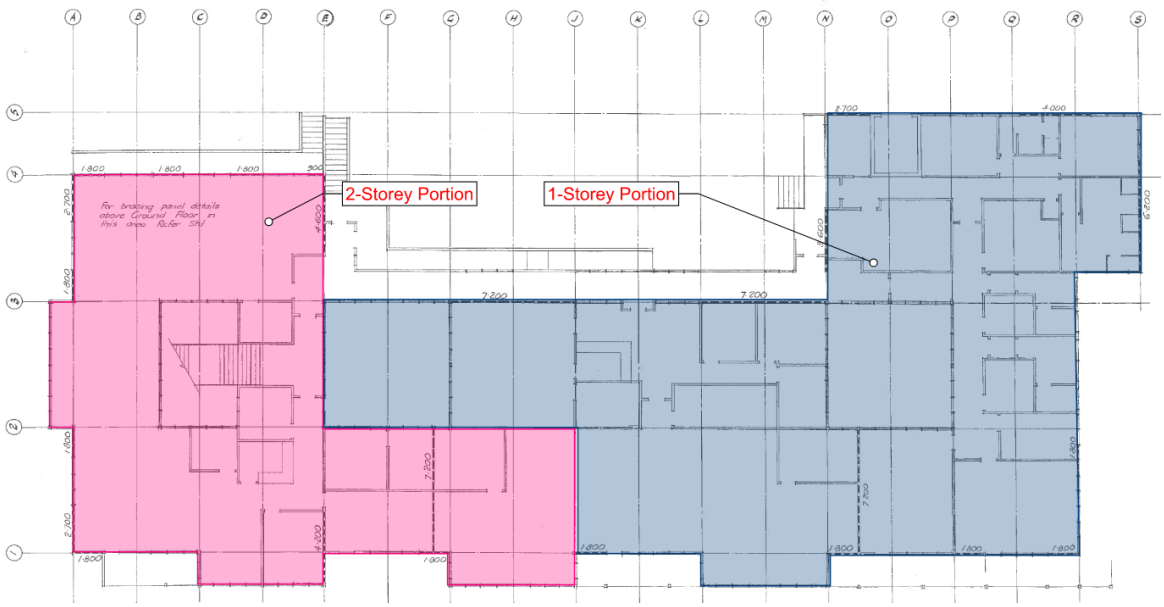
2.3 Building description

The description of the building and key structural features that may influence the response of the building is presented Table 2.2.

Table 2.2: Building description and structural features

General			
Territorial Authority	Waitomo District Council		
Year of Design	1985		
Heritage Status	None, the building is not listed in www.heritage.org.nz		
Building Description			
No. of Storeys	2	Area of Typical Floor	Approx. 1150 m^2
General Building Geometry	• The building is mainly a timber structure that comprises a two-storey portion and a single storey portion constructed as a single building with no seismic gap between them. (Figure 2.1). • The difference in height between the portions is addressed by a retaining block wall (Figure 2.2). • In addition to this vertical irregularity, the building's footprint also presents a somewhat irregular shape (Figure 2.1).		
Roof System	• Light weight steel roofing installed over plywood sheets that are supported on purlins over the timber trusses (Figure 2.3). • Plywood sheets are used as bracing elements to control displacements and provide load paths (Figure 2.3).		
Floor System	• The floor system consists of particle boards over timber joists, which in turn are supported by timber posts and bearers in the 1-storey portion, and by steel beams and columns in the 2-storey portion (Figure 2.4). • The ground floor for the 2-storey portion has a slab-on-grade over a DPC on hardfill.		
Gravity Structural System	• The gravity system of the structure is composed of timber roof trusses, timber floor joists, steel beams, load bearing timber walls and reinforced concrete block walls.		
Foundation System	• The foundation system for the 1-storey portion comprises ϕ150mm timber piles at 1800 mm c/c and strip beam footings for the periphery walls (Figure 2.4). • The foundation system for the 2-storey portion comprises strip and pad footings below walls and columns respectively.		
Lateral Load Resisting System (LLRS)	• The lateral load resisting system is composed of framed timber walls with plywood panels. It is worth noting that the retaining block wall also participates resisting lateral loads (Figure 2.5). Some walls have been altered after construction.		
Structural Elements Shared with Adjacent Titles	N/A		
Ground Profile and Identified Geohazards	• Levelled land on both sides of the retaining walls with gentle slope. • No liquefaction risk as per Geotechnical report.		

Previous Strengthening and/ or Significant Alteration	• No previous structural strengthening was found in the property files.
Other Relevant Information	N/A

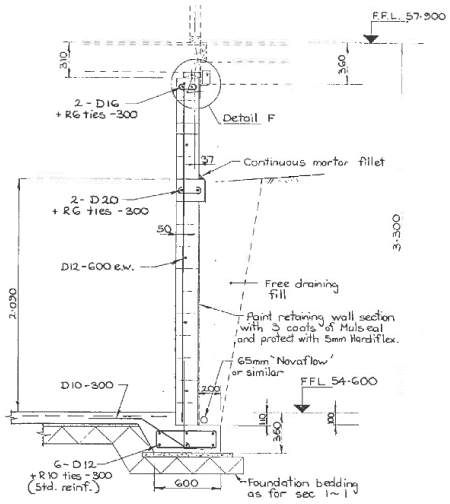


(a) Building footprint and areas

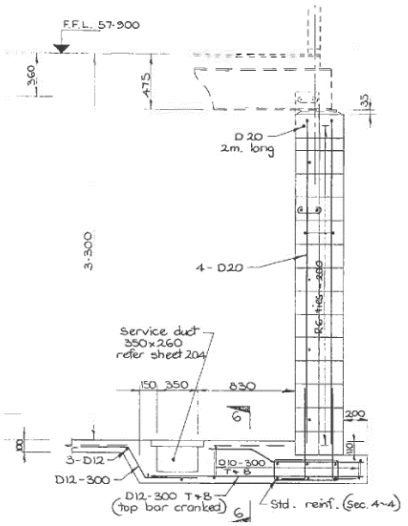
(b) 2-storey portion

(c) 1-storey portion

Figure 2.1: Building Geometry

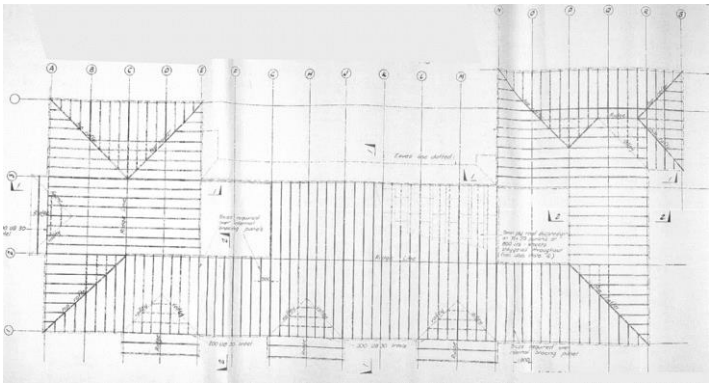


(a) Block Wall cross-section

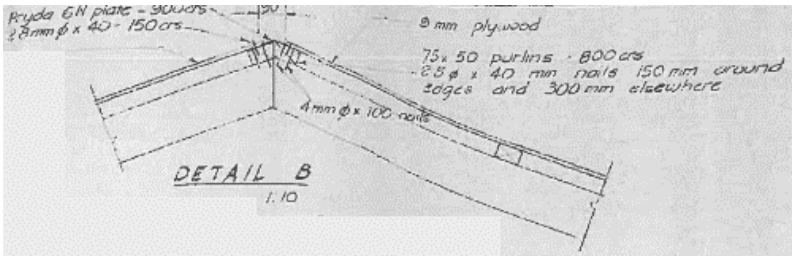


(b) Block Wall Pilaster cross-section

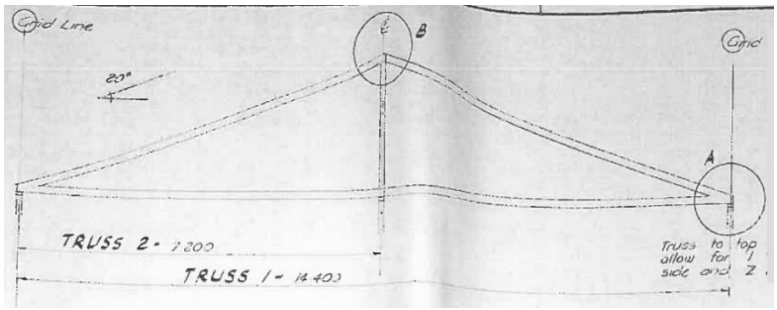
Figure 2.2: Cross section of the Retaining Block Wall



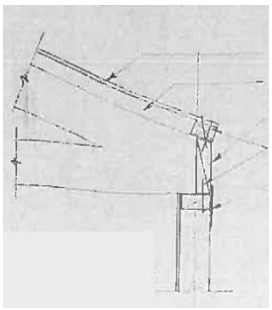
(a) Roof Layout Plan



(b) Detail at the apex of the truss

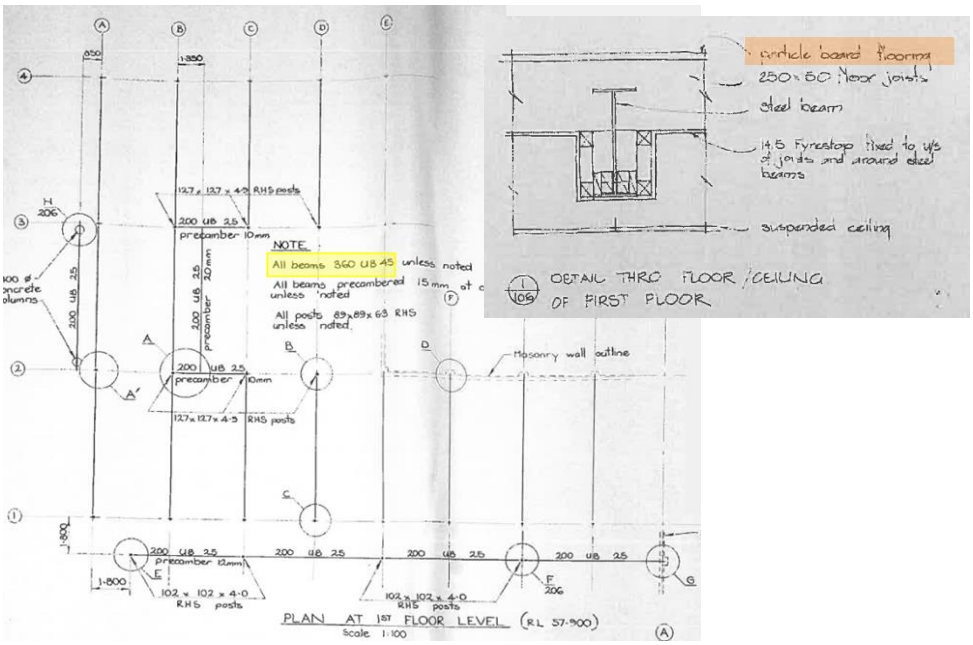


(c) Roof timber truss

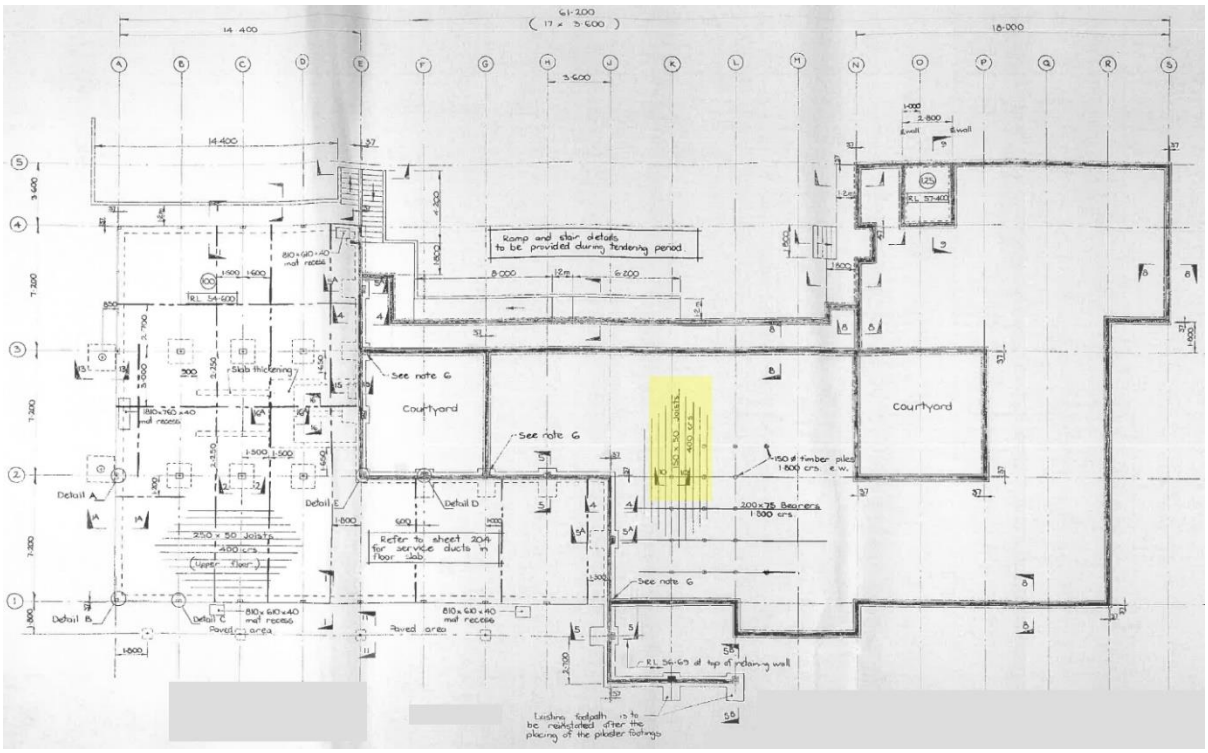


(d) Support of the truss

Figure 2.3: Roof structural details

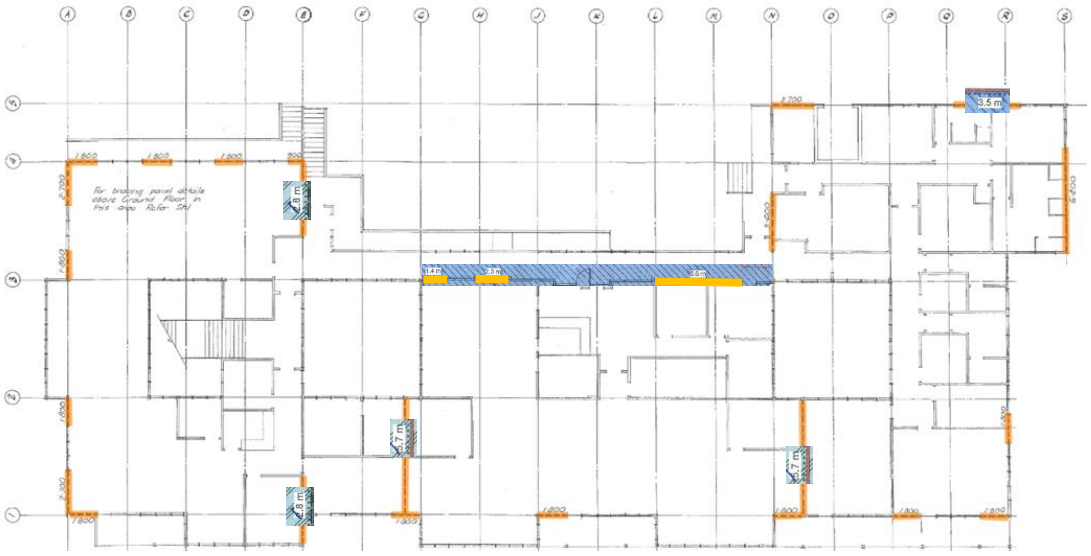


(a) First storey framing plan of the 2-storey portion

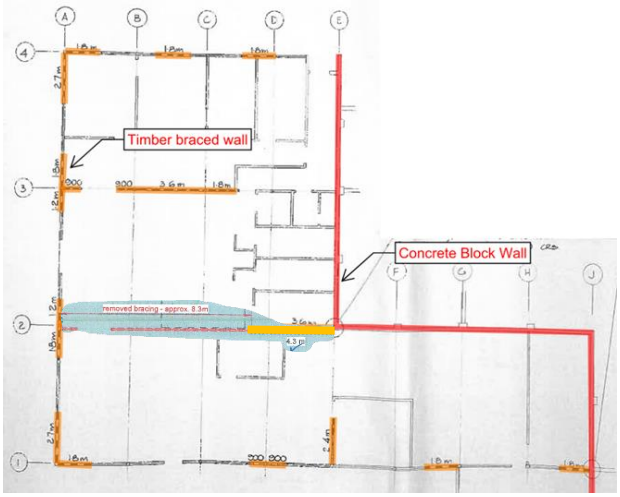


(b) Ground storey framing plan and foundation plan for 1-storey portion

Figure 2.4: Floor structural details



(a) Existing bracing timber walls on the First Floor



(b) Existing bracing timber walls and blockwall (retaining) on the Ground Floor

Figure 2.5: Structural system

3. Assessment methodology

3.1 Standards and guidelines

The building has been assessed to the current New Zealand Seismic Assessment guidelines and NZ standards. Other international standards and guidelines were also used where it was deemed necessary. The standards and guidelines that were used are listed below:

Name	Title
MBIE Guidelines	The Detailed Seismic Assessment of Existing Buildings (July 2017)
AS/NZS 1170.0:2002	General Principles
AS/NZS 1170.1:2002	Structural Design Actions NZS 1170.5:2004
NZS 3101:2006	Concrete Structures
NZS 3603: 1993	Timber Structures Standard
NZS 1720.1:2022	Timber Structures Standard

The MBIE (Ministry of Business, Innovation and Employment) Seismic Assessment Guidelines published in the EQ Assess webpage were the basis for the Detailed Seismic Assessment. These guidelines are referred to as the 'MBIE Guidelines' throughout the report. The specific sections used are as follows:

Name	Title
Part A	Assessment Objectives and Principles Part C
Part C	Detailed Seismic Assessment
	Section C1 General Issues
	Section C2 Assessment procedures and Analysis Techniques Section
	Section C3 Earthquake demands
	Section C4 Geotechnical Considerations Section
	Section C5 Concrete Buildings
	Section C9 Timber Buildings

3.2 Seismic assessment philosophy

The current adopted philosophy in New Zealand for a seismic assessment and improvement is to compare the building's Ultimate Limit State (ULS) earthquake resistance with the current New Zealand Building Code requirements for a new building constructed on the same site. The seismic rating of the building is then expressed as a percentage of New Building Standard (%NBS).

The New Zealand Society for Earthquake Engineering (NZSEE) has proposed a way for classifying earthquake risk for existing buildings in terms of %NBS and this is detailed in Table 3.1. The table is the basis of a proposed grading system for existing buildings. Accordingly, occupants in *Earthquake Prone* buildings (less than 34% NBS) are exposed to more than 10 times the risk that they would be in a similar new building. For buildings that are potentially *Earthquake Risk* (less than 67% NBS), the

risk is at least 5 times greater than that of an equivalent new building. Descriptions of the life-safety risk can be assigned to the building grades as shown in Table 3.1.

Table 3.1: Relative Earthquake Risk (from Table A3.1 of the MBIE Guidelines)

Percentage of New Building Standard (%NBS)	Building Score	Approximate Risk Relative to a New Building	Life-safety Risk Description
>100	A+	Less than or comparable to	Low risk
80-100	A	1 to 2 times greater	Low risk
67-79	B	2 to 5 times greater	Low to Medium risk
34-66	C	5 to 10 times greater	Medium risk
20-33	D	10 to 25 times greater	High risk
<20	E	25 times greater	Very high risk

In addition to this classification, it is worth mentioning the Qualitative Risk Classification commonly used. This is shown in Figure 3.1, and represents a combination of the language used by the Building Act 2004 Section 133AB and NZSEE as described in the NZ Assessment Guidelines – Part A.

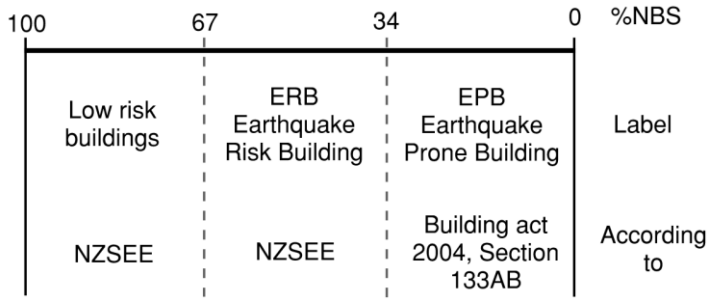


Figure 3.1: Qualitative Risk Classification

3.3 Seismic restraint of SSNS items

During an earthquake, the safety of people can be put at risk due to secondary and non-structural (SSNS) items falling on them. These items should be adequately seismically restrained, where possible, to the NZS 4219:2009 “The Seismic Performance of Engineering Systems in Buildings”.

At this stage, GHD has no available information about the secondary and non-structural elements in the subject building, neither were they observed in the site inspection other than the main stairs. However, due to the size and occupancy type of the building it is considered that no SSNS poses a life safety risk for the building occupants.

3.4 Seismic assessment requirements

3.3.1 Limit state design and loading

The seismic assessment of the subject building was undertaken to the Ultimate Limit State (ULS), as defined in AS/NZS1170.0. The ULS design level allows the structure to exhibit damage but requires the collapse of the structure to be prevented in addition to other life safety requirements. The ULS

design level also requires designers to avoid damage that can cause SNSS systems necessary for building evacuation to be non-operational.

The reliable structural ductility was set as $\mu = 2.0$ for timber structural elements and $\mu = 1.0$ for concrete walls & footings. The following ULS load cases were considered during the analysis of the structure.

- $G + \psi_e \cdot Q + E_u$

A full gravity, wind and snow analysis of the existing structure is outside the scope of the DSA and has not been performed.

3.3.2 Assessment parameters

All gravity loads were derived based on AS/NZS1170.0 or as otherwise noted within the calculations. All seismic loads were derived based on NZS 1170.5. The summary of design loads and general seismic factors are presented in Table 3.2 and Table 3.3 respectively. All gravity loads were calculated using a gravity acceleration of 9.81m/s^2.

3.3.3 Building design life

The building design life is assumed to be 50 years in accordance with clause B2 of the New Zealand Building Code.

3.3.4 Building importance level and annual probability of exceedance

As requested by the client and in line with AS/NZS1170.0 Clause 3.3, this building is currently considered to be an Importance Level (IL) 2 structure. **IL2** structures include buildings that are *normal structures and structures not falling into other levels*. This has been defined in AS/NZS1170 as *medium consequence for loss of human life, or considerable economic, social or environmental consequences*.

In accordance with Table 3.3 of AS/NZS 1170.0 and with reference to the Building Importance Level, this building has been assessed with 1/500 annual probability of exceedance and Return Period Factor, R_u of 1.0.

Table 3.2: Design dead and live loads

Type of Load	Load Name	Load Magnitude
Permanent load	Self-weight concrete elements	24 kN/m^3
	Concrete block wall (fully filled)	3.65 kPa
	Roof	0.50 kPa
	Floor	0.55 kPa
	Timber wall (External)	0.35 kPa
	Timber wall (Internal)	0.25 kPa
Imposed	Roof	0.25 kPa
	Floor	3.00 kPa

Table 3.3: General seismic factors

Seismic Factor Coefficient	Document used	Selected Value
Ductility Factor (μ)	NZS1170.5, Cl. 4.3	μ = 2.0 for Timber elements μ = 1.0 for Concrete walls and footings
Structural Performance Factor (S_p)	NZS3101 Cl2.6.2.2.	Sp = 0.7 for timber elements Sp = 0.9 for concrete elements
Soil Type	NZS1170.5, Cl. 3.1.3	C
Hazard Factor (Z)	NZS1170.5, Table 3.3	Z = 0.18
Earthquake combination factor	NZS1170.5, Cl. 4.2	ψ_E Description 0.15 Reducible floor 0.3 Non reducible floor 0.6 Non reducible storage 0 Roof
Near-Fault Factor N(T,D)	NZS1170.5, Cl.3.16	N(T,D) = 1.0
Return Period Factor (R_u)	NZS1170.5, Cl.3.15	R_u = 1.0

3.5 Structural analysis

3.5.1 Analysis description and materials

The building was analysed with both hand calculations and three-dimensional (3D) modelling. The soil retaining demands of the blockwalls were determined using a 3D numerical model in the software CSi Etabs, while its in-plane demands and the demands of the rest of the structure (timber and steel) were analysed based on hand calculations.

The Equivalent Static Method (ESM) in NZS1170.5 was used to determine the seismic load demands in the structure, while the MBIE Geotechnical Modules 1 and 6 were used to determine the load demands on the retaining wall. The loads resulting from the interaction between the retaining wall and the rest of the structure were manually added to the structural demands calculated by the ESM and applied to the affected elements. It should be noted that despite the building is classified as irregular by NZS1170.5, the ESM was used as it was considered to provide a conservative case scenario for the seismic loading of this particular building.

The material strengths were obtained from the structural plans and the indications from the MBIE Guidelines. These are shown in Table 3.4.

Table 3.4: Material properties used in the assessment

Material	Property	Strength
Concrete	Probable compression strength, f'_c	30 MPa
Block wall	Probable compression strength, f'_c	12 MPa
Reinforcement	Probable yield strength, f_{yp}	297 MPa

3.5.2 Assessment of block walls

The block walls have a double function in this building, to retain soil (out-of-plane behaviour) and to be part of the bracing system (in-plane behaviour). For the assessment of the soil retaining behaviour the walls were analysed using a three-dimensional (3D) numerical model as previously described. The model was created in such a way that closely represents the geometry, dimension and cross sections shown in the building plans.

The model represented the walls with shell elements and the pilasters with frame elements. The materials were linear elastic isotropic materials. Loading was applied by using uniform and non-uniform load patterns. Figure 3.2 shows a graphical representation of the 3D analysis model for the block walls.

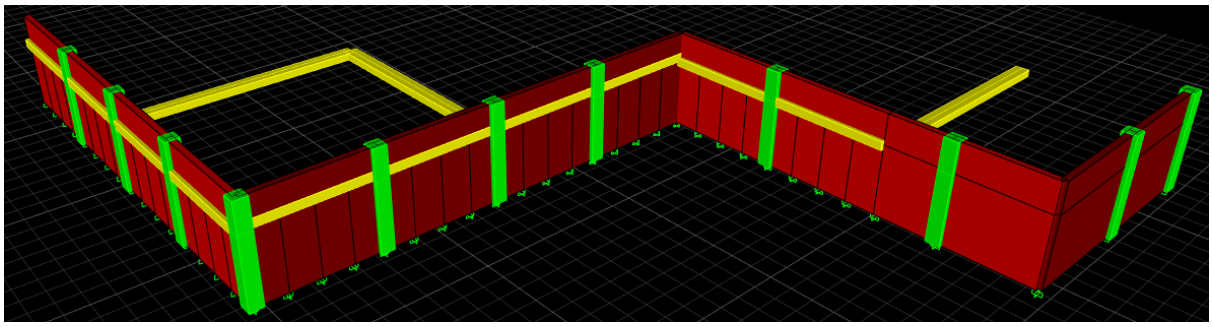


Figure 3.2 Etabs block wall model

The assessment was performed based on a progressive assumption-verification basis as described below:

Stage 1:

Assumption: retaining wall system (wall-foundation) resist forces by cantilever action with wall top displacement less than 0.4%h.

Verification: From an elastic analysis the wall displaces less than 0.4%, however it doesn't have enough capacity. So, the top of the wall will push against the floor diaphragm.

Action: Due to the expected displacements the retaining wall will push against the floor diaphragm. So, the load from wall top will be transferred to the structure. This changes the support condition to fixed base - pinned top.

Stage 2:

Assumption: Floor system props top of the wall driving the forces to the braced timber walls/ block walls (in-plane).

Verification: Retaining wall is verified as fixed base - pinned top. The wall can achieve 70% NBS. But the diaphragm is not strong enough and can achieve only 40%NBS.

Action: the floor diaphragm element is recognised as a structural weakness and requires strengthening

3.5.3 Assessment of roof and floor system

The diaphragms in the roof and level 1 floor were assessed using the girder analogy in NZS3603. Shear forces are resisted by the diaphragm panels and are assumed constant along the diaphragm depth. Bending moments are resisted by the chord elements (steel beams / floor joist / wall timber top plate) acting in tension and compression. Panel shear is transferred to timber braced walls and block walls via collector elements and in some cases direct connections.

3.5.4 Assessment of timber walls

The assessment of the timber braced walls was conducted in accordance with the MBIE Seismic Assessment Guidelines Part C9. Due to the flexibility of the diaphragms, the demands were determined based on the tributary area loading each line of resistance. The strength was determined based on the prescriptive capacity values provided in Part 9 and lumped on a per-grid (line of resistance) basis.

3.5.5 Assessment of the foundation system

The assessment of the foundation system was conducted in accordance with the recommendations in the MBIE Guidelines. The soil bearing capacity for the seismic cases were checked for the relevant elements.

4. Assessment results

The results of the Detailed Seismic Assessment indicate that the overall earthquake rating of the administrative building is **15%NBS(IL2) Grade E**. Grade E buildings represent more than 25 times greater risk compared to that expected from an equivalent new building, indicating a high-risk exposure to life-safety. Key results are summarised in Table *4.1*.

Table 4.1: Summary of assessment results for key structural elements

ID	Element	*%NBS(IL4)*	Location, mode of failure and engineering statement of structural weaknesses
1	Timber braced walls (Ground Floor)	15%	**Critical Structural Weakness (CSW) – Very high risk to life-safety should a large earthquake occur** Location: Timber walls on ground floor Mode of failure: Shear failure of the wall which is a combination of over-turning of the panels; bending of the studs; connection failure; and pull-out of the studs
2	Timber braced walls (First Floor)	15%	**Critical Structural Weakness (CSW) – Very high risk to life-safety should a large earthquake occur** Location: Timber walls on first floor Mode of failure: Shear failure of the wall which is a combination of over-turning of the panels; bending of the studs; connection failure; and pull-out of the studs
3	Floor Diaphragm	40%	**Structural Weakness (SW) – Medium risk to life-safety should a large earthquake occur** Location: First Floor Mode of failure: tension failure of the floor chord, open-up the floor leading to local collapse.
4	Retaining Blockwall	85%	**Structural Weakness (SW) – Low risk to life-safety should a large earthquake occur** Location: External part of the retaining wall Mode of failure: shear failure of the pilaster which can lead to local collapse of retained soil.

Notes:
The acronyms' description below are a short version of the comprehensive descriptions provided in clauses A6.6, C1.5.3.1 and C2G of the MBIE Seismic Assessment Guidelines

SW: An SW is any element that scores less than 100%NBS.
CSW: is the lowest scoring element(s) among the identified SWs
SSW: is an element or system that have little margin after their %NBS is reached and has a step-change brittle behaviour.

While several elements were identified as structural weaknesses (SW) in the assessment, the Critical Structural Weaknesses (CSWs) controlling the building's score are the timber braced walls in the Ground floor and the timber braced walls in the First floor.

In line with Part C2G of the MBIE Assessment Guidelines, the timber walls and diaphragm are identified as Severe Structural Weaknesses (SSW) because their failure could lead to local or general collapse of the building.

The following items have not been assessed in this document due to lack of information:

- Connections to the top plate of the walls
- Secondary structural and non-structural elements (however see 3.3)

5. DSA summary and recommendations

The results of the Detailed Seismic Assessment indicates that the overall earthquake rating of the administrative building is **15%NBS(IL2) Grade E**. This score is below the 67%NBS threshold for Earthquake Risk buildings and also below the 34%NBS threshold for Earthquake Prone Buildings.

Based on the findings and assessed %NBS score, in conjunction with the requirements of the building Act 2004, this building must be retrofitted to at least 34%NBS. However, and in line with WDC request, it is recommended that the building is strengthen to 67%NBS(IL2), so it does not fall below the threshold for acceptable seismic risk, as recommended by NZSEE.

A high-level concept strengthening scheme was prepared and it is attached to this report in Appendix B. It should be noted that the strengthening scheme is indicative in nature and is not a fully developed design.

Appendix A
Building Plans

61·200 (17 × 3·600)

14·400 | 3·600 | 18·000

Ramp and stair details to be provided during tendering period.

Courtyard

Courtyard

See note G

See note G

See note G

Slab thickening

810×610×40 mat recess

1810×760×40 mat recess

810×610×40 mat recess

810×610×40 mat recess

RL 54·600

RL 57·400

RL 56·69 at top of retaining wall

Detail A

Detail B

Detail C

Detail D

Detail E

250×50 Joists 400 crs (Upper floor)

150×50 Joists 400 crs

150 ø timber piles 1·800 crs. e.w.

200×75 Bearers 1·800 crs.

Refer to sheet 204 for service ducts in floor slab

Refer to detail C sheet 207 - anchor bars set into concrete floor slab

Paved area

Paved area

Existing footpath is to be reinstated after the placing of the pilaster footings

NOTES

1. Concrete strength to be 20 MPa min at 28 days
2. Place DPC, site concrete, sand and hardfill under all foundations as shown typically on sections 1-1 & 8-8
3. Sawcut positions are shown —— -- —— Cuts are to be 25 mm deep and made not more than 36 hours after placing conc. At not less than 28 days, clean out and fill with sand/cement at 3:1, dampen and finish smooth. Refer also to sheet 204 for saw cut positions
4. For sections and details refer to sheets 202 & 203.
5. Column recesses in floor slab are to be grout filled after columns are levelled and squared.
6. Provide starters from retaining wall to tie in single story perimeter wall.
7. Provide weather bars to external doors.
8. Ventilation blocks to be placed in perimeter masonry wall as per NZS 3604 section 4.1.2. Architect to determine location but must be kept clear of wall reinforcement.
9. Control joints are to be placed in masonry walls at max. centres of 7·2m. Refer ⑨ sheet 211

	BY	CHECKED	DATE
Designed			8/85
Drawn			8/85
Supervised			
Co-ord. Chk			
Recommended			

AMENDMENTS | BY | APPD. | DATE

R. L. PRESTON, CHIEF CIVIL ENGINEER

T. N. MITCHELL, CHIEF STRUCTURAL ENGINEER

APPROVED 18/1/85

Ministry of Works and Development

CIVIL ENGINEERING HAMILTON

STRUCTURAL DESIGN OFFICE

TG SHADWELL Commissioner

G.O.A.B. — TE KUITI

DEPARTMENTAL BUILDING

FLOOR PLAN

ORIGINAL SCALES	1:100	FILE
W.A.R. 4A077		

JOB	CODE	SHEET	REVISION
2/850/1	7202	201	

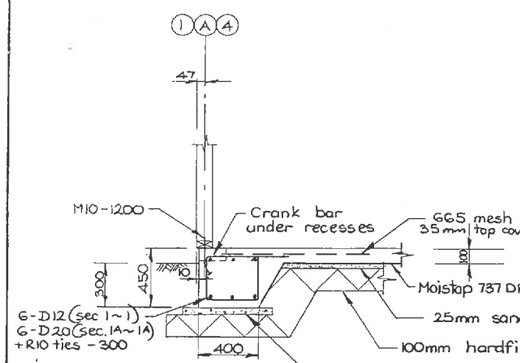
ORIGINAL SIZE A1

PW 482-A1 Rev. April 1984

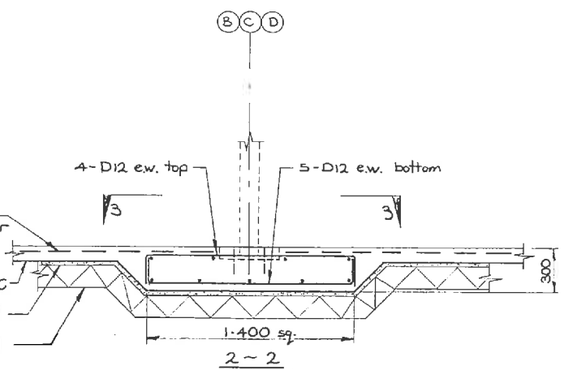
LOCAL OR TRACING No.

1:1 | 1:2 | 1:5

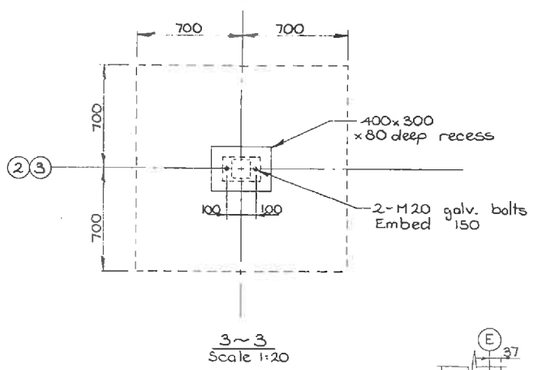
Whole numbers = mm
Decimalised expressions = m
unless indicated otherwise



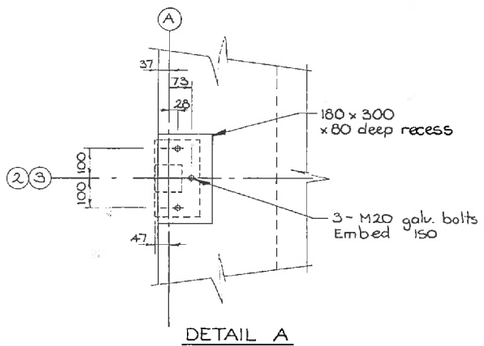
1 ~ 1
1A ~ 1A (differs as noted)
Scale 1:20



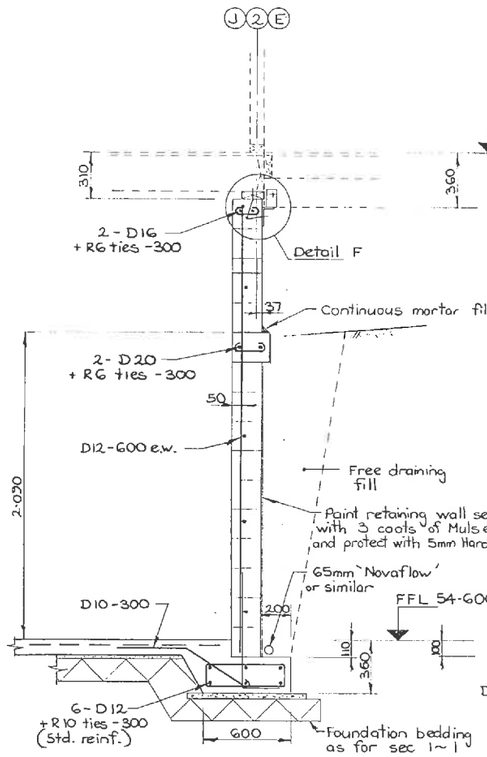
2 ~ 2
Scale 1:20



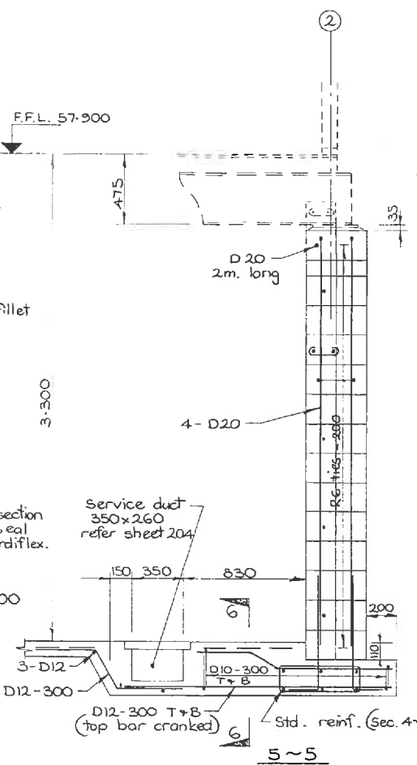
3 ~ 3
Scale 1:20



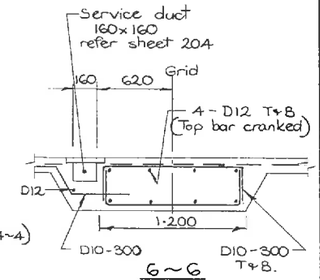
DETAIL A
Scale 1:10



4 ~ 4



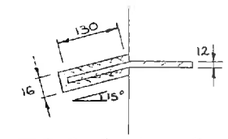
5 ~ 5
5A ~ 5A - Similar
1. Delete duct in footing and extend top D12 reinforcement.
2. Full height masonry.
5B ~ 5B - Similar but R.L. at top of wall is 56·69.



6 ~ 6

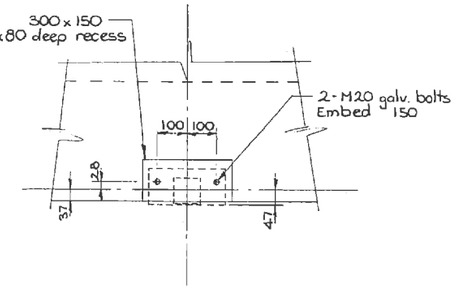
NOTES

1. Masonry Blocks are generally 20·16 series with all cells filled. Grout strength 17·5MPa min. at 28 days.
2. Place first course of masonry inverted to allow clear clean out tunnel.
3. Resin Bonded Dowel Detail

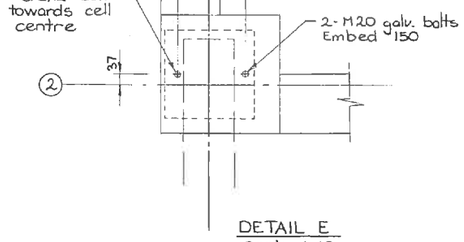


- Drill dowel holes with a percussion rotary drill.
- Thoroughly clean holes with a clean air jet immediatly prior to setting-in dowels using 'Expocrete S epoxy or equiv.

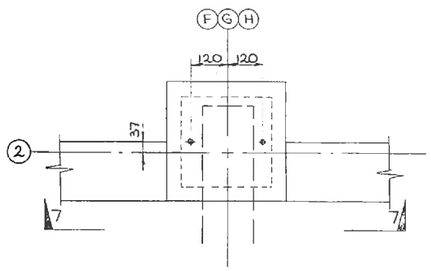
DETAIL B
Scale 1:10



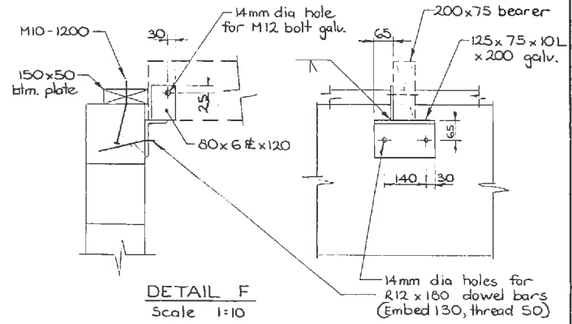
DETAIL C
Scale 1:10



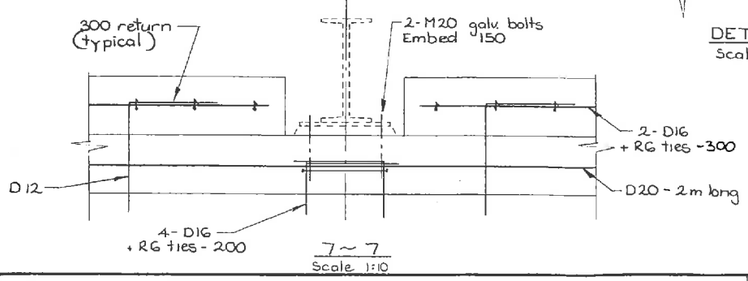
DETAIL E
Scale 1:10



DETAIL D
Scale 1:10



DETAIL F
Scale 1:10



7 ~ 7
Scale 1:10

	BY	CHECKED	DATE
Designed			8/85
Drawn			8/85
Supervised			
Co-ord.Chk.			
Recommended			

AMENDMENTS | BY | APPD. | DATE

R. L. PRESTON
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APPROVED 12/10/88

Ministry of Works and Development
CIVIL ENGINEERING
HAMILTON
STRUCTURAL DESIGN OFFICE
T.G. SHADWELL Commissioner

G. O. A. B. – TE KUITI
DEPARTMENTAL BUILDING
FOUNDATION & RETAINING WALL DETAILS

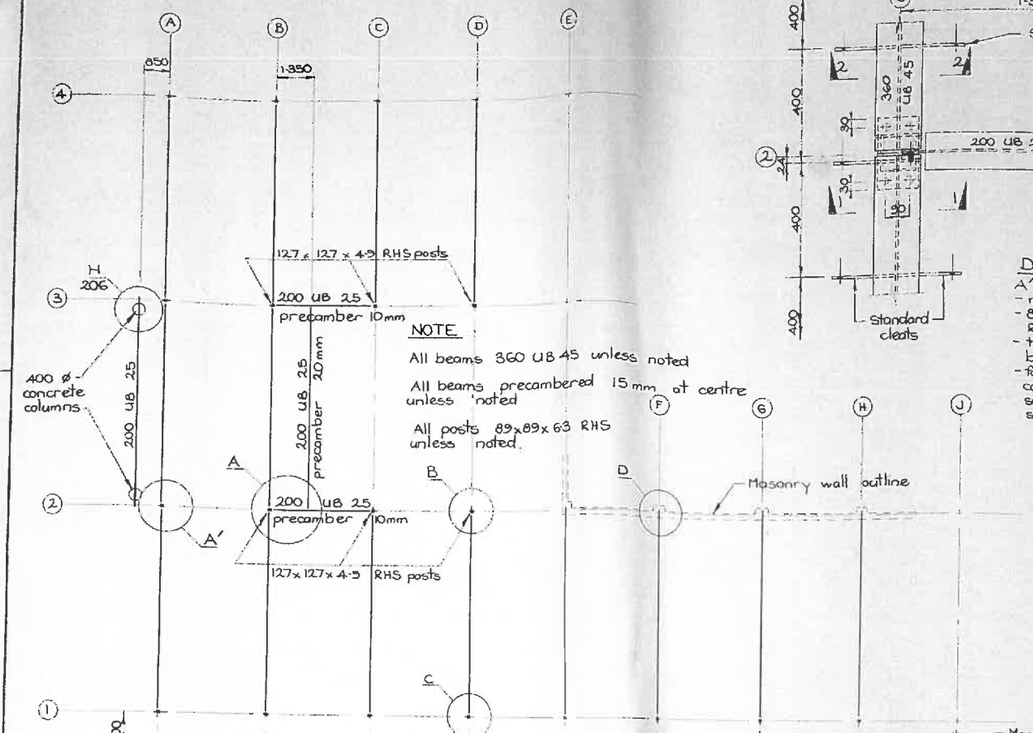
ORIGINAL SCALES 1:10 & 1:20 | FILE
W.A.R. 4A077

JOB	CODE	SHEET	REVISION
2/850/1	7202	202	

ORIGINAL SIZE A1 | LOCAL OR TRACING No. | P.W. 482—A1 | Rev. April 1984

1:1 1:2 1:5

Whole numbers = mm
Decimalised expressions = m
unless indicated otherwise



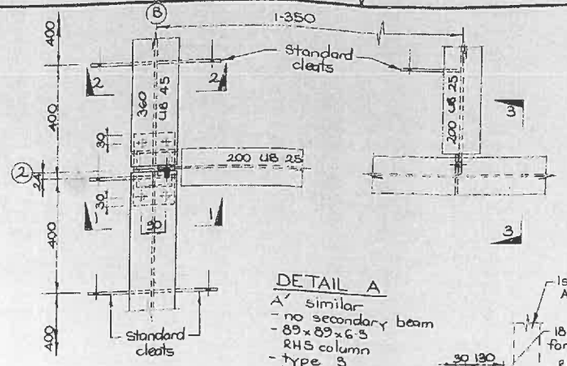
PLAN AT 1ST FLOOR LEVEL (RL 57·900)
Scale 1:100

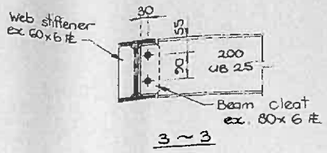
NOTE

All beams 360 UB 45 unless noted

All beams precambered 15 mm at centre unless noted

All posts 89x89x6·3 RHS unless noted.

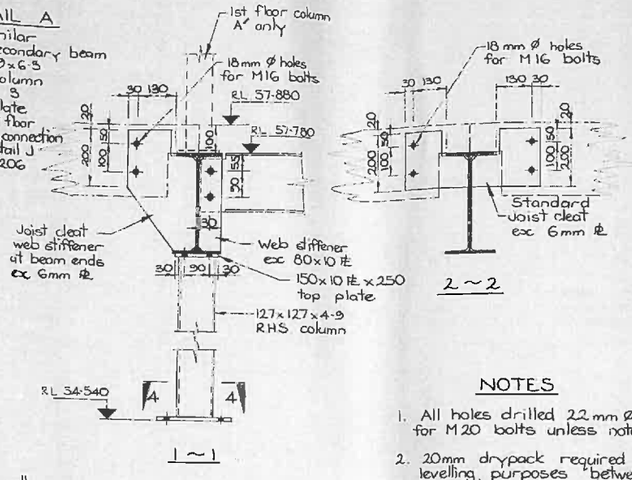




3 ~ 3

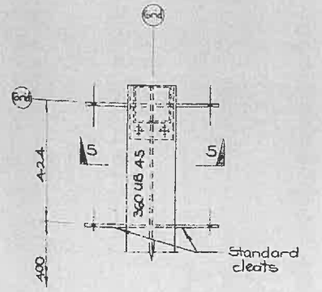
DETAIL A

A' similar
- no secondary beam
- 89x89x6·3 RHS column
- Type 3 baseplate
- for 1st floor column connection see detail J sheet 206



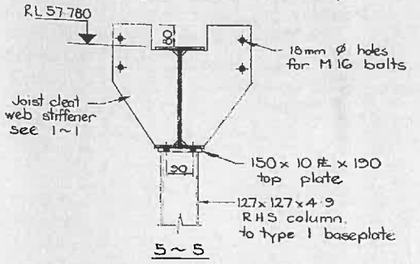
1 ~ 1

2 ~ 2



DETAIL B

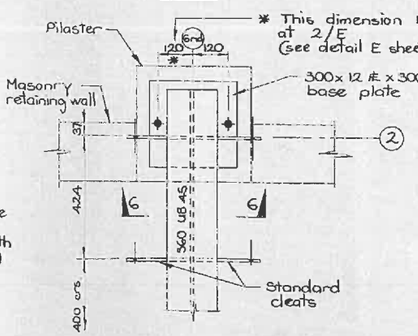
C similar
- 89x89x6·3 RHS column
- Type 2 baseplates
- 1st floor column connections at 1/C,E+6. (see detail J sheet 206)

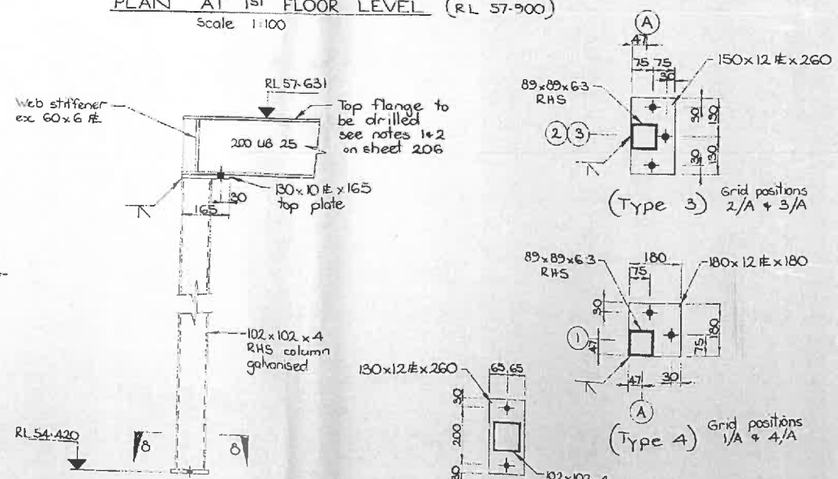


5 ~ 5

NOTES

1. All holes drilled 22 mm ø for M20 bolts unless noted
2. 20mm drypack required for levelling purposes between all baseplates and concrete/masonry surfaces.
3. All welds 5mm continuous fillet welds unless noted.
4. Welding : Symbols and preparation to C.D. 301
5. All nuts, bolts, washers and 102x102x4 RHS exterior columns to be supplied galvanised.
6. Surface Finish : Steelwork to be blast cleaned to C.D 305 grade Sa 2½ and painted with inorganic zinc silicate (C.D. 502) to 75 µm.
7. Damaged galvanised steelwork to be repaired with organic zinc epoxy to 75 µm.

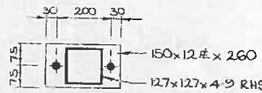




7 ~ 7

DETAIL E

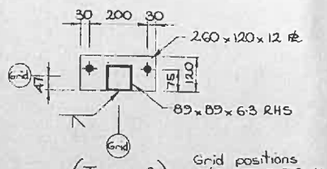
(Type 3) Grid positions 2/A + 3/A



4 ~ 4 (Type 1) Grid positions 2/B,C+D 3/B,C+D.

8 ~ 8 (Type 5) Adjacent to grid 1

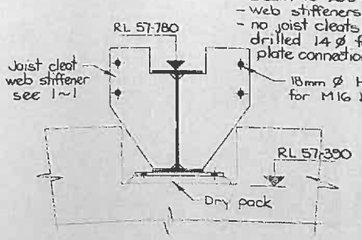
(Type 4) Grid positions 1/A + 4/A



(Type 2) Grid positions 1/B,C,D,E,F,G+H 4/B,C+D.

COLUMN BASEPLATES

DETAIL D G similar
- Beam is 200 UB 25
- Web stiffeners at beam ends
- no joist cleats, top flange drilled 14 ø for timber plate connection, see notes 1+2 sheet 206



6 ~ 6

	BY	CHECKED	DATE
Designed			
Drawn			10/85
Supervised			
Co-ord Chk			
Recommended			

AMENDMENTS | BY | APPD. | DATE

R. L. PRESTON
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T. N. MITCHELL
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APPROVED

Ministry of Works and Development
CIVIL ENGINEERING HAMILTON
STRUCTURAL DESIGN OFFICE
T.G. SHADWELL Commissioner

G.O.A.B. — TE KUITI
DEPARTMENTAL BUILDING

STEELWORK DETAILS

ORIGINAL SCALES		FILE
1:10		
W.A.R. 4A077		
JOB	CODE	SHEET	REVISION
2/850/1	7202	205	

ORIGINAL SIZE A1

P.W. 482—A1
Rev. April 1984

LOCAL OR TRACING No.

Whole numbers = mm
Decimalised expressions = m
unless indicated otherwise

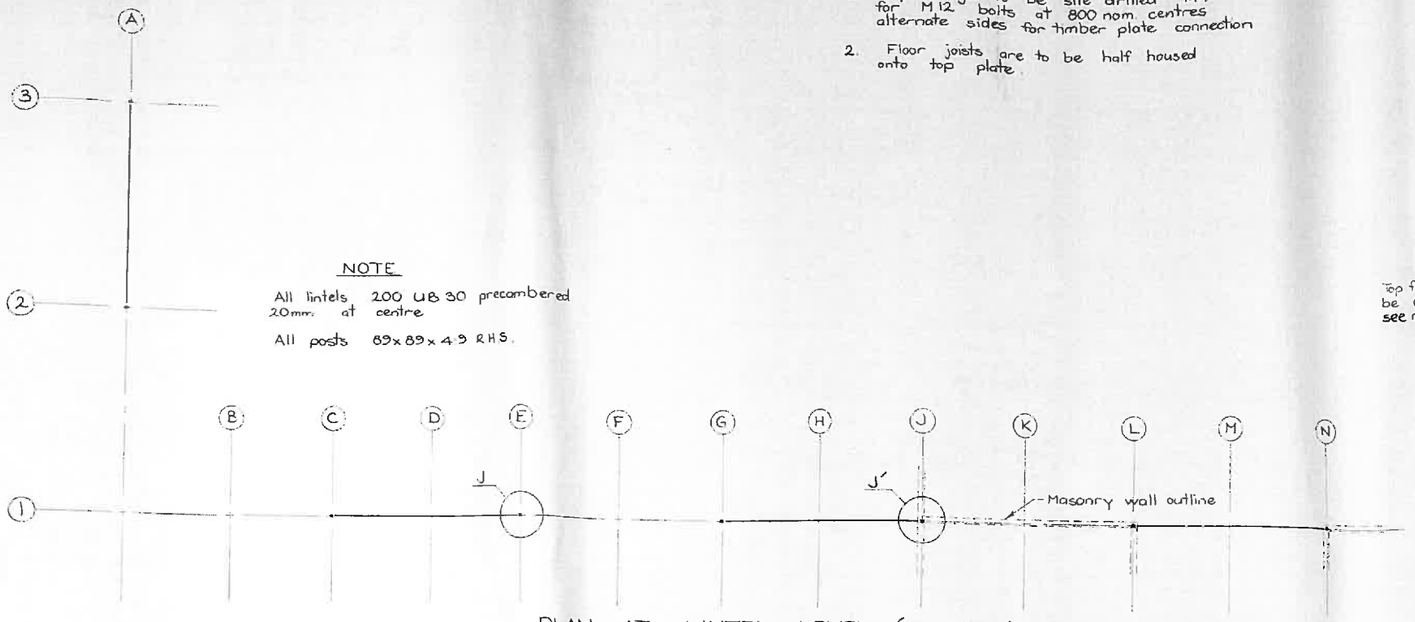
NOTES

1. Top flange to be site drilled 14 ø for M12 bolts at 800 nom. centres alternate sides for timber plate connection
2. Floor joists are to be half housed onto top plate.

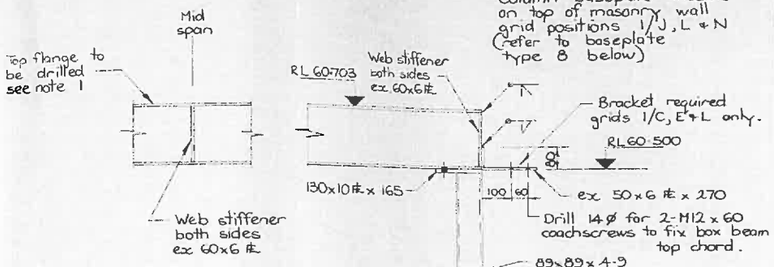
NOTE

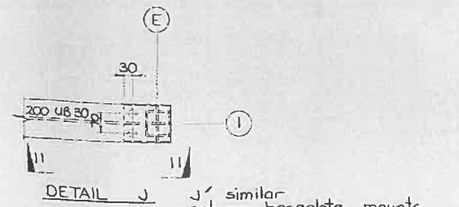
All lintels 200 UB 30 precambered 20mm at centre

All posts 89x89x4.9 RHS.



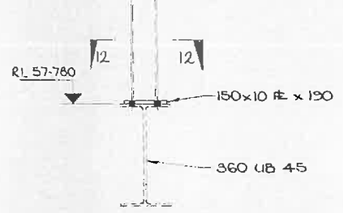
PLAN AT LINTEL LEVEL (RL 60·703)
Scale 1:100



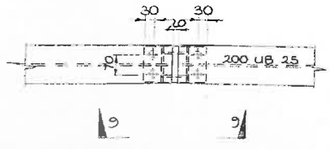


DETAIL J

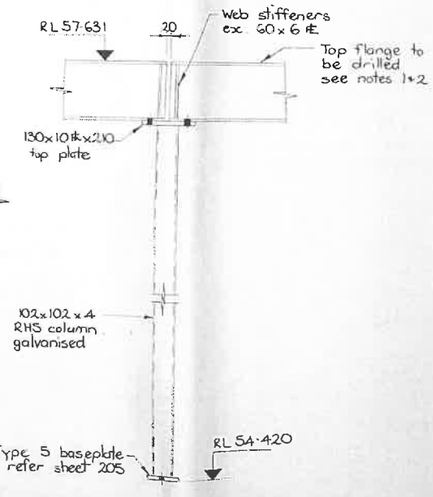
J' similar - column baseplate mounts on top of masonry wall grid positions 1/J, L & N (refer to baseplate type 8 below)



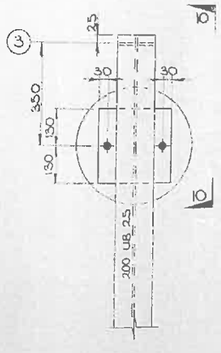
11 ~ 11



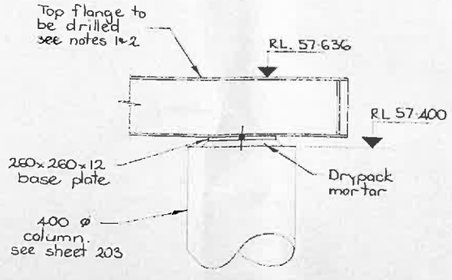
DETAIL F
From sheet 205



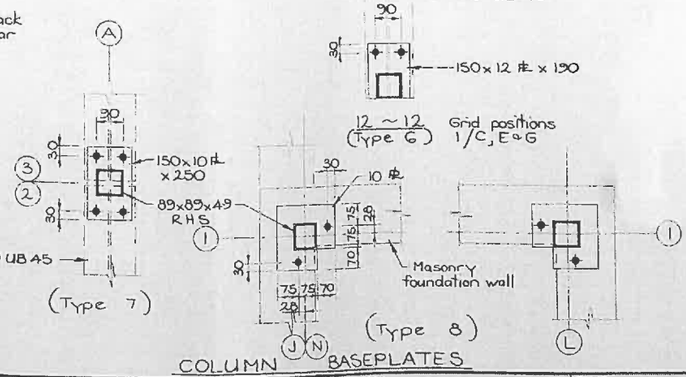
9 ~ 9



DETAIL H
From sheet 205



10 ~ 10



COLUMN BASEPLATES

	BY	CHECKED	DATE
Designed			9/85
Drawn			10/85
Supervised			
Co-ord. Chk			
Recommended			

R. L. PRESTON
CHIEF CIVIL ENGINEER

T. N. MITCHELL
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APPROVED

Ministry of Works and Development
CIVIL ENGINEERING HAMILTON
STRUCTURAL DESIGN OFFICE
T.G. SHADWELL Commissioner

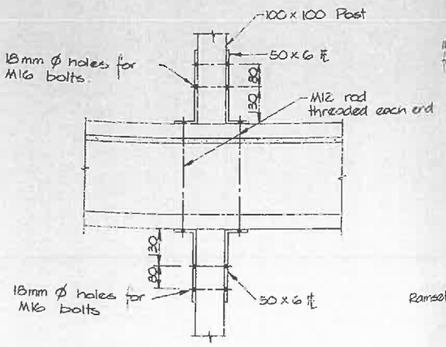
G.O.A.B. - TE KUITI
DEPARTMENTAL BUILDING
STEELWORK DETAILS

AMENDMENTS	BY	APPD.	DATE

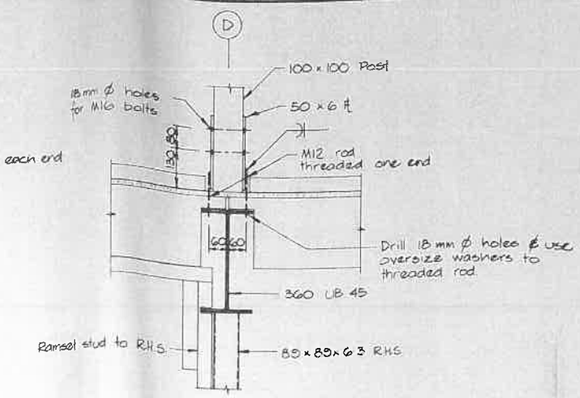
ORIGINAL SCALES	FILE
1:10	
W.A.R. 4A077	

JOB	CODE	SHEET	REVISION
2/850/1	7202	206	

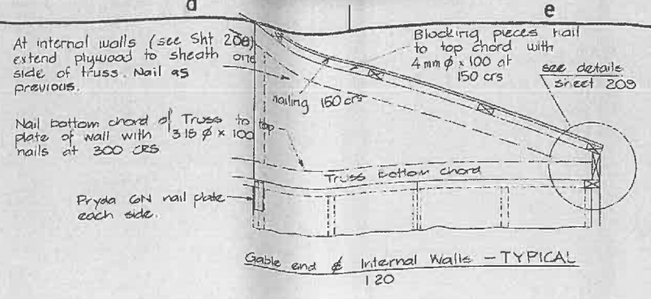
ORIGINAL SIZE A1
P.W. 482-A1
Rev. April 1984
LOCAL OR TRACING No.
1:1 1:2 1:5
Whole numbers = mm
Decimalised expressions = m
unless indicated otherwise



A
1:10

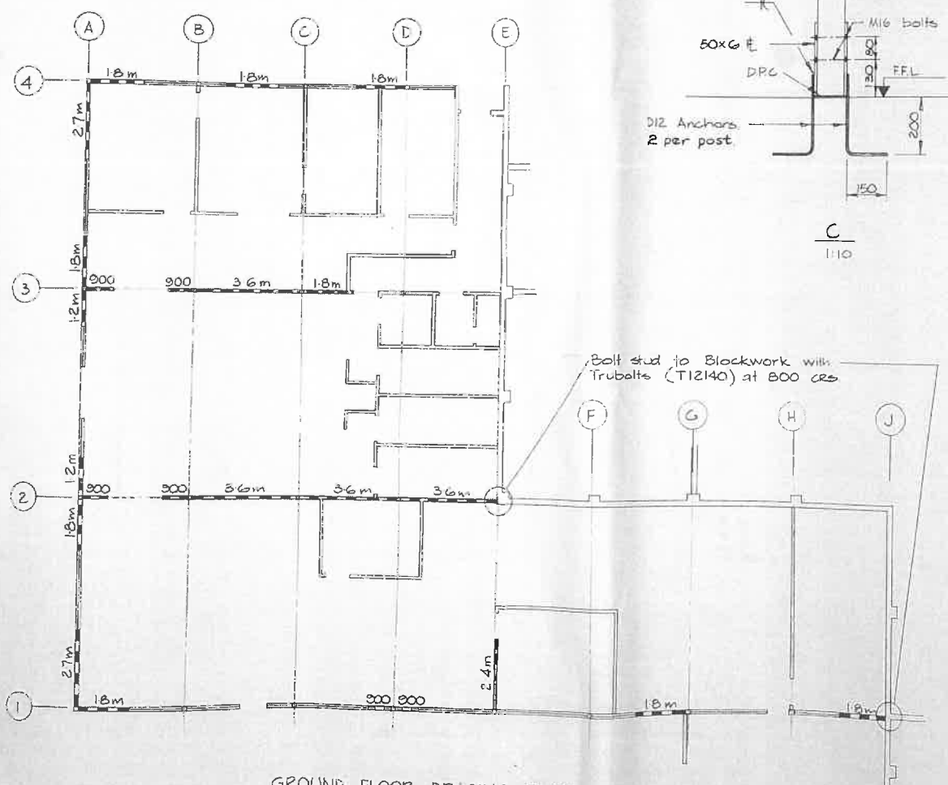


B
1:10



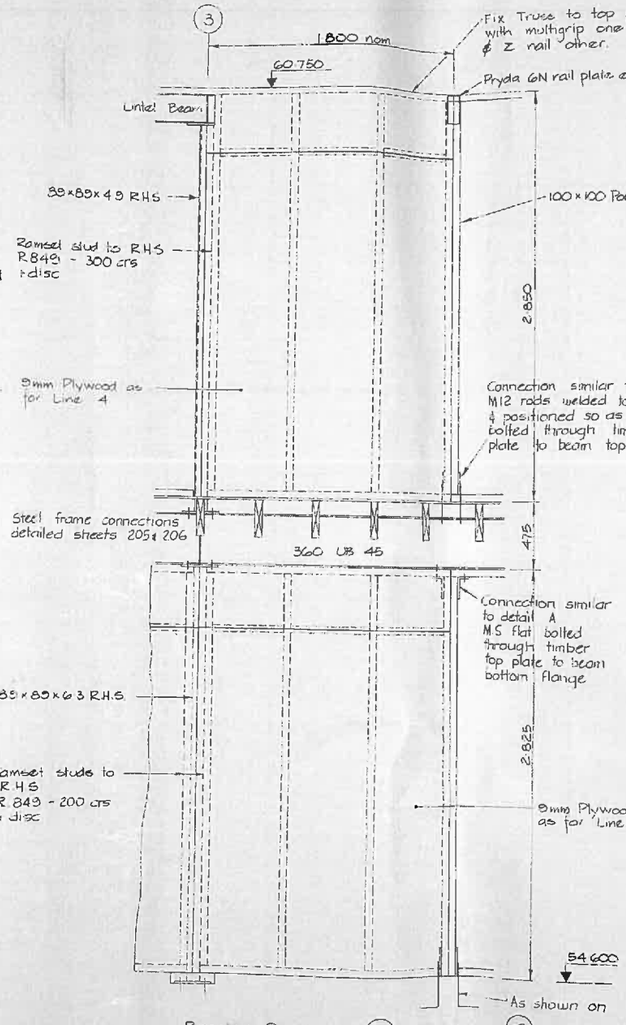
Gable end & Internal Walls – TYPICAL
1:20

NOTES
1. Check all dimensions on site before fabrication
2. Where not specified otherwise, nail plates are to be placed on both sides of Panel Pads, top & bottom.
3. Plywood is to be construction type, grade D-D
4. Plywood to be fixed to interior faces of exterior walls.
5. ═══ denotes Bracing Panel

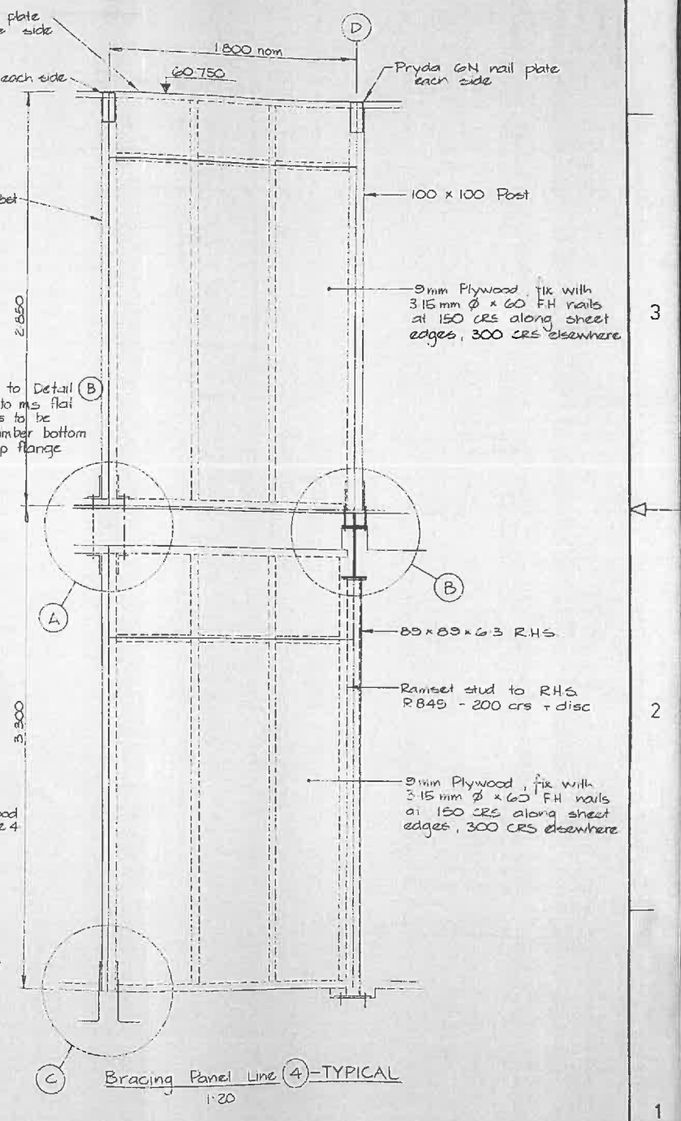


GROUND FLOOR BRACING PLAN
1:100

C
1:10



Bracing Panel Line (A) – TYPICAL
For connection details refer to sheets 205 & 206
1:20



Bracing Panel Line (4) – TYPICAL
1:20

	BY	CHECKED	DATE
Design			9/85
Drawn	Howes		10/85
Dwg Sup			
Co-ord chkd			
Recommended			

R. L. PRESTON
CHIEF CIVIL ENGINEER

T. N. MITCHELL
CHIEF STRUCTURAL ENGINEER
APPROVED 31/10/85

Ministry of Works and Development
CIVIL ENGINEERING HAMILTON
STRUCTURAL DESIGN OFFICE
T.G. SHADWELL Commissioner

G.O.A.B. — TE KUITI
DEPARTMENTAL BUILDING

BRACING PANELS AND DETAILS

AMENDMENTS	BY	APPD.	DATE
LOCAL OR TRACING No.			

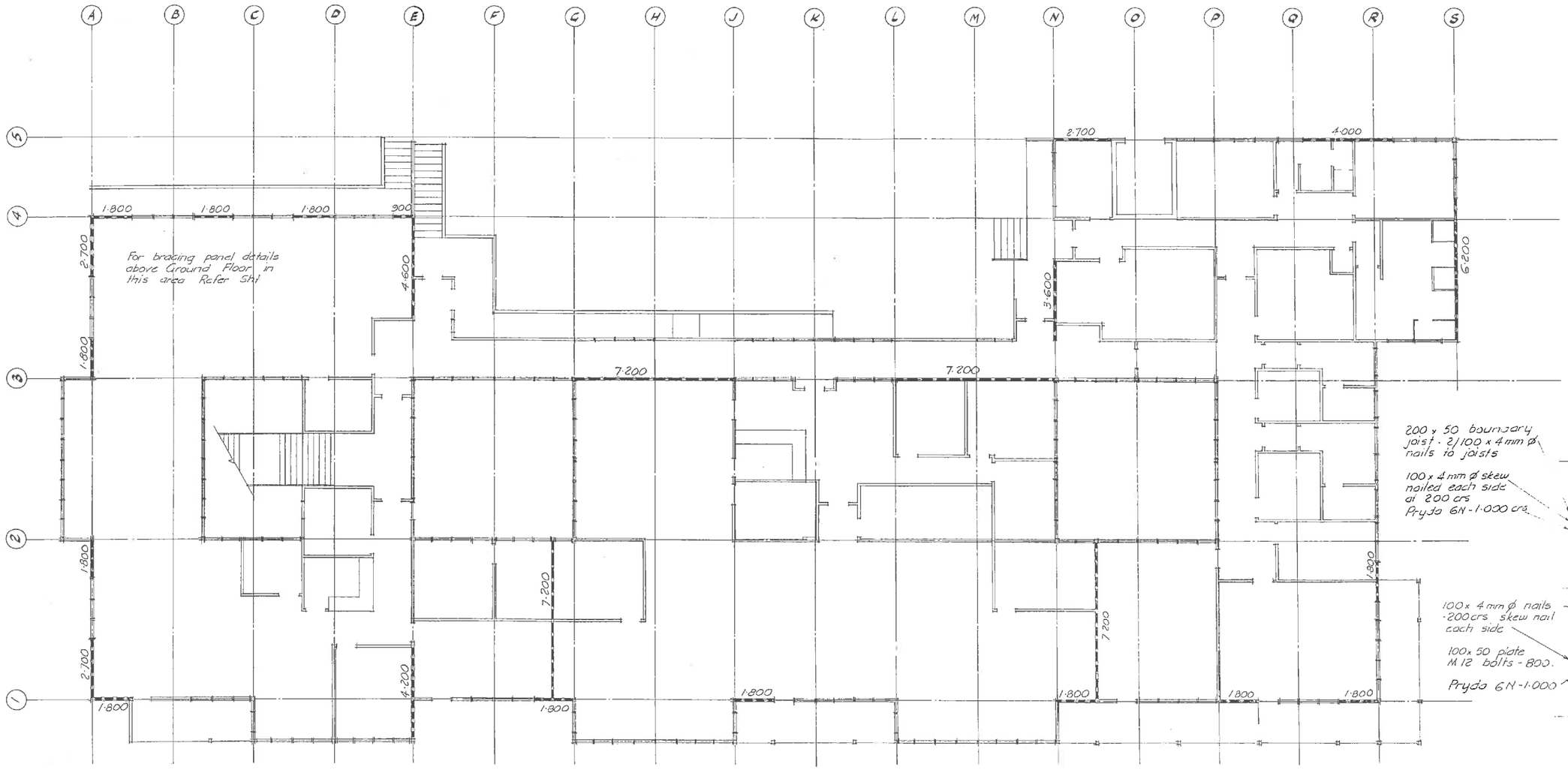
ORIGINAL SCALES As shown
Job No 4A077
FILE

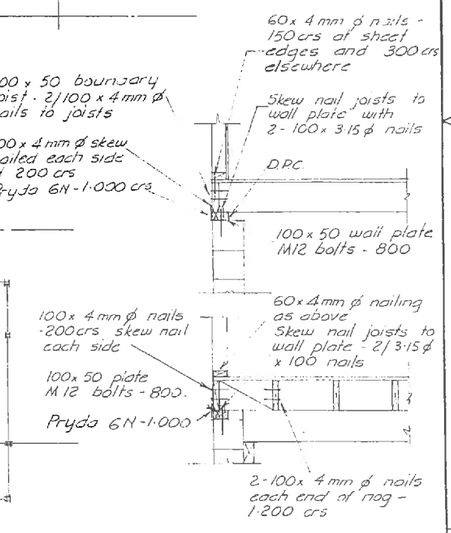
JOB	CODE	SHEET	REVISION
2/850/1	7202	207 of	

ORIGINAL SIZE A1
P.W. 482–A1
Rev. April 1984

1:1 0
1:2 0
1:5 0

Whole numbers = mm
Decimalised expressions = m
unless indicated otherwise





DIAPHRAGM FLOOR FIXING
1:20

NOTE:-

1. All bracing panels to be 9 mm plywood - 100 x 100 post each end
2. For Ground Floor bracing plan - refer Sheet 207
3. For further bracing panel fixing details - refer Sheet 207

	BY	CHECKED	DATE
DESIGN			9-85
DRAWN			10-85
DRG. SUP.			
COORD CHK			

RECOMMENDED:-

APPROVED 17.10.85

AMENDMENTS	BY	APPD.	DATE

R. L. PRESTON
CHIEF CIVIL ENGINEER

T. N. MITCHELL
CHIEF
STRUCTURAL ENGINEER

Ministry of Works and Development
CIVIL ENGINEERING
HAMILTON
STRUCTURAL DESIGN OFFICE
T.G. SHADWELL Commissioner

G.O.A.B. TE KUITI
DEPARTMENTAL BUILDING

BRACING PLAN

ORIGINAL SCALES	1: 100 1:20	FILE
	4A077	

JOB	CODE	SHEET	REVISION
2/850/1	7202	208	

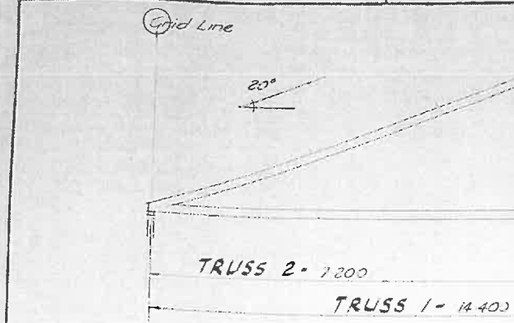
LOCAL OR TRACING No.

1:1 1:2 1:5

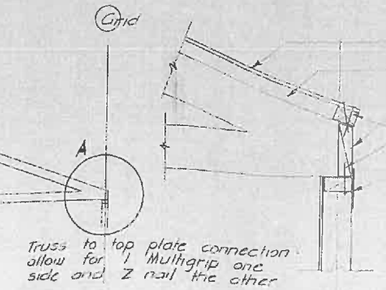
ORIGINAL SIZE A1

Whole numbers = mm
Decimalised expressions = m
unless indicated otherwise

P.W. 482--A1
Dec. April 1984

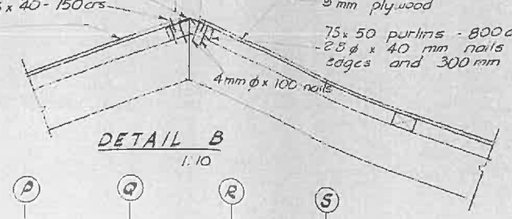


TYPICAL TRUSS SHAPE 1 & 2 1:50



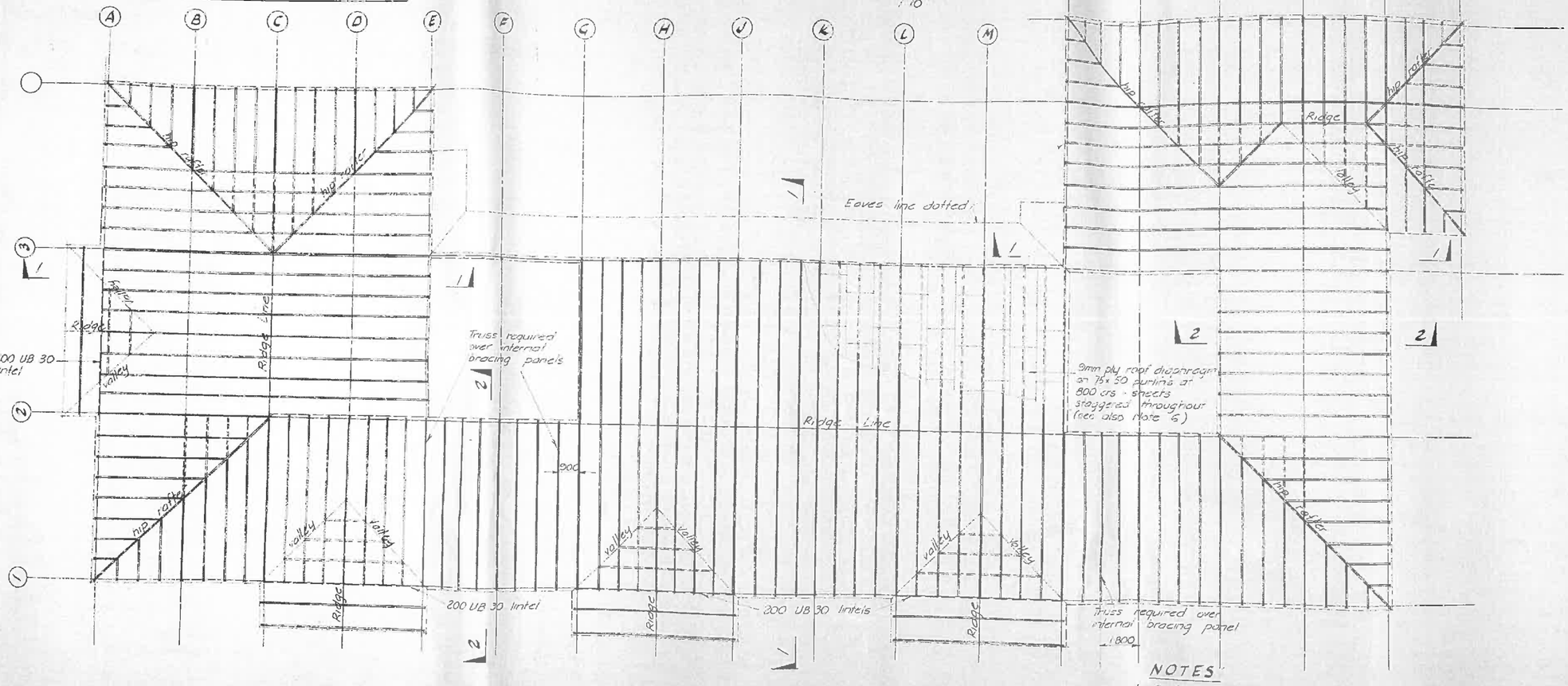
DETAIL A
1:10

9 mm plywood
- 75 x 50 purlins and blocking
ex 200 x 50 blocking
3.15 ϕ x 100 nails - 300 crs
Top plate to post - Pryda 6N each side



DETAIL B
1:10

9 mm plywood
75 x 50 purlins - 800 crs
2.8 ϕ x 40 mm nails 150 mm around edges and 300 mm elsewhere



TRUSS LAYOUT PLAN
1:100

NOTES

1. Contractor to verify all dimensions on site before fabrication
2. Trusses at 900 crs are indicative only. Trusses and nail plates to be designed by the Manufacturer as per the Specification
3. Trusses fixed to top plate with Multigrip one side and 1 Z type nail the other side
4. 9mm ply roof diaphragm fixed to purlins with 2.8 ϕ x 40 mm nails at 150 mm around sheet edges and 300 mm at intermediate supports
5. All framing, nogging, packing to be in accordance with NZS 3604
6. Ply sheets to be fully supported around edges nog 75 x 50 as required

	BY	CHECKED	DATE
DESIGN			9-85
DRAWN			10-85
DRG SUP			
COORDCHK			
RECOMMENDED			

R. L. PRESTON
CHIEF CIVIL ENGINEER

T. N. MITCHELL
CHIEF
STRUCTURAL ENGINEER
APPROVED
1/10/85

Ministry of Works and Development
CIVIL ENGINEERING
HAMILTON
STRUCTURAL DESIGN OFFICE
Commissioner

G.O.A.B. TE KUITI
DEPARTMENTAL BUILDING

TRUSS LAYOUT

AMENDMENTS	BY	APPD.	DATE

ORIGINAL SCALES 1:100
FILE 4A077

JOB	CODE	SHEET	REVISION
21 850/1	7202	209	

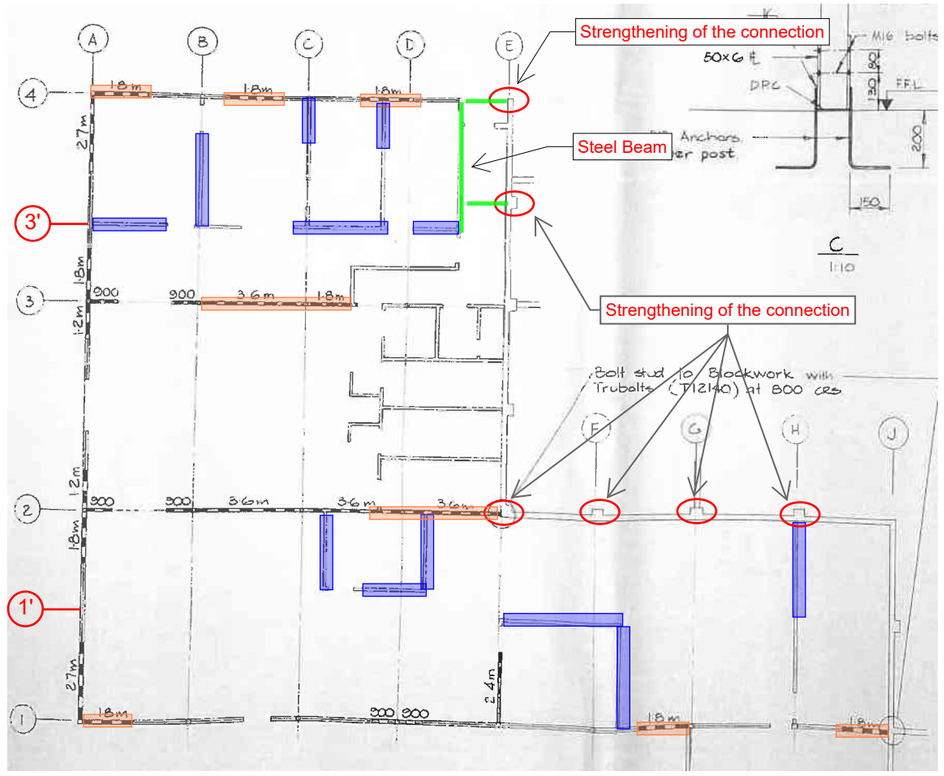
ORIGINAL SIZE A1
P.W. 482—A1
Rev. April 1984
LOCAL OR TRACING No.
1:1 1:2 1:5

Whole numbers = mm
Decimalised expressions = m
unless indicated otherwise

Appendix B

Concept Strengthening Plans

Concept Strengthening Plan
(to achieve 67% NBS)



Ground Floor Strengthening Plan

- Strengthening of Existing bracing Elements by replacing the current lining with new GIB lining

- Strengthening of Existing walls by new GIB lining

- New Steel Beam

Notes:

- Fix the existing roof ply board with additional 3.15 mm dia nails at 150 c/c at edges of the ply.

SCALE: NTS

Rev	Description		Checked	Approved	Date
A	PRELIMINARY STRENGTHENING PLAN		EE	AV	12.04.23
Author	SB	Drafting Check	EE		
Designer	SB	Design Check	EE		

GHD

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GHD Pty Ltd

Project No. 12545999

Client: Waitomo District Council

Project: WDC Administrative Building

Status: PRELIMINARY DESIGN

Status Code: S0

Drawing Title: Preliminary Strengthening for 67%NBS

(For IL2)

Drawing No. 12545999-SKT-STR-001

Size: A3

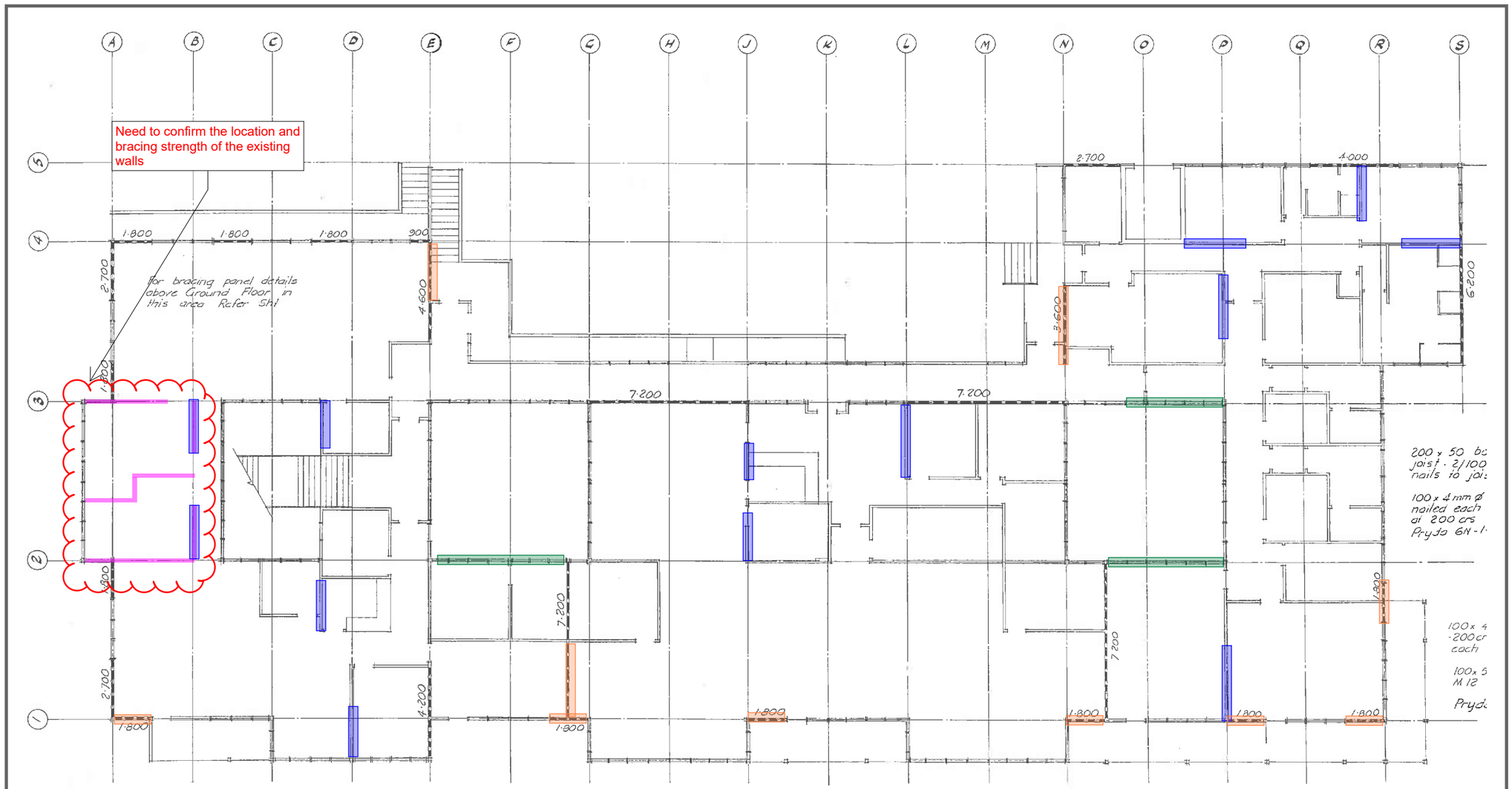
Rev: A

Concept Strengthening Plan (to achieve 67% NBS)

- Strengthening of Existing bracing Elements by replacing the current lining with new GIB lining

- Strengthening of Existing walls by new GIB lining (Tentative locations)

- New GIB braced walls



First Floor Strengthening Plan

Notes:

-As the connection details for the existing particle board with the timber walls/ concrete block walls at first floor are missing in the existing drawings, the extent and detail for the strengthening of the diaphragm can only be determined following inspection of the existing connections.

SCALE: NTS

Rev	Description	Checked	Approved	Date
A	PRELIMINARY STRENGTHENING PLAN	EE	AV	12.04.23

Author SB Drafting Check EE

Designer SB Design Check EE

GHD

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GHD Pty Ltd

Project No. 12545999

Client **Waitomo District Council**

Project **WDC Administrative Building**

Status PRELIMINARY DESIGN Status Code **S0**

Drawing Title **Preliminary Strengthening for 67%NBS**

(For IL2)

Drawing No. 12545999-SKT-STR-002

Size A3

Rev A

Appendix C
Geotechnical Report

Mark T Mitchell Ltd

Consulting Geotechnical Engineers

1150 Victoria Street
P O Box 9123
Hamilton 3240
New Zealand
Telephone 07 838 3119
Facsimile 07 839 3125
email: mtm@geocon.co.nz

Ref: W – 15387.7
5 October, 2017

Waitomo District Council
c/- Design Management Consultants Ltd
PO Box 5254
Hamilton 3242

Attention: Lyall Green

Dear Sirs,

Re: Soils Investigation, Geotechnical Assessment for Site Subsoil Class and Liquefaction Potential
Waitomo District Council Building – Queen Street, Te Kuiti

In accordance with your request, we have carried out a Soils Investigation and Geotechnical Assessment of the above referenced property. The purpose of our investigation and assessment was to determine and evaluate the subsurface conditions within the property and provide a structural assessment of the Waitomo District Council building.

Our associate company, Geocon Geotechnical Ltd has carried out soil testing of the proposed building site area and the results of that testing are presented in the attached Geocon report dated 21 August, 2017.

1. Site Information

The near level, industrial site is accessed from the south-eastern side of Queen Street, Te Kuiti. An existing commercial building for Waitomo District Council with a carpark at the rear of the building are located as shown on the attached Geocon Site Plan.

2. Soil Conditions

2.1 Local Geology

The Waitomo District Council building is founded on a deposit known as the Ongatiti Formation. The Ongatiti Formation is understood to have been deposited as variably-welded ignimbrites and airfall ash deposits, and as such typically show a broad range of strengths. These soils in their weathered form typically consist of pumiceous silts and clays with weathered vitrophyric pumice inclusions.

The soils underlying the ignimbrite deposits are mapped by GNS (QMAP, 2005) as early Miocene Taumatamaire Formation, being a massive to weakly bedded calcareous mudstone of the Mahoenui Group.

2.2 Subsoil Classification

The Australian/NZ Standard AS/NZS 1170.5:2004: *Part 4: Earthquake Loads* provides a subsoil classification as a means to assess the susceptibility of subsoils to amplify seismic waves arising from motions of the underlying bedrock.

In terms of alluvial deposits, such as occur within Te Kuiti, where the depth to Ignimbrite or mudstone is shallow, the soils are classified as *Class C; Shallow soil*. But within the central part of the Te Kuiti valley, the depth to rock may be in the order of 40 metres, in which case the subsoil classification is *Class D: Deep soil types.*

The results of the Cone Penetrometer Tests carried out at this site (refer to Geocon Report Figs. B-1A to B-2B) indicate effective refusal at depths of 9.0m and 15.0m respectively.

In terms of AS/NZ 1170.5: 2004, Part 5 the Site Subsoil Class is *Class C; Shallow soil types*

3. Liquefaction Potential Asessment

3.1. Cone Penetrometer Testing

The site investigations included two Cone Penetrometer Tests (CPT) to depths of 9 and 15 metres that were carried out by Opus International Consultants Ltd. The results of these tests are presented on Figs. B-1A, B-1B, B-2A and B-2B.

3.2. Assumed Groundwater Levels

Groundwater was detected in CPT Nos. 1 and 2 at a depth of 2.2 and 2.1 metres respectively. The liquefaction analyses described below have assumed groundwater level to be present at these indicated depths. Within a liquefaction assessment, the location of the groundwater level is critical, as liquefaction will only occur within soils located below the groundwater level.

Ground settlement in response to earthquake-related ground vibrations will also occur in any loose soils that are located above groundwater levels, but that situation does not normally form part of a liquefaction assessment

3.3 Liquefaction Assessment - Ultimate (ULS) and Serviceability Limit (SLS) States

The New Zealand design loads code NZS 1170 defines two design conditions which need to be assessed for the purpose of liquefaction assessment.

- ULS – Ultimate Limit State is concerned with ground damage associated with a 500-year earthquake event, and all commercial buildings such as this one are to be designed to avoid collapse and potential loss of life.

- SLS – Serviceability Limit State is concerned with ground damage associated with smaller earthquakes with a return period of 25 years. Buildings and their non-structural components are to be designed to withstand permanent damage for a 25-year event.

In addition, our analyses include an intermediate state, based on a 100-year return period earthquake event, with a typically assumed design life for most buildings being in the range of 50 to 100 years.

For the subject site, peak ground acceleration (PGA) for SLS and ULS are determined to be 0.05g and 0.21g respectively and 0.10g for the 100-year event. Earthquake magnitude is determined to be 6.0, in accordance with New Zealand Geotechnical Society and MIBE Guidelines for Earthquake Geotechnical Engineering Practice in NZ: Module 1 (2016).

3.4 Liquefaction Assessment Method

The liquefaction assessment was carried out in accordance with the Idriss and Boulanger (2014) Method.

For this method the CPT database has been updated adding data from more recent earthquakes, with a significant number of liquefaction case histories from the Canterbury Earthquake Sequence (50 in total) being added to the dataset. In addition, some of the older case studies have been re-examined.

3.5 Liquefaction Assessment Results

Liquefaction studies were carried out for the soil profiles of CPT-01 and CPT-02 and results are attached in a series of figures (Figs C-1 to C-8), with the Basic Data presented as the front page of each set.

3.5.1 Analyses for SLS Event

- All FS plots (Factor of safety plots) for the SLS event show zero potential for liquefaction under a 25-year return period seismic event. Refer to Figs. C-2 and C-6.

3.5.2 Analyses for 100-year Event

- The FS plots for the 100-year return period seismic event show associated ground settlements are expected to be in the order of between 1 to 4mm and lateral displacement values to be moderate. Refer to Figs. C-3 and C-7.
- However as the site is near-level, the predicted lateral displacement values do not apply to this site.
- Therefore no special construction works will be required to mitigate the potential effects of a seismic event of this return period.

3.5.3 Analyses for ULS Event

- The FS plots for the ULS (extreme) event show associated ground settlements are expected to be in the order of between 40mm to 110mm and lateral displacement values to be moderate to high. Refer to Figs. C-4 and C-8.
- There is a moderate probability of liquefaction under a seismic event of this return period, this being on account of the presence of interbedded, low-strength silt and sand soils located at depths of between 4.0 to 9.5 metres below ground level.
- These results also indicate that no special construction works will be required to mitigate the potential effects of ULS seismic event at this site, apart from for building egress considerations.
- The ULS event is assessed primarily to ensure that the structure is designed to ensure that egress from the building is available in the event of the as-calculated ground settlements occurring.

3.6 Recommendations – Liquefaction Mitigation

The results of our studies indicates that site liquefaction is not expected to occur for the SLS (25-year return period) and that the effects of site liquefaction from the 100-year and 500-year events is expected to be minimal.

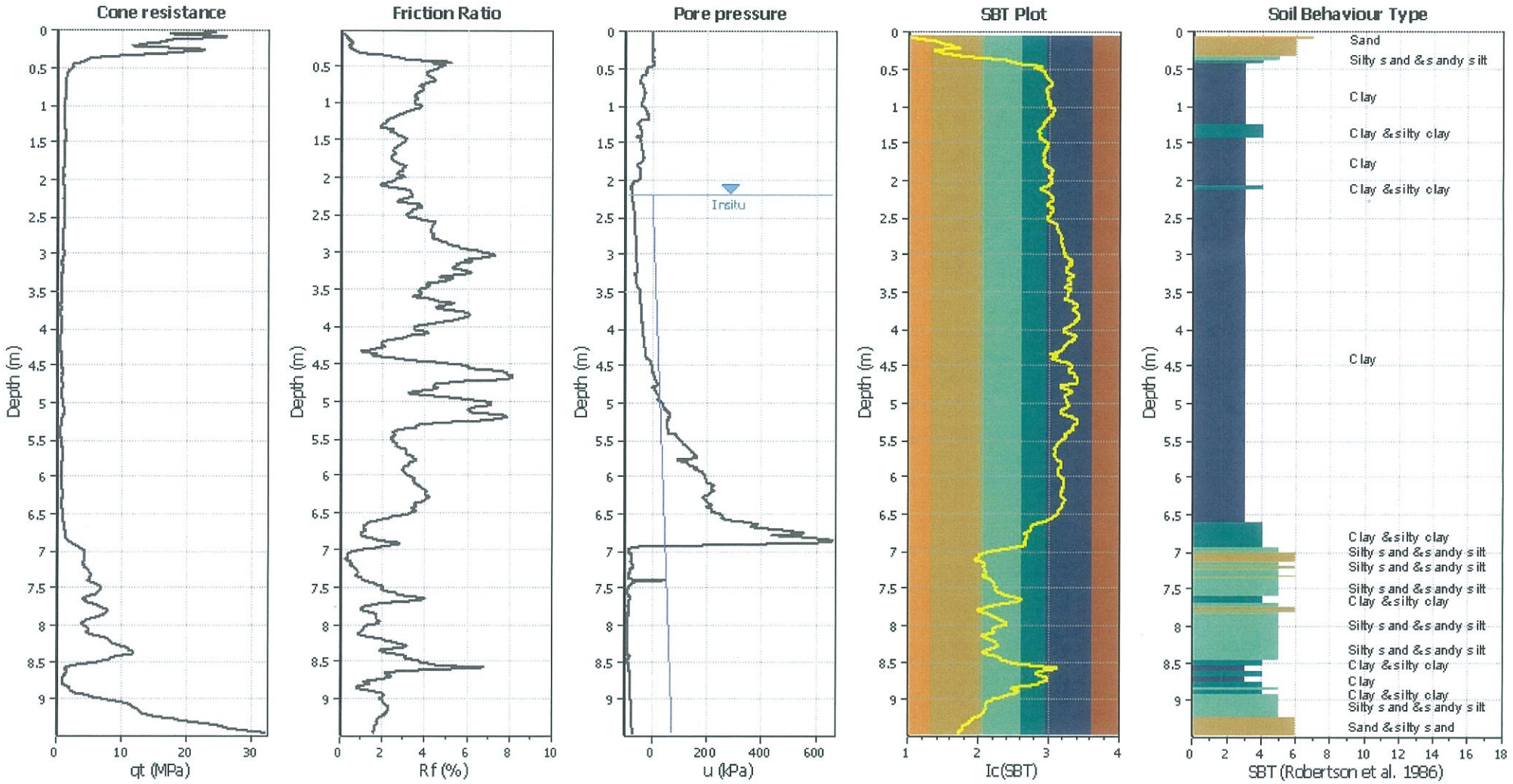
Therefore we advise there is no requirement to use deepened piles or other ground improvement measures are required to mitigate the effects of earthquake-related ground movements.

Yours faithfully

Mark T Mitchell Ltd

Mark T Mitchell
Director

CPT basic interpretation plo



Input parameters and analysis data

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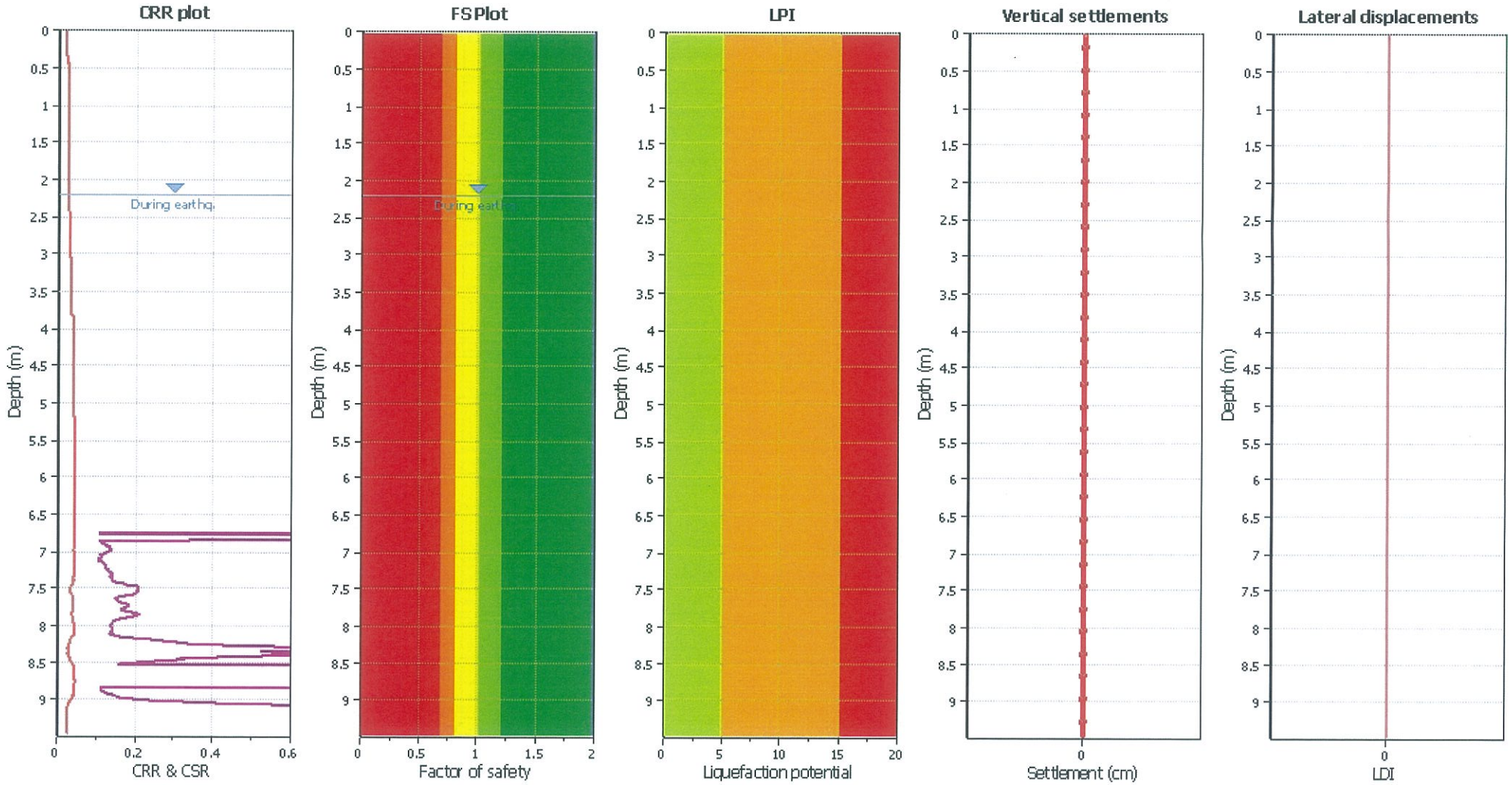
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.10	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT1 GW = 2.2m Fig. C-1

Liquefaction analysis overall plot



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Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

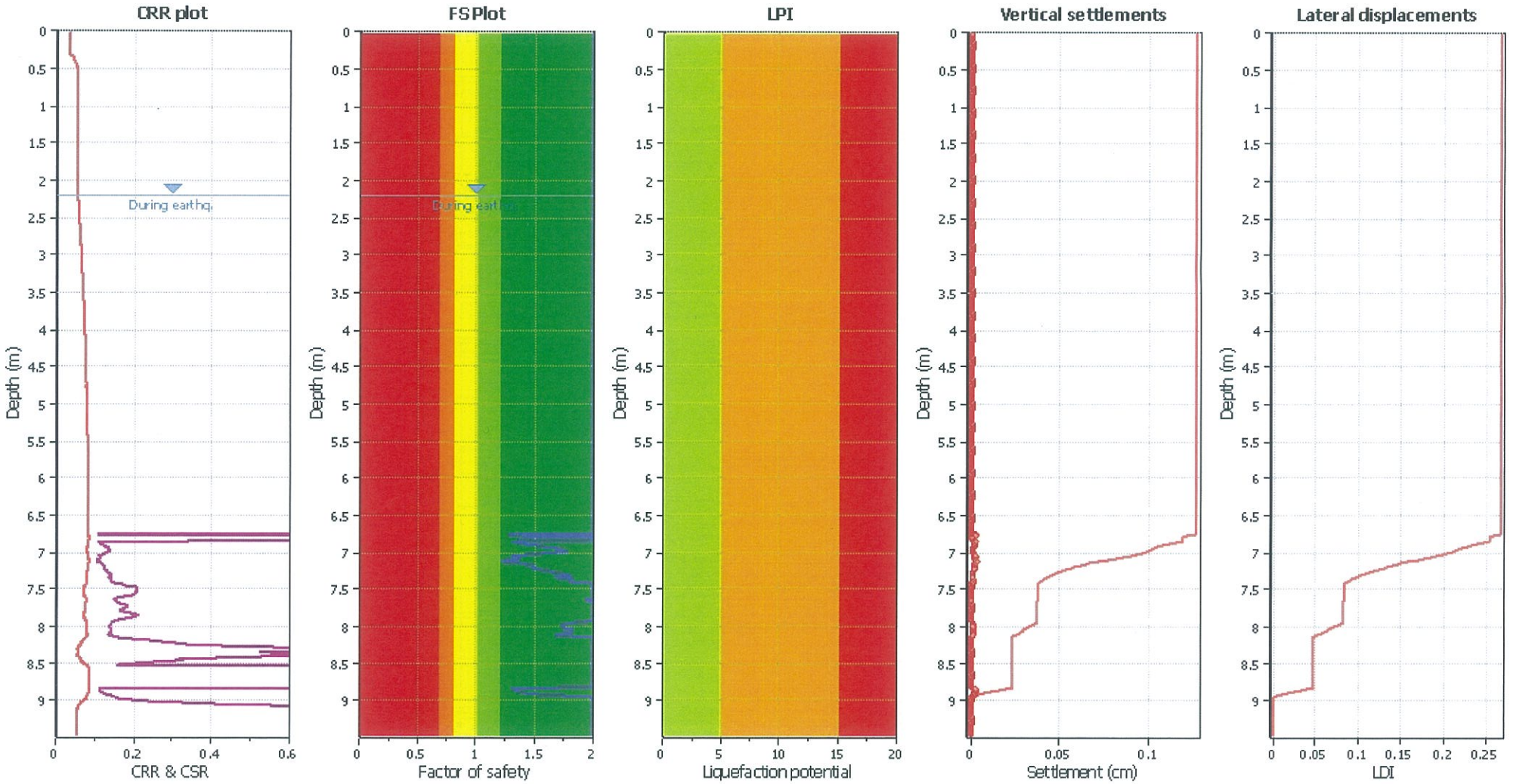
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis overall plot



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.10	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

- Almost certain it will liquefy
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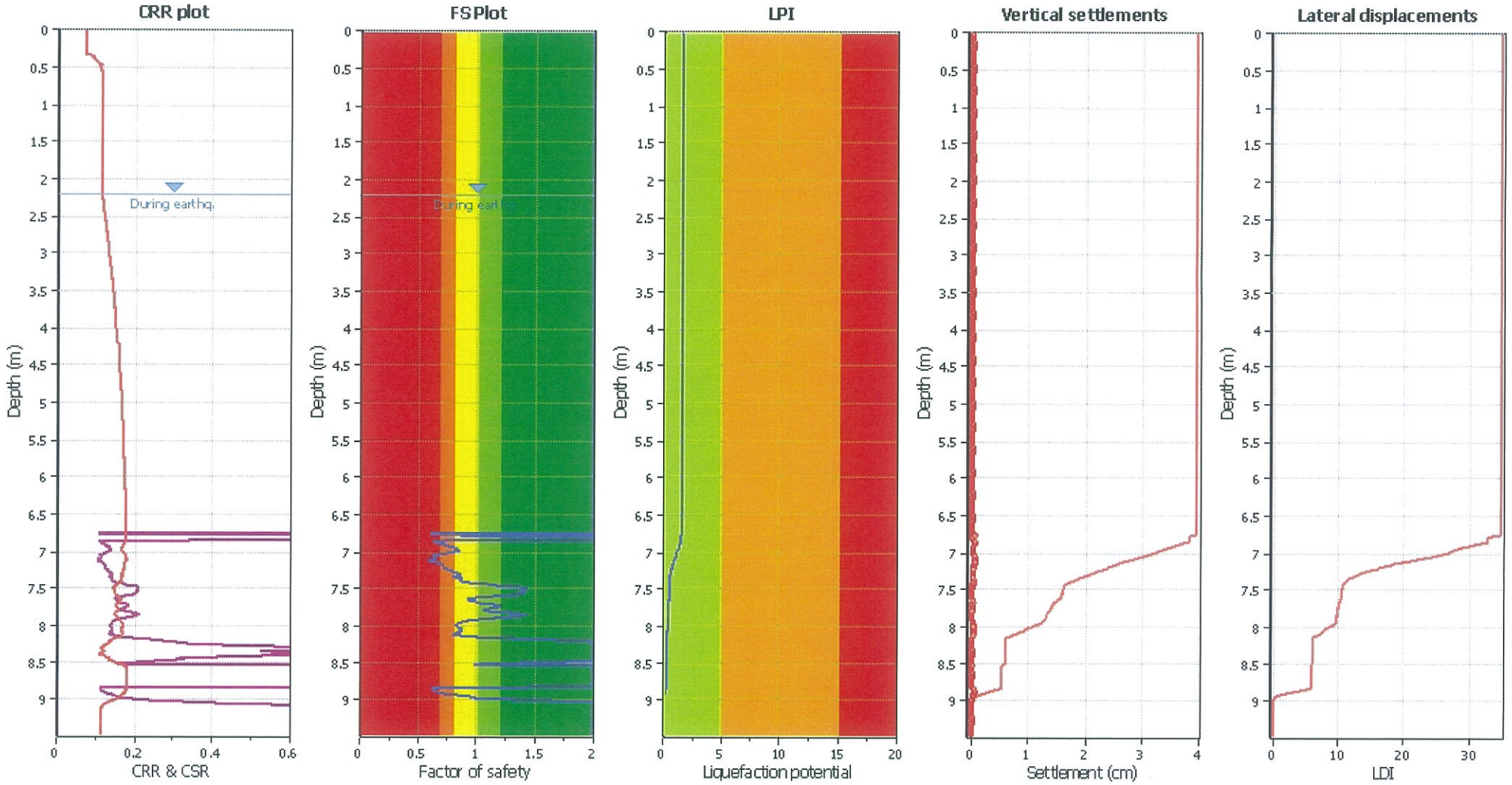
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis overall plot



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.20 m	Fill height:	N/A	Limit depth:	N/A

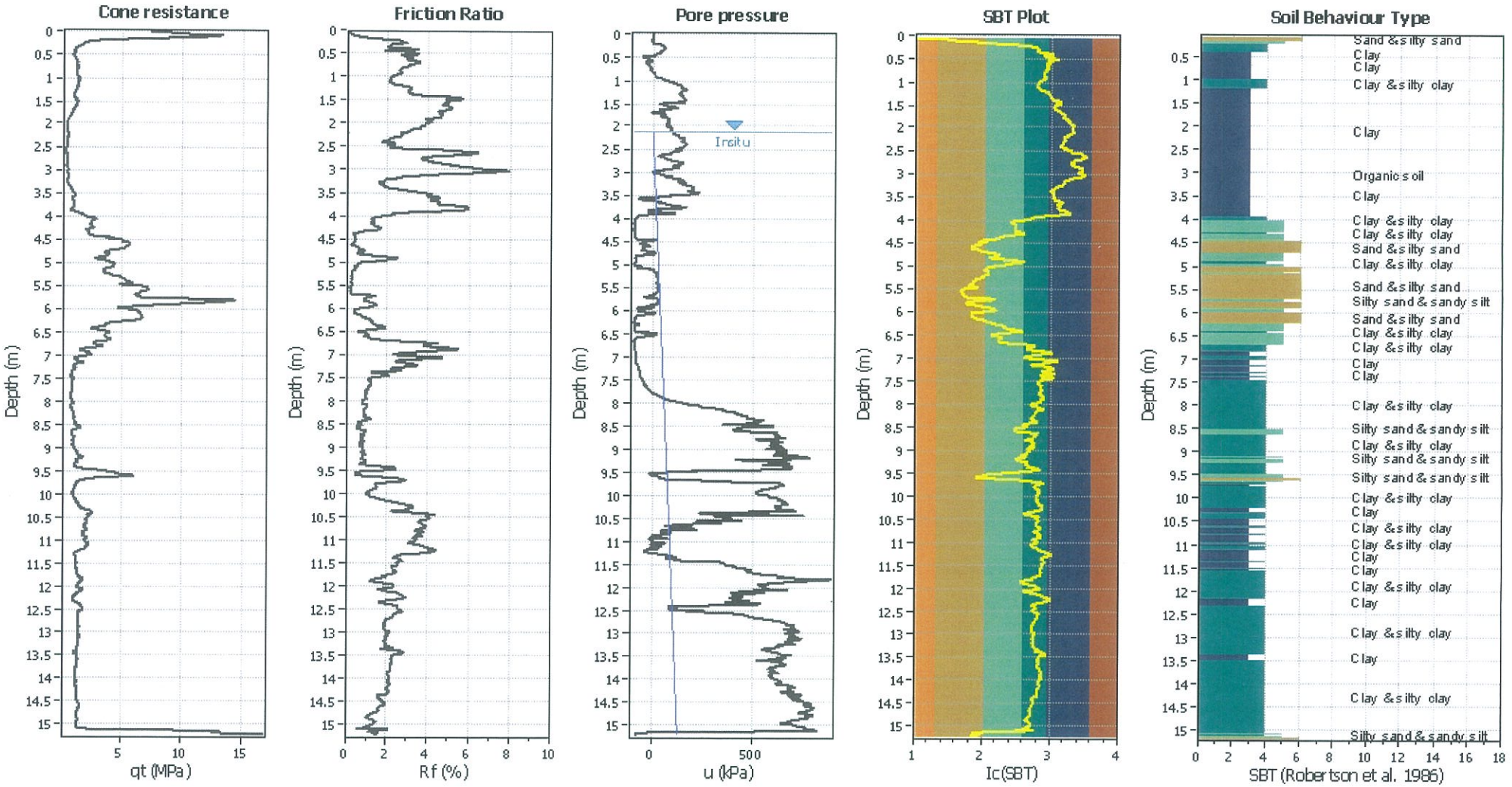
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

CPT basic interpretation plo



Input parameters and analysis data

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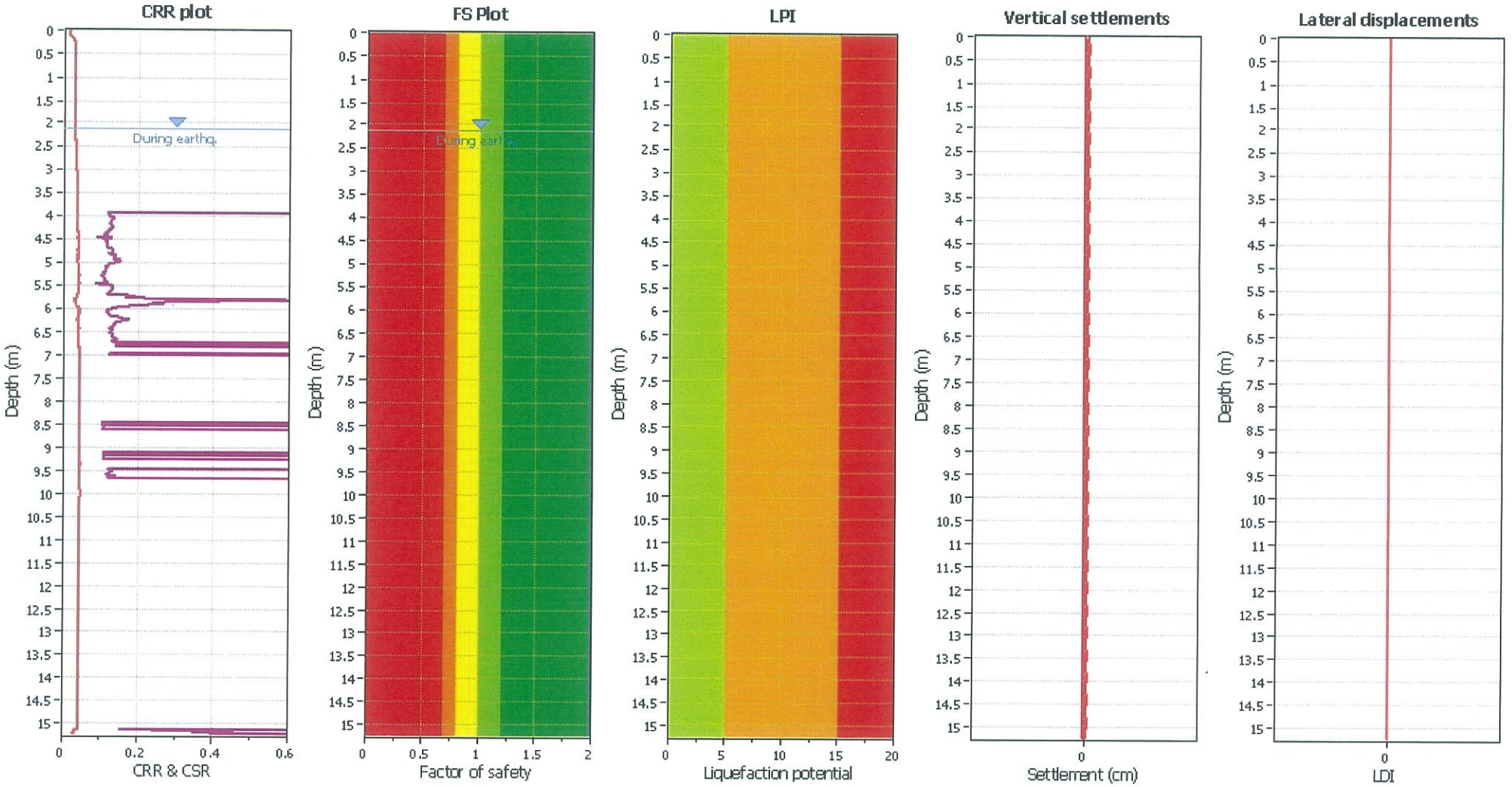
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.10 m	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

CPT2 GW = 2.1m Fig. C-5

Liquefaction analysis overall plot



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.10 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.05	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.10 m	Fill height:	N/A	Limit depth:	N/A

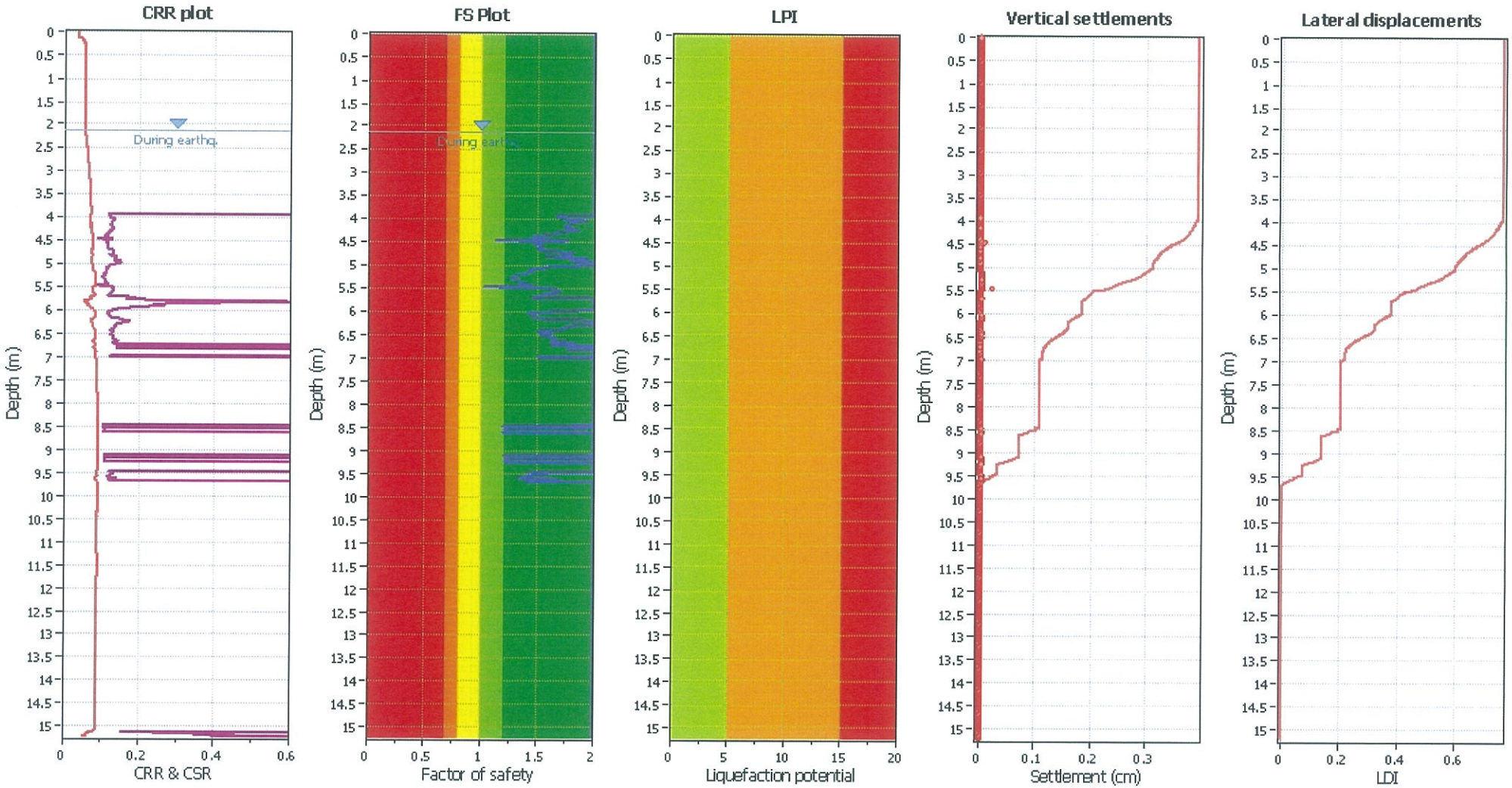
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis overall plot



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.10 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.10	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.10 m	Fill height:	N/A	Limit depth:	N/A

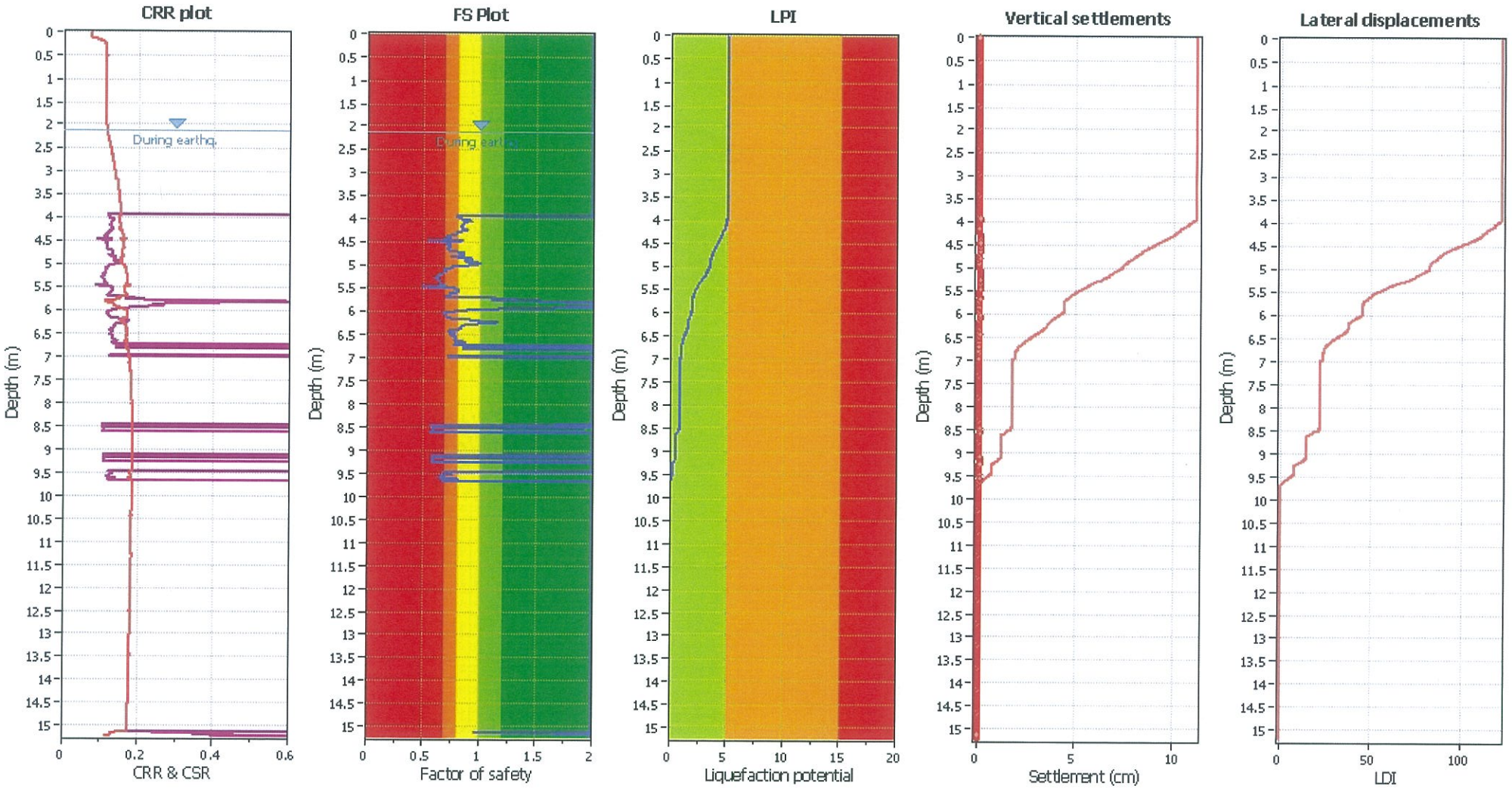
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis overall plot



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.10 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.10 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Geocon Geotechnical Ltd

Geotechnical Engineers

1150 Victoria Street
PO Box 9123
Hamilton, New Zealand
Facsimile 07 839 3125
Telephone 07 838 3119
email:kevin@geocon.co.nz

Ref: G-15387.1
4 September, 2017

Waitomo District Council
c/- Mark T Mitchell Ltd
Consulting Geotechnical Engineers
P O Box 9123
Hamilton 3240

Attention: Lyall Green

Dear Sir,

Re: Site Investigation for Soil Classification
Waitomo District Council, Queen Street, Te Kuiti

In accordance with your request, we have carried out a Site Investigation at the above referenced property. The purpose of our studies was to determine the soils for the proposed structural assessment of the existing Waitomo District Council building.

The following report is based on site conditions as observed during a site investigation carried out by our geologists on 21 August, 2017 and Cone Penetrometer testing (CPT) completed by Opus International Consultants (NZ) (OPUS) Ltd on 21 August, 2017.

The near level, commercial site is accessed from the south-eastern side of Queen Street, Te Kuiti. An existing building used by Waitomo District Council with a carpark at the rear are located as shown on the attached Site Plan, Drawing No. 15387-01.

The results of the investigation are as follows:

1. Geomorphology and Geology

The natural soils encountered at the test locations consist primarily of a deposit known as the Ongatiti Formation. The Ongatiti Formation is understood to have been deposited as variably-welded ignimbrites and airfall ash deposits, and as such typically show a broad range of strengths. These soils in their weathered form typically consist of pumiceous silts and clays with weathered vitrophyric pumice inclusions.

The soils underlying the ignimbrite deposits are mapped by GNS (QMAP, 2005) as early Miocene Taumatamaire Formation, being a massive to weakly bedded calcareous mudstone of the Mahoenui Group.

2. Field Investigation

The subsurface conditions at the site were investigated by drilling two machine-auger borings together with Scala Penetrometer probes and *in-situ* shear vanes at the locations shown on the Site Plan. The Bore Holes are designated Nos. 1 and 2 with the Bore Hole Logs and associated test results presented on Figs. A-1 and 2.

The purpose of the borings and associated testing was to provide guidance as to the general subsurface soil profile, variability and relative density of soils within the proposed building areas. Actual conditions may vary across these areas however, and in some locations may differ slightly from those as described below.

Two, CPT's were carried out by OPUS and their locations are also shown on Site Plan. The CPT logs are designated CPT Nos. 1 and 2 and the results are presented on Figs B-1 and 2.

3. Subsurface Conditions

The near-surface soil conditions at the site, as revealed by the bore holes, consist of 300mm of BASECOURSE overlying alternating layers of stiff to very stiff, pumiceous slightly clayey or clayey SILT, and stiff to very stiff, silty CLAY (Ongatiti Formation) to at least the base of the 6.0 metre deep bore holes.

Groundwater was encountered at 2.2 to 2.3 metres deep within the bore holes at the time of the site investigation.

Yours faithfully,

Geocon Geotechnical Ltd.

Josh Moir
Engineering Geologist

Approved by:

Geraint Walters
Operations Manager

NOTE:

1. This drawing is reproduced from aerial imagery prepared by Waitomo District Council Intramaps.
2. All areas and distances where shown are subject to survey.

N

QUEEN STREET

Boundary

Existing Dwelling

No. 9

No. 11

Boundary

Existing Shed

No. 15

CPT No. 1
Bore Hole No. 1

Existing Garage

Boundary

Existing Storage Area

No. 6 Seddon St

QUEEN STREET

Boundary

Existing Waitomo District Council Building

No. 8 Seddon St

Boundary

Existing Carpark

CPT No. 2
Bore Hole No. 2

Boundary

Boundary

LEGEND

- denotes Bore Hole locations
- " Cone Penetrometer Test locations

SCALE 1:500

0 10 20 30 40 50 Metres

Geocon Geotechnical Ltd
Consulting Geotechnical Engineers
1150 Victoria Street, P.O. Box 9123, Hamilton

WAITOMO DISTRICT COUNCIL

Site Investigation for Soil Classification
Queen Street, Te Kuiti

SITE PLAN

DRAWING No. 15387-01
DATE September 2017
ISSUE One

BORE HOLE LOG No. 1

GRAPHIC LOG	SOIL DESCRIPTION	DEPTH (metres)	GEOLOGICAL FORMATION	VANE SHEAR STRENGTH - kPa (In-situ/Remoulded)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
	BASECOURSE.		B/C			
	SILT with trace clay. Stiff, moist, pumiceous, low plasticity, light brown.	1	Ongatiti Formation	88/12 80/10 62/18 70/20		After Drilling
	clayey SILT. Stiff, moist, pumiceous, highly plastic, slightly iron stained, light greyish brown. Becoming very stiff @ 2.5 metres. " wet @ 3.0 metres.	2		94/32 90/34		
	SILT with some clay. Very stiff, moist to wet, light yellowish brown.	3		110/60 114/60 120/62		
	silty CLAY. Very stiff, moist to wet, highly plastic, light grey and light brown. Containing light grey pumiceous gravels and lithics.	4 5		140+ 140+ 140+		
	silty CLAY. Very stiff, moist, reddish orange with light grey mottling.	6		140+		
	Bottom of Bore Hole completed 21/08/17					

NOTES
- The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
- Vane shear values shown are as-recorded in the field, to which a calibration factor from Geotechnics Vane 1432 of 1.558 should be applied to attain Undrained Shear Strength (kPa).
- Scala test was carried out in 1.0 metre depth increments.

JOB NAME: WAITOMO DISTRICT COUNCIL
JOB LOCATION: Waitomo District Council, Queen Street, Te Kutiti
JOB NUMBER: W-15387

DRILL METHOD: Machine Auger
RIG: Hilux
DRILLER: JZ

LOGGED: JM PLOTTED: JM
DATE LOGGED: 21/08/17
CHECKED:

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Geotechnical Engineers
1150 Victoria Street, P.O. Box 9123, Hamilton

BORE HOLE LOG

BORE HOLE No. 1
LOCATION: Refer Site Plan RL (m):
SHEET: 1 OF 1 Fig. No. A-1

BORE HOLE LOG No. 2

GRAPHIC LOG	SOIL DESCRIPTION	DEPTH (metres)	GEOLOGICAL FORMATION	VANE SHEAR STRENGTH - kPa (In-situ/Remoulded)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
	BASECOURSE.		B/C			
	SILT with trace clay. Very stiff, moist, pumiceous, low plasticity, light brown. Becoming firm @ 0.6 metres.	1	Ongatiti Formation	100/24 40/2 38/4 42/6		
	clayey SILT. Stiff, moist, pumiceous, highly plastic, slightly iron stained, light greyish brown. Becoming silty CLAY @ 1.5 metres. " wet @ 3.0 metres.	2		78/18 78/28		After Drilling
	SILT with some clay. Very stiff, moist to wet, light yellowish brown. Containing pumiceous gravels and lithics.	3		80/34 84/30		
	silty CLAY. Stiff, moist, highly plastic, reddish orange with light grey mottling.	4		86/40 92/14		
	clayey SILT. Stiff, moist to wet, light grey and brown. Containing pumiceous gravels and dark red and black lithics.	5		90/16 82/24		
	Bottom of Bore Hole completed 21/08/17	6		86/36 90/42		

NOTES
- The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
- Vane shear values shown are as-recorded in the field, to which a calibration factor from Geotechnics Vane 1432 of 1.558 should be applied to attain Undrained Shear Strength (kPa).
- Scala test was carried out in 1.0 metre depth increments.

JOB NAME: WAITOMO DISTRICT COUNCIL
JOB LOCATION: Waitomo District Council, Queen Street, Te Kutiti
JOB NUMBER: W-15387

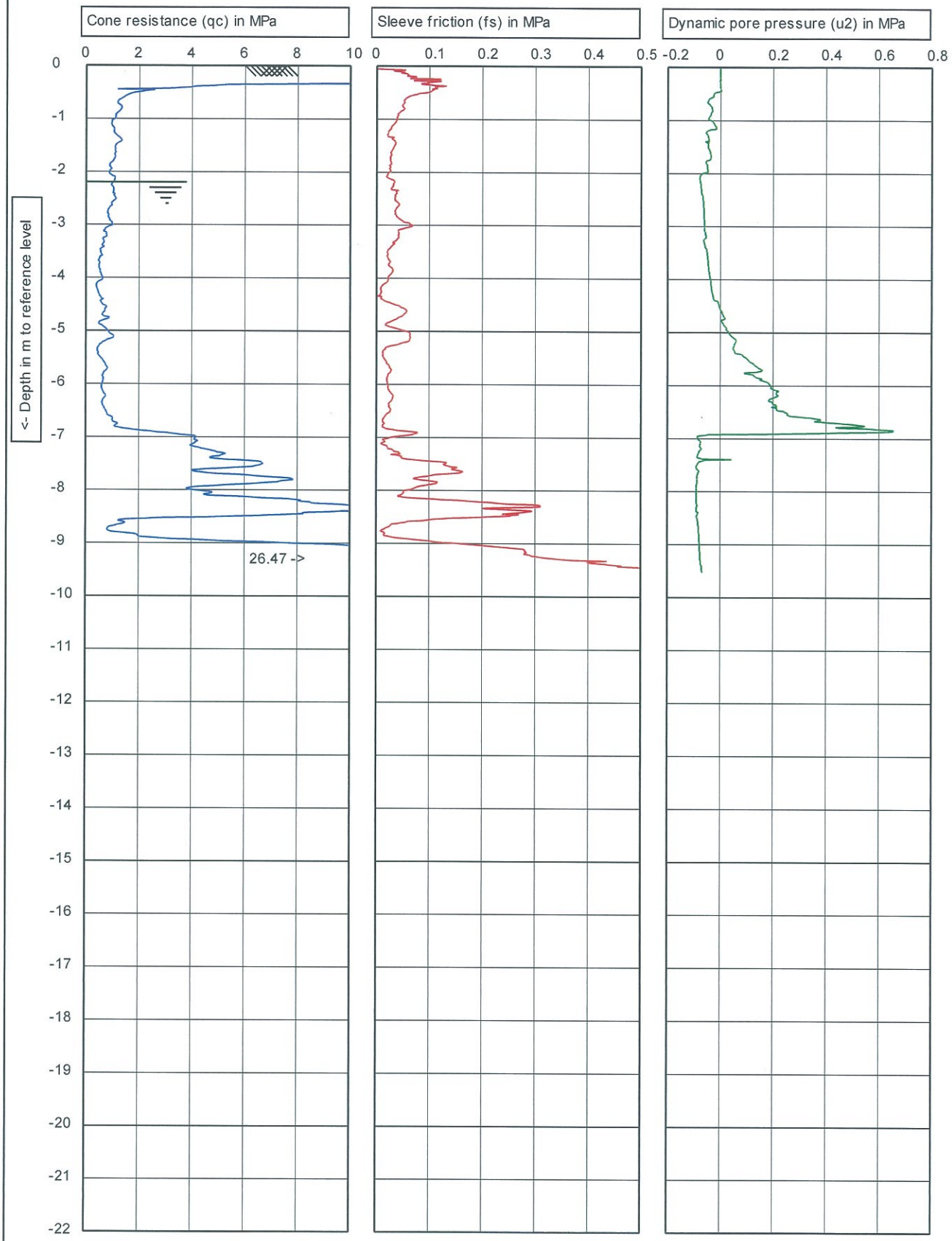
DRILL METHOD: Machine Auger
RIG: Hilux
DRILLER: JZ

LOGGED: JM PLOTTED: JM
DATE LOGGED: 21/08/17
CHECKED:

Geocon Geotechnical Ltd
Geotechnical Engineers
1150 Victoria Street, P.O. Box 9123, Hamilton

BORE HOLE LOG

BORE HOLE No. 2
LOCATION: Refer Site Plan RL (m):
SHEET: 1 OF 1 Fig. No. A-2



OPUS

IANZ ACCREDITED LABORATORY

Graphs indicated as not accredited are outside the scope of the laboratory's accreditation

1.45

r u2 150 cm² 10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** W.L.: **-2.20 m**

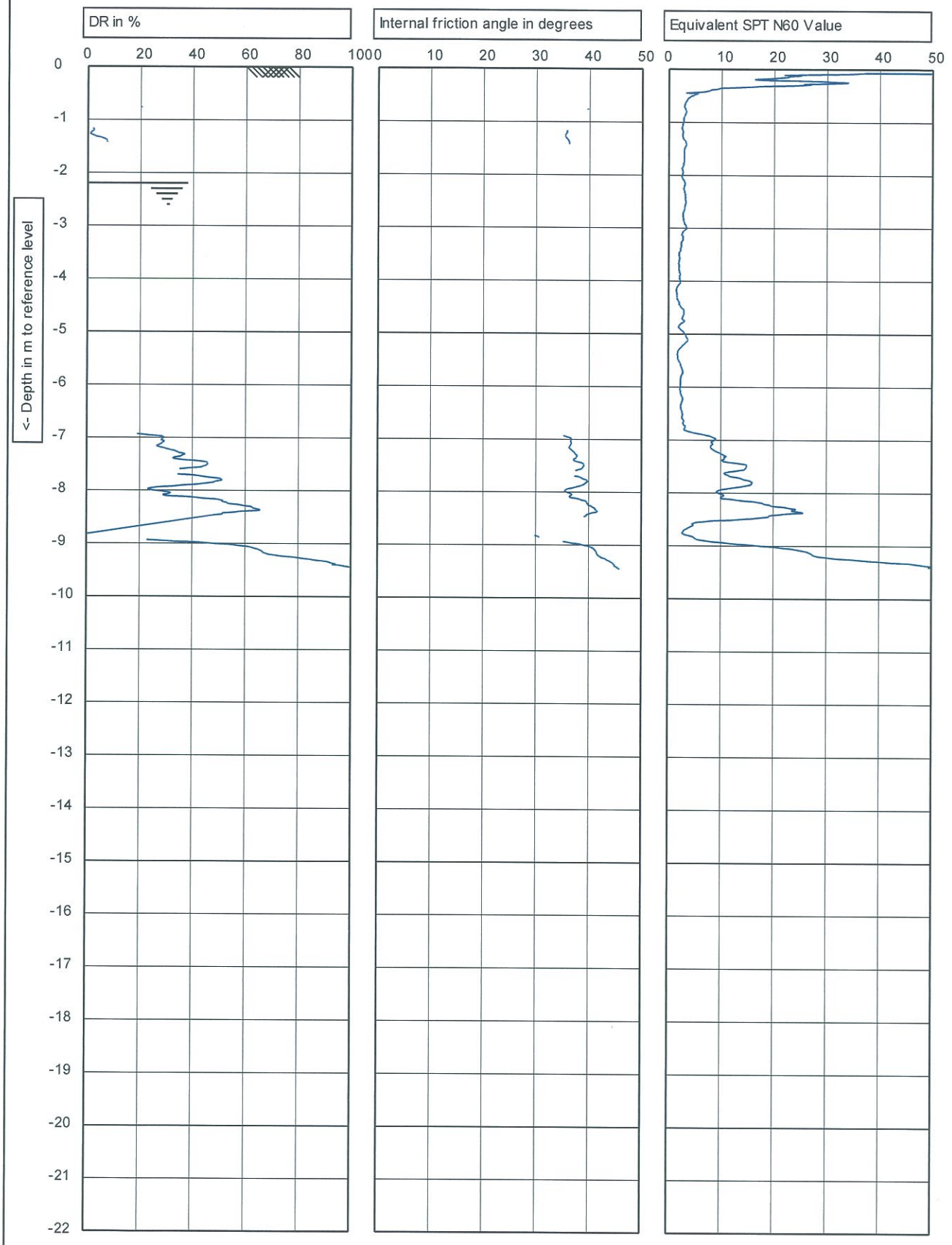
Project: **Waitomo District Council**

Location: **Queen St - Te Kuiti**

Position: **1789213, 5754520 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**21/08/2017**
Cone no.:	**C10CFIIP.C15215**
Project no.:	**2-68002.00_HA1773**
CPT no.:	**01** 1/6

CPT1 Fig. B-1A



Refusal (qc 40+ MPa)

EOH - Dipped - GWL @ 2.2m

OPUS

Graphs on this page are not IANZ accredited

r u2
150 cm²
10 cm²

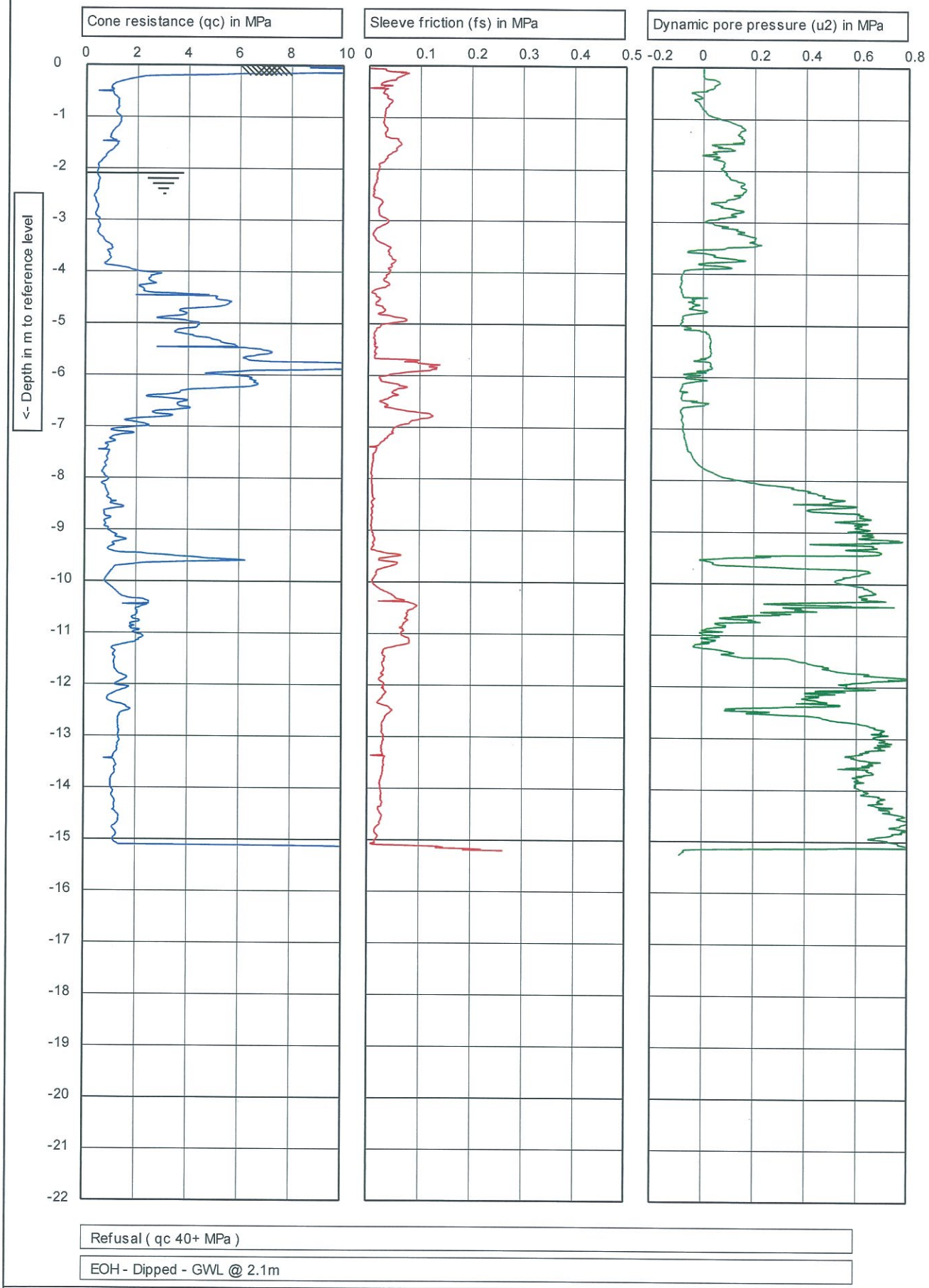
Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** W.L.: **-2.20 m**

Project: **Waitomo District Council**
Location: **Queen St - Te Kuiti**
Position: **1789213, 5754520 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**21/08/2017**
Cone no.:	**C10CFIIP.C15215**
Project no.:	**2-68002.00_HA1773**
CPT no.:	**01** 5/6

CPT1 Fig. B-1B



Refusal (qc 40+ MPa)

EOH - Dipped - GWL @ 2.1m

OPUS IANZ ACCREDITED LABORATORY

Graphs indicated as not accredited are outside the scope of the laboratory's accreditation

1.45

r u2
150 cm²
10 cm²

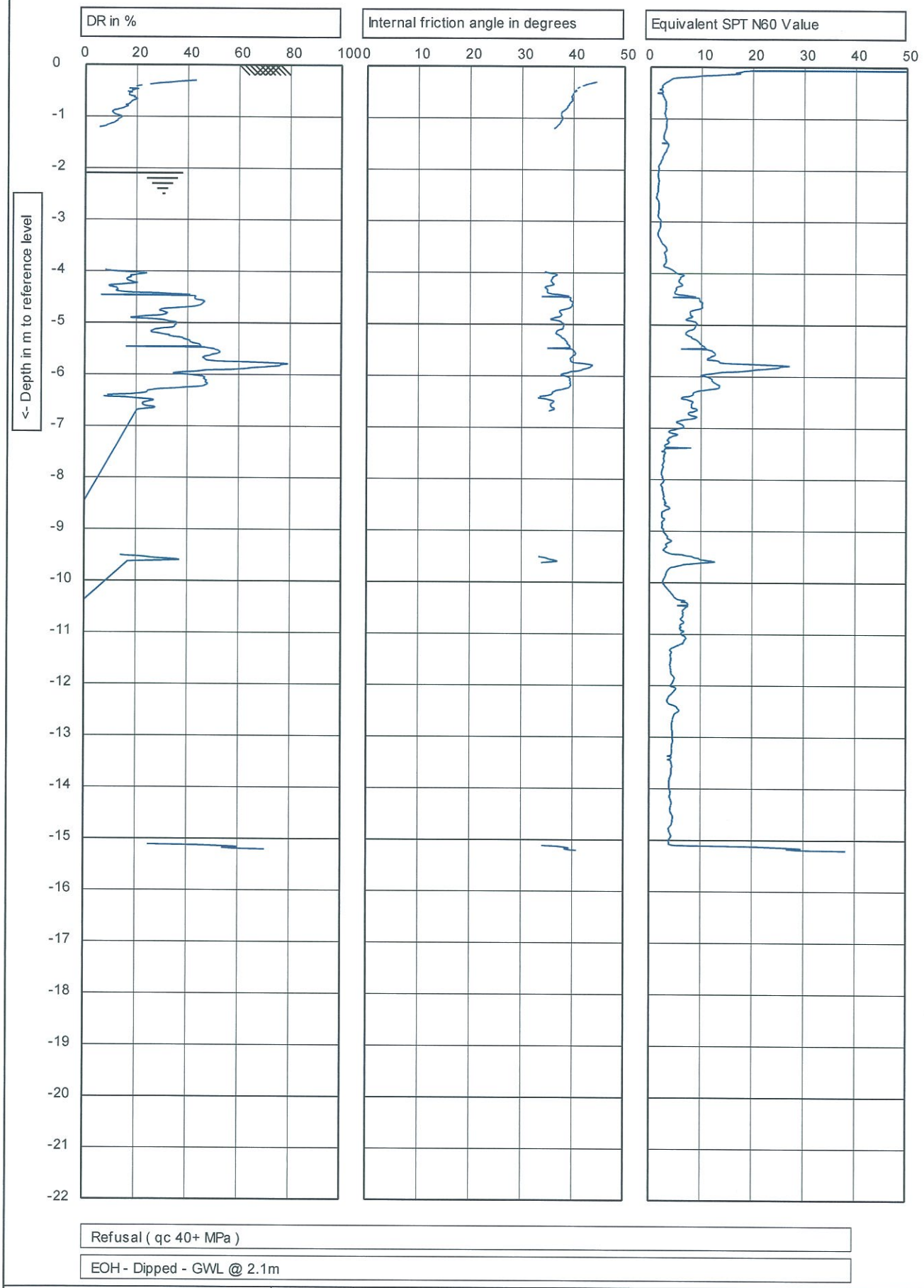
Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** W.L.: **-2.10 m**

Project: **Waitomo District Council**
Location: **Queen St - Te Kuiti**
Position: **1789210, 5754472 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**21/08/2017**
Cone no.:	**C10CFIIP.C15215**
Project no.:	**2-68002.00_HA1773**
CPT no.:	**02** 1/6

CPT2 Fig. B-2A



Refusal (qc 40+ MPa)

EOH - Dipped - GWL @ 2.1m

OPUS

Graphs on this page are not IANZ accredited

r u2
150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** W.L.: **-2.10 m**

Project: **Waitomo District Council**
Location: **Queen St - Te Kuiti**
Position: **1789210, 5754472 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**21/08/2017**
Cone no.:	**C10CFIIP.C15215**
Project no.:	**2-68002.00_HA1773**
CPT no.:	**02** 5/6

1.45

CPT2 Fig. B-2B

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The Power of Commitment