# Port Levy Community Hall
# Detailed Engineering Evaluation
# Quantitative Report

Christchurch City Council

*Christchurch City Council*

# Port Levy Community Hall

# Detailed Engineering Evaluation Quantitative Report


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| | |
|---|---|
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| Status: | Final |

Port Levy Community Hall Building
BU 3575-002 EQ2

Detailed Engineering Evaluation
Quantitative Report - SUMMARY
Version 1 - FINAL

Port Levy, Banks Peninsula

**Background**
This is a summary of the quantitative report for the Port Levy Community Hall building, and is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011, visual inspections on 19 January 2012, available drawings and calculations.

**Key Damage Observed**
No seismic damage was identified.

**Critical Structural Weaknesses**
No potential critical structural weaknesses have been identified.

**Indicative Building Strength**
Based on the information available, and from undertaking a quantitative assessment, the building's capacity has been assessed to be less than 33% NBS along and across the building, as limited by the wall bracing and subfloor bracing. The building's post-earthquake capacity excluding critical structural weaknesses is in the order of 10% NBS along the building and 11% NBS across the building.

The chimney contributes notable mass to the building, as well as representing a significant overhead hazard. The capacity of the building following the removal of the chimney is improved to 16% NBS along the building and 17% NBS across the building. These figures are still at a level where the building is considered earthquake prone.

The building has been assessed to have a seismic capacity of less than 33% NBS and is therefore classed as earthquake prone.

**Recommendations**
It is recommended that:

a) The brick chimney in the rear end wall of the building appears to have pulled away from the building and be unstable and represents a significant overhead collapse hazard. The chimney is to be removed down to the ground. A cordon to the external area around the chimney should be placed until the chimney has been removed.
b) The building's capacity following the removal of the chimney is still below 33% NBS. We recommend that the CCC review the on-going occupancy of this building until such time that any strengthening works have been undertaken
c) A strengthening scheme be developed to increase the overall capacity of the building to at least 67% NBS.

# Contents

# 1 Introduction

Opus International Consultants Limited has been engaged by Christchurch City Council (CCC) to undertake a detailed seismic assessment of the Port Levy Community Hall building, located in Port Levy, Banks Peninsula, following the M6.3 Christchurch earthquake on 22 February 2011.

The purpose of the assessment is to determine if the building is classed as being earthquake prone in accordance with the Building Act 2004.

The seismic assessment and reporting have been undertaken based on the qualitative and quantitative procedures detailed in the Detailed Engineering Evaluation Procedure (DEEP) document (draft) issued by the Structural Engineering Society (SESOC) on 19 July 2011.

# 2 Compliance

This section contains a brief summary of the requirements of the various statutes and authorities that control activities in relation to buildings in Christchurch at present.

## 2.1 Canterbury Earthquake Recovery Authority (CERA)

CERA was established on 28 March 2011 to take control of the recovery of Christchurch using powers established by the Canterbury Earthquake Recovery Act enacted on 18 April 2011. This act gives the Chief Executive Officer of CERA wide powers in relation to building safety, demolition and repair. Two relevant sections are:

**Section 38 – Works**

This section outlines a process in which the chief executive can give notice that a building is to be demolished and if the owner does not carry out the demolition, the chief executive can commission the demolition and recover the costs from the owner or by placing a charge on the owners' land.

**Section 51 – Requiring Structural Survey**

This section enables the chief executive to require a building owner, insurer or mortgagee to carry out a full structural survey before the building is re-occupied.

We understand that CERA require a detailed engineering evaluation to be carried out for all buildings (other than those exempt from the Earthquake Prone Building definition in the Building Act). CERA have adopted the Detailed Engineering Evaluation Procedure (DEEP) document (draft) issued by the Structural Engineering Society (SESOC) on 19 July 2011. This document sets out a methodology for both initial qualitative and detailed quantitative assessments.

It is anticipated that a number of factors, including the following, will determine the extent of evaluation and strengthening level required:

1. The importance level and occupancy of the building.

2. The placard status and amount of damage.
3. The age and structural type of the building.
4. Consideration of any critical structural weaknesses.

Any building with a capacity of less than 33% of new building standard (including consideration of critical structural weaknesses) will need to be strengthened to a target of 67% as required by the CCC Earthquake Prone Building Policy.

## 2.2 Building Act

Several sections of the Building Act are relevant when considering structural requirements:

**Section 112 - Alterations**

This section requires that an existing building complies with the relevant sections of the Building Code to at least the extent that it did prior to the alteration.

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

**Section 115 – Change of Use**

This section requires that the territorial authority (in this case Christchurch City Council (CCC)) is satisfied that the building with a new use complies with the relevant sections of the Building Code 'as near as is reasonably practicable'.

This is typically interpreted by CCC as being 67% of the strength of an equivalent new building. This is also the minimum level recommended by the New Zealand Society for Earthquake Engineering (NZSEE).

**Section 121 – Dangerous Buildings**

This section was extended by the Canterbury Earthquake (Building Act) Order 2010, and defines a building as dangerous if:

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

**Section 122 – Earthquake Prone Buildings**

This section defines a building as earthquake prone (EPB) if its ultimate capacity would be exceeded in a 'moderate earthquake' and it would be likely to collapse causing injury or death, or damage to other property.

A moderate earthquake is defined by the building regulations as one that would generate loads 33% of those used to design an equivalent new building.

**Section 124 – Powers of Territorial Authorities**

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

**Section 131 – Earthquake Prone Building Policy**

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

### 2.3 Christchurch City Council Policy

Christchurch City Council adopted their Earthquake Prone, Dangerous and Insanitary Building Policy in 2006. This policy was amended immediately following the Darfield Earthquake on 4 September 2010.

The 2010 amendment includes the following:

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

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

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

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

### 2.4 Building Code

The Building Code outlines performance standards for buildings and the Building Act requires that all new buildings comply with this code. Compliance Documents published by The Department of Building and Housing can be used to demonstrate compliance with the Building Code.

On 19 May 2011, Compliance Document B1: Structure was amended to include increased seismic design requirements for Canterbury as follows:

- 36% increase in the basic seismic design load for Christchurch (Z factor increased from 0.22 to 0.3);
- Increased serviceability requirements.

### 2.5 Institution of Professional Engineers New Zealand (IPENZ) Code of Ethics

One of the core ethical values of professional engineers in New Zealand is the protection of life and safeguarding of people. The IPENZ Code of Ethics requires that:

*Members shall recognise the need to protect life and to safeguard people, and in their engineering activities shall act to address this need.*

*1.1 Giving Priority to the safety and well-being of the community and having regard to this principle in assessing obligations to clients, employers and colleagues.*

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

All recommendations on building occupancy and access must be made with these fundamental obligations in mind.

## 3 Earthquake Resistance Standards

For this assessment, the building's earthquake resistance is compared with the current New Zealand Building Code requirements for a new building constructed on the site. This is expressed as a percentage of new building standard (%NBS). The loadings are in accordance with the current earthquake loading standard NZS1170.5 [1].

A generally accepted classification of earthquake risk for existing buildings in terms of %NBS that has been proposed by the NZSEE 2006 [2] is presented in Figure 1 below.

| Description | Grade | Risk | %NBS | Existing Building Structural Performance | Improvement of Structural Performance | |
|---|---|---|---|---|---|---|
| | | | | | Legal Requirement | NZSEE Recommendation |
| Low Risk Building | A or B | Low | Above 67 | Acceptable (improvement may be desirable) | The Building Act sets no required level of structural improvement (unless change in use) This is for each TA to decide. Improvement is not limited to 34%NBS. | 100%NBS desirable. Improvement should achieve at least 67%NBS |
| Moderate Risk Building | B or C | Moderate | 34 to 66 | Acceptable legally. Improvement recommended | | Not recommended. Acceptable only in exceptional circumstances |
| High Risk Building | D or E | High | 33 or lower | Unacceptable (Improvement required under Act) | Unacceptable | Unacceptable |

**Figure 1: NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE Guidelines**

Table 1 below compares the percentage NBS to the relative risk of the building failing in a seismic event with a 10% risk of exceedance in 50 years (i.e. 0.2% in the next year). It is noted that the current seismic risk in Christchurch results in a 6% risk of exceedance in the next year.

**Table 1: %NBS compared to relative risk of failure**

| Percentage of New Building Standard (%NBS) | Relative Risk (Approximate) |
|---|---|
| >100 | <1 time |
| 80-100 | 1-2 times |
| 67-80 | 2-5 times |
| 33-67 | 5-10 times |
| 20-33 | 10-25 times |
| <20 | >25 times |

## 3.1 Minimum and Recommended Standards

Based on governing policy and recent observations, Opus makes the following general recommendations:

### 3.1.1 Occupancy

– The Canterbury Earthquake Order[1] in Council 16 September 2010, modified the meaning of "dangerous building" to include buildings that were identified as being EPB's. As a result of this, we would expect such a building would be issued with a Section 124 notice, by the Territorial Authority, or CERA acting on their behalf, once

[1] This Order only applies to buildings within the Christchurch City, Selwyn District and Waimakariri District Councils authority

they are made aware of our assessment. Based on information received from CERA to date, this notice is likely to prohibit occupancy of the building (or parts thereof) until its seismic capacity is improved to the point that it is no longer considered an EPB.

#### 3.1.2 Cordoning

– Where there is an overhead falling hazard, or potential collapse hazard of the building, the areas of concern should be cordoned off in accordance with current CERA/Christchurch City Council guidelines.

#### 3.1.3 Strengthening

– Industry guidelines (NZSEE 2006 [2]) strongly recommend that every effort be made to achieve improvement to at least 67%NBS. A strengthening solution to anything less than 67%NBS would not provide an adequate reduction to the level of risk.

– It should be noted that full compliance with the current building code requires building strength of 100%NBS.

#### 3.1.4 Our Ethical Obligation

– In accordance with the IPENZ code of ethics, we have a duty of care to the public. This obligation requires us to identify and inform CERA of potentially dangerous buildings; this would include earthquake prone buildings.

# 4 Building Description

## 4.1 General

The Port Levy Community Hall building is a single storey timber framed structure with timber weatherboard cladding and a lightweight high pitched corrugated iron roof. The building sits on plastered brick piles around the perimeter and stones as interior piles.

The building is situated on a flat section adjacent to a swimming pool and a masonry changing room building. The building is approximately 11m long in the east-west direction and 5.9m wide in the north-south direction. The apex of the roof is approximately 9m from the ground and the stud height is approximately 4m. The building consists of a single main hall room with fireplace and chimney at one end, and a small entry area at the front door. The walls and ceiling in the main hall are lined with softboard and the entry area is lined with timber tongue and groove.

The building age is unknown, but is expected to have been built before 1960.

## 4.2 Gravity Load Resisting System

The roof is a timber framed roof clad in lightweight corrugated iron, with the ceiling lined with softboard panels.

The subfloor consists of timber flooring on suspended timber framing sitting on plastered brick and stone piles. The building is not connected to the piles and there is no damp proof course between the timber bearers and piles.

### 4.3 Seismic Load Resisting System

Seismic loads in both principal directions are resisted by wall braces within the softboard lined walls. These braces are assumed to be in pairs with only the compression brace providing load resistance. The ceiling and walls in the entry area is lined with tongue and groove timber. The ceiling is assumed to provide a form of flexible diaphragm to distribute the lateral loads to the wall bracing elements.

There was no sign of any subfloor bracing having been provided and there was no sign of any hold down connections between the piles and bearers.

## 5 Survey

The building currently has a green placard (not issued as part of this inspection).

Copies of the following drawings were referred to as part of the assessment:

- One architectural sketch of the building completed by Opus Architecture, titled “Port Levy Community Hall, Floor Plan and Section”.

No copies of the design calculations or structural drawings have been obtained for this building.

The drawings have been used to confirm the structural systems, investigate potential critical structural weaknesses (CSW) wherever possible and identify details which required particular attention.

## 6 Damage Assessment

The main building structure does not appear to have suffered any damage as a result of the recent earthquake events.

There does seem to be some separation of the chimney from the main structure and the chimney has horizontal cracks at some bed joints.

## 7 General Observations

Overall the building has performed well under seismic conditions which would be expected for a timber framed single storey structure. The building has sustained little damage and continues to be fully operational.

The chimney poses a significant overhead hazard due to the separation from the building and the cracking, and should be cordoned off.

Due to the non-intrusive nature of the original survey, many connection details could not be ascertained.

# 8 Detailed Seismic Assessment

## 8.1 Critical Structural Weaknesses

As outlined in the Critical Structural Weakness and Collapse Hazards draft briefing document, issued by the Structural Engineering Society (SESOC) on 7 May 2011, the term 'Critical Structural Weakness' (CSW) refers to a component of a building that could contribute to increased levels of damage or cause premature collapse of the building.

We have not identified any critical structural weaknesses with this building.

## 8.2 Seismic Coefficient Parameters

The seismic design parameters based on current design requirements from NZS1170.5:2004 and the NZBC clause B1 for this building are:

- Site soil class D, clause 3.1.3 NZS 1170.5:2004;
- Site hazard factor, Z=0.3, B1/VM1 clause 2.2.14B;
- Return period factor $R_u$ = 1.0 from Table 3.5, NZS 1170.5:2004, for an Importance Level 2 structure with a 50 year design life;
- $\mu_{max}$ = 1.25 for the softboard wall linings with cut in braces.

## 8.3 Detailed Seismic Assessment Results

A summary of the structural performance of the building is shown in the following table. Note that the values given represent the worst performing elements in the building, as these effectively define the building's capacity. Other elements within the building may have significantly greater capacity when compared with the governing element.

**Table 2: Summary of Seismic Performance**

| Structural Element/System | Failure mode and description of limiting criteria | Critical Structural Weakness and Collapse Hazard | % NBS based on calculated capacity |
|---|---|---|---|
| Walls in the east-west direction i.e. along the building | Bracing capacity of wall linings along the building | No | 10% |
| Walls in the east-west direction i.e. along the building | Bracing capacity of wall linings along the building – Without chimney | No | 16% |
| Walls in the north-south direction i.e. across the building | Bracing capacity of wall linings across the building – Without chimney | No | 17% |
| Walls in the north-south direction i.e. across the building | Bracing capacity of wall linings across the building | No | 11% |
| Ceiling diaphragm | Capacity of the ceiling lining/diaphragm | No | 76% |

| Structural Element/System | Failure mode and description of limiting criteria | Critical Structural Weakness and Collapse Hazard | % NBS based on calculated capacity |
|---|---|---|---|
| Subfloor bracing | Complete lack of bracing capacity of the subfloor structure | No | <33% |

## 8.4 Discussion of Results

The building has a calculated capacity of less than 33% NBS as limited by a complete lack of subfloor bracing in both directions and the capacity of the wall linings in both directions.

As one of the major influences on the seismic loading and risk of the building comes from the brick chimney, results have also been included for comparison purposes assuming the chimney is removed.

It has been assumed that the ceiling lining acts as a flexible diaphragm.

As the building has a capacity less than 33% NBS it is defined as earthquake prone in accordance with the Building Act 2004. We recommend that the CCC review on-going occupancy of this building until such time that any strengthening works have been undertaken.

## 8.5 Limitations and Assumptions in Results

Our analysis and assessment is based on an assessment of the building in its undamaged state. Therefore the current capacity of the building will be lower than that stated.

The results have been reported as a %NBS and the stated value is that obtained from our analysis and assessment. Despite the use of best national and international practice in this analysis and assessment, this value contains uncertainty due to the many assumptions and simplifications which are made during the assessment. These include:

- Simplifications made in the analysis, including boundary conditions such as foundation fixity;
- Assessments of material strengths based on limited drawings, specifications and site inspections;
- The normal variation in material properties which change from batch to batch;
- Approximations made in the assessment of the capacity of each element, especially when considering the post-yield behaviour.

# 9 Geotechnical Assessment

## 9.1 Regional Geology

The published geological map of the area (Geology of the Christchurch Area 1:250,000, Forsyth, Barrell and Jongens, 2008) indicates the site is located on grey to brown alluvium, comprising of silty sub-angular gravel and sand forming alluvial fans.

## 9.2 Peak Ground Acceleration

Interpolation of United States Geological Survey (USGS) Shakemap: South Island of New Zealand (22 Feb, 2011) indicates that this location has likely experienced a Horizontal Peak Ground Acceleration (PGA) of approximately 0.15g to 0.25g during the 22$^{nd}$ February 2011 Earthquake. Estimated PGA's have been cross checked with Geonets' Modified Mercalli intensity scale observations.

## 9.3 Expected Ground Conditions

One ECan borehole is located 300m north of the Community Hall which indicates clay-bound gravels up to 16m below ground level where rock is encountered. Refer to ECan borehole log. The location of this well is representative to the Community Hall due to the similar topography and elevations.

## 9.4 Site Observations

The building was inspected by Opus Structural Engineers on the 18th January 2012. The following observations were made from site notes and photographs.

- The building is situated on a flat site. A pool and changing sheds are located directly south of the building.
- A stream is located 90m south east of the building and runs parallel to the building.
- The building is founded on masonry piles around the perimeter with bearers resting on rocks underneath the building. The rocks appear to be undisturbed. Refer to Photo 2.
- There does not appear to have been any ground movement in the vicinity of the building.
- The pavement around the north east corner of the swimming pool appears to have settled by 10mm. Refer to Photo 1.
- There is no obvious cracking in the pavement north of the site.

## 9.5 Conclusions and Discussion

The existing foundations appear to have performed satisfactorily in the recent seismic events, even though the bearers are not connected to appropriate footings. Some deterioration of one corner masonry pile is evident, which may need to be plastered to avoid further deterioration. It is not obvious if the observed settlement around the pool has been caused by the earthquakes. No liquefaction has been observed on site. The stream is located 90m south east therefore it is considered to be low risk of lateral spreading. Due to the likely presence of claybound gravels at shallow depths, the liquefaction potential of this site is considered to be low. No further geotechnical testing is recommended.

# 10 Remedial Options

Any remedial options for increasing the seismic capacity above 67% NBS would need to address the bracing capacity of the wall linings, the chimney and the subfloor bracing capacity. As a number of piles consist of rock or stacked bricks, this may require underpinning the building with new piles. Selected wall linings could be replaced with new gib board to increase the seismic capacity in each direction.

# 11 Conclusions

(a) The building has a seismic capacity of less than 33% NBS and is therefore classed as earthquake prone.

(b) The seismic capacity is limited by the lack of subfloor bracing and the capacity of the braced wall.

(c) Strengthening work is required to increase the overall building capacity to at least 67% NBS.

(d) The existing foundations have performed satisfactorily, and no further geotechnical testing is required.

(e) The chimney represents a significant overhead collapse hazard and should be cordoned off until such time that it is removed.

# 12 Recommendations

(a) The chimney should be cordoned off until such time that it is removed down to the ground.

(b) The building is not to be occupied until the chimney is removed and any strengthening works are carried out.

(c) Strengthening options be developed for increasing the seismic capacity of the building to at least 67% NBS.

# 13 Limitations

(a) This report is based on an inspection of the structure with a focus on the damage sustained from the 22 February 2011 Canterbury Earthquake and aftershocks only. Some non-structural damage is mentioned but this is not intended to be a comprehensive list of non-structural items.

(b) 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 the time.

(c) This report is prepared for the CCC to assist with assessing remedial works required for council buildings and facilities. It is not intended for any other party or purpose.

# 14 References

[1] NZS 1170.5: 2004, *Structural design actions, Part 5 Earthquake actions,* Standards New Zealand.

[2] NZSEE: 2006, *Assessment and improvement of the structural performance of buildings in earthquakes,* New Zealand Society for Earthquake Engineering.

[3] Engineering Advisory Group, *Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury, Part 2 Evaluation Procedure*, Draft Prepared by the Engineering Advisory Group, Revision 5, 19 July 2011.

[4] Engineering Advisory Group, *Guidance on Detailed Engineering Evaluation of Non-residential buildings, Part 3 Technical Guidance*, Draft Prepared by the Engineering Advisory Group, 13 December 2011.

[5] SESOC, *Practice Note – Design of Conventional Structural Systems Following Canterbury Earthquakes*, Structural Engineering Society of New Zealand, 21 December 2011.

# Appendix A – Photographs

**Photo 2: 10mm of pavement settlement around the north east corner of the swimming pool.**

**Photo 3: Foundation of the Community Hall.**

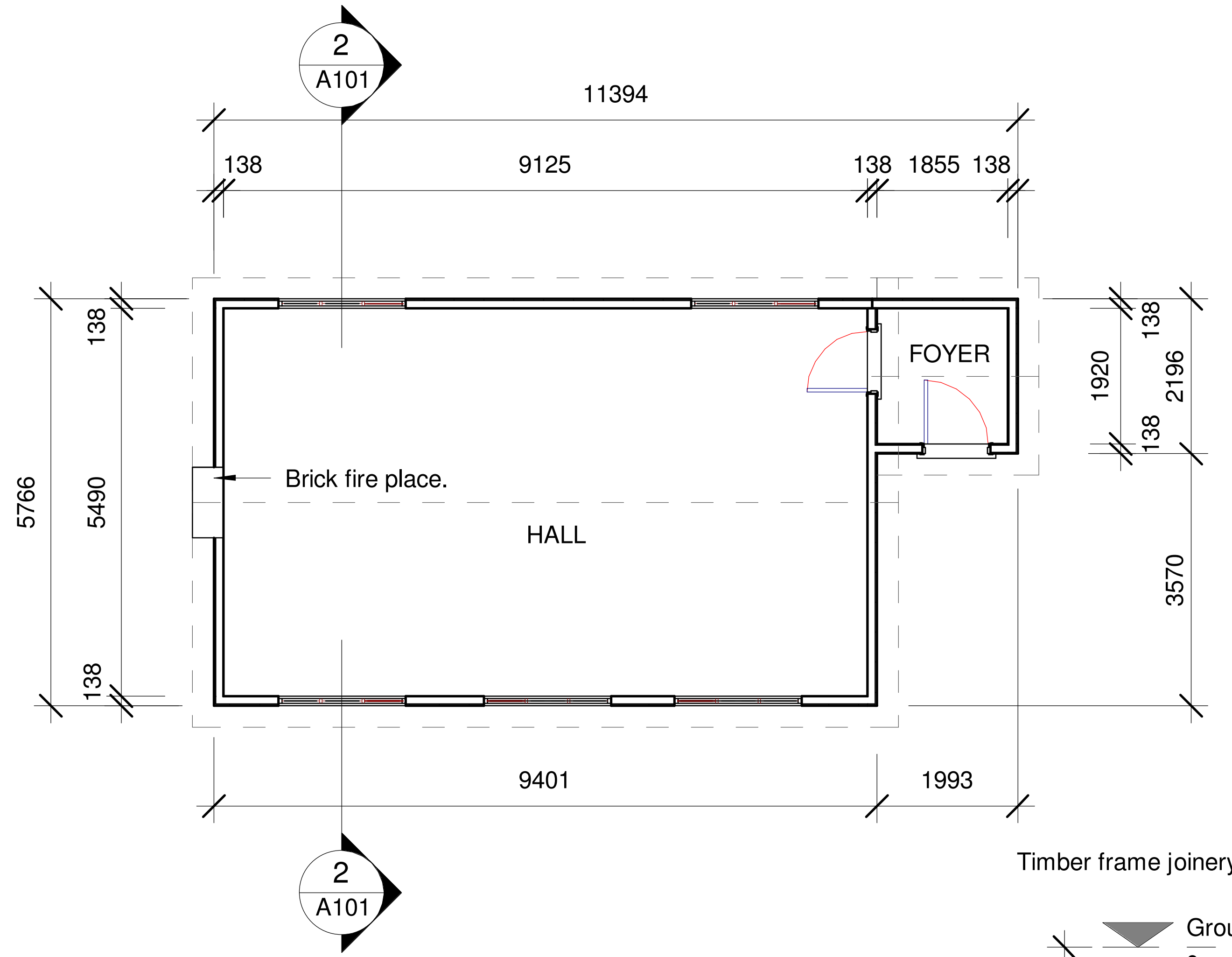
**Photo 3: View of the building from the north**

**Photo 4: View of the building from the south**

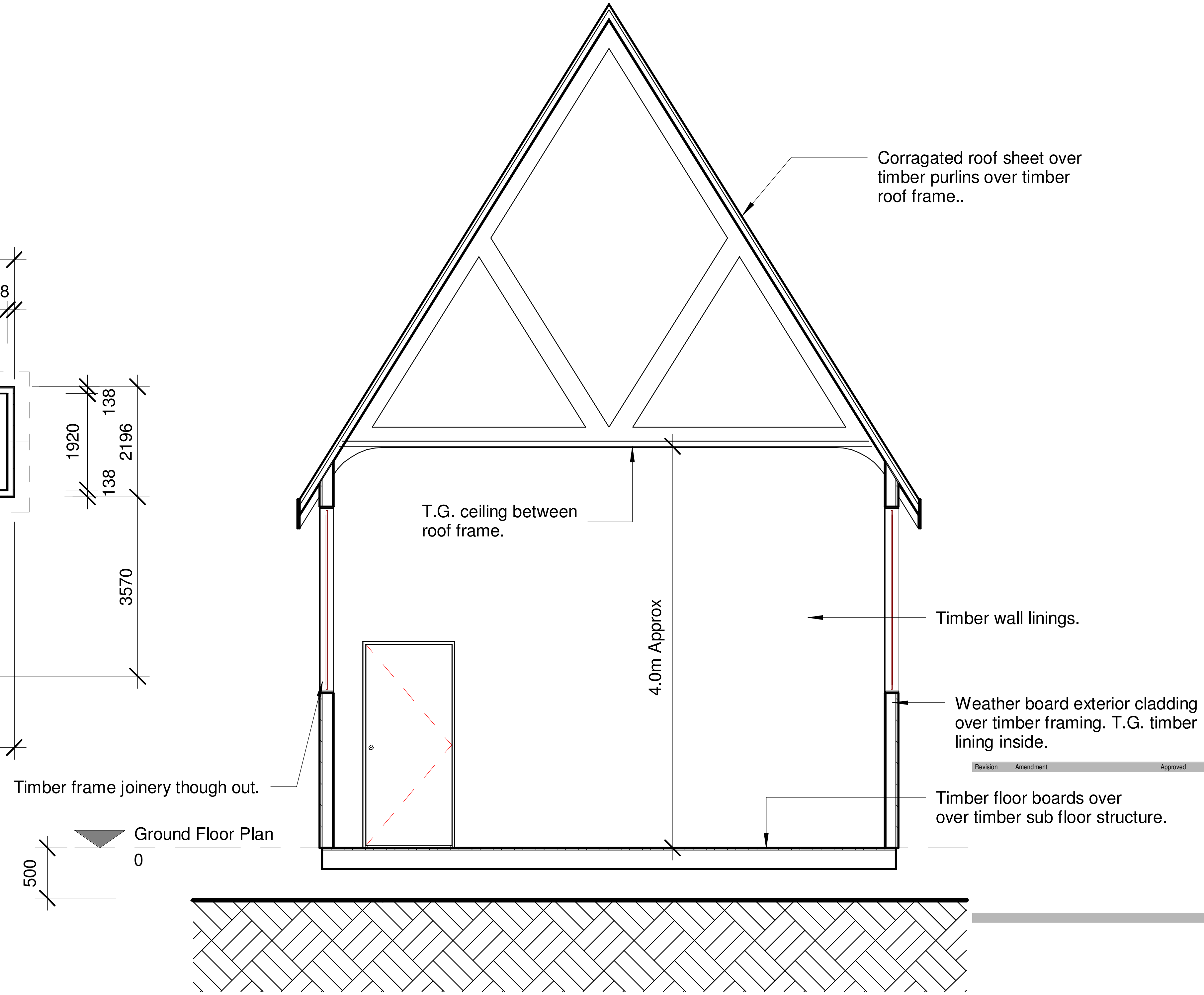
**Photo 5: View of the main hall**

**Photo 6: View of the tongue and groove ceiling and walls in the entrance area**

# Appendix B – Floor Plan




1 A101 **Ground Floor Plan** 1 : 100




2 A101 **Section 1** 1 : 50

| Revision | Amendment | Approved | Revision Date |
|---|---|---|---|

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| Drawn | Designed | Approved | Revision Date |
|---|---|---|---|
| Author | Designer | Approver | |

| Project No. | Scale |
|---|---|
| | As indicated |

Project
Christchurch City Council
Western Vally Road, Port Levi.
Port Levi Community Hall.

Title
FLOOR PLAN AND SECTION.

**Draft**

| Drawing No. | Sheet No. | Revision |
|---|---|---|
| | A101 | RA |

# Appendix C – DEE Spreadsheet

**Detailed Engineering Evaluation Summary Data** V1.11

## Location

| | | | | |
|---|---|---|---|---|
| Building Name: | Port Levy Community Hall | | Reviewer: | Alistair Boyce |
| | Unit / No: / Street | | CPEng No: | 209860 |
| Building Address: | Port Levy | | Company: | Opus International Consultants |
| Legal Description: | | | Company project number: | 6-QUCCC.70 |
| | | | Company phone number: | 03 363 5400 |

| | Degrees | Min | Sec | | |
|---|---|---|---|---|---|
| GPS south: | 43 | 39 | 59.00 | Date of submission: | 21-May-12 |
| GPS east: | 172 | 48 | 33.70 | Inspection Date: | 20/01/2012 |
| | | | | Revision: | Draft |
| Building Unique Identifier (CCC): | | | | Is there a full report with this summary? | yes |

## Site

| | | | |
|---|---|---|---|
| Site slope: | slope < 1in 10 | Max retaining height (m): | 0 |
| Soil type: | silty sand | Soil Profile (if available): | |
| Site Class (to NZS1170.5): | D | | |
| Proximity to waterway (m, if <100m): | | If Ground improvement on site, describe: | |
| Proximity to clifftop (m, if < 100m): | | | |
| Proximity to cliff base (m,if <100m): | | Approx site elevation (m): | 10.00 |

## Building

| | | | | |
|---|---|---|---|---|
| No. of storeys above ground: | 1 | single storey = 1 | Ground floor elevation (Absolute) (m): | 10.00 |
| Ground floor split? | no | | Ground floor elevation above ground (m): | 0.30 |
| Storeys below ground | 0 | | | |
| Foundation type: | other (describe) | | if Foundation type is other, describe: | Brick and stone piles |
| Building height (m): | 9.00 | | height from ground to level of uppermost seismic mass (for IEP only) (m): | |
| Floor footprint area (approx): | 60 | | | |
| Age of Building (years): | 80 | | Date of design: | Pre 1935 |
| Strengthening present? | no | | If so, when (year)? | |
| | | | And what load level (%g)? | |
| Use (ground floor): | public | | Brief strengthening description: | |
| Use (upper floors): | | | | |
| Use notes (if required): | | | | |
| Importance level (to NZS1170.5): | IL2 | | | |

### Gravity Structure

| | | | |
|---|---|---|---|
| Gravity System: | load bearing walls | | |
| Roof: | timber framed | rafter type, purlin type and cladding | Corrugated iron cladding |
| Floors: | timber | joist depth and spacing (mm) | |
| Beams: | timber | type | |
| Columns: | timber | typical dimensions (mm x mm) | |
| Walls: | | | |

### Lateral load resisting structure

| | | | | |
|---|---|---|---|---|
| Lateral system along: | lightweight timber framed walls | **Note: Define along and across in detailed report!** | note typical wall length (m) | 1m - 4m |
| Ductility assumed, μ: | 1.25 | | | |
| Period along: | 0.40 | 0.00 | estimate or calculation? | estimated |
| Total deflection (ULS) (mm): | | | estimate or calculation? | |
| maximum interstorey deflection (ULS) (mm): | | | estimate or calculation? | |
| Lateral system across: | lightweight timber framed walls | | note typical wall length (m) | 1m-4m |
| Ductility assumed, μ: | 1.25 | | | |
| Period across: | 0.40 | 0.00 | estimate or calculation? | |
| Total deflection (ULS) (mm): | | | estimate or calculation? | |
| maximum interstorey deflection (ULS) (mm): | | | estimate or calculation? | |

### Separations:

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

### Non-structural elements

| | | | |
|---|---|---|---|
| Stairs: | | | |
| Wall cladding: | other light | describe | Timber weatherboard |
| Roof Cladding: | Metal | describe | Corrugated iron |
| Glazing: | timber frames | | Tonge and groove |
| Ceilings: | strapped or direct fixed | | |
| Services(list): | | | |

## Available documentation

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

## Damage

Site:
(refer DEE Table 4-2)

| | | | |
|---|---|---|---|
| Site performance: | | Describe damage: | |
| Settlement: | none observed | notes (if applicable): | |
| Differential settlement: | none observed | notes (if applicable): | |
| Liquefaction: | none apparent | notes (if applicable): | |
| Lateral Spread: | none apparent | notes (if applicable): | |
| Differential lateral spread: | none apparent | notes (if applicable): | |
| Ground cracks: | none apparent | notes (if applicable): | |
| Damage to area: | none apparent | notes (if applicable): | |

Building:

| | | | | |
|---|---|---|---|---|
| | Current Placard Status: | green | | |
| Along | Damage ratio: | | Describe how damage ratio arrived at: | |
| | Describe (summary): | | | |
| Across | Damage ratio: | #DIV/0! | | |
| | Describe (summary): | | | |
| Diaphragms | Damage?: | no | Describe: | |
| CSWs: | Damage?: | yes | Describe: | Lack of subfloor bracing |
| Pounding: | Damage?: | no | Describe: | |
| Non-structural: | Damage?: | yes | Describe: | Cracking & separation of chimney |

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

## Recommendations

| | | | | |
|---|---|---|---|---|
| | Level of repair/strengthening required: | significant structural and strengthening | Describe: | |
| | Building Consent required: | yes | Describe: | |
| | Interim occupancy recommendations: | do not occupy | Describe: | |
| Along | Assessed %NBS before: | ##### %NBS from IEP below | If IEP not used, please detail assessment methodology: | Quantitative assessment |
| | Assessed %NBS after: | 10% | | |
| Across | Assessed %NBS before: | ##### %NBS from IEP below | | |
| | Assessed %NBS after: | 11% | | |

## IEP

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

Period of design of building (from above): Pre 1935

$h_n$ from above: m

Seismic Zone, if designed between 1965 and 1992:

not required for this age of building

not required for this age of building

| | along | across |
|---|---|---|
| Period (from above): | 0.4 | 0.4 |
| (%NBS)nom from Fig 3.3: | | |
| Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0 | | 1.00 |
| Note 2: for RC buildings designed between 1976-1984, use 1.2 | | 1.0 |
| Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0) | | 1.0 |
| **Final (%NBS)nom:** | **0%** | **0%** |

**2.2 Near Fault Scaling Factor**

| | along | across |
|---|---|---|
| Near Fault scaling factor, from NZS1170.5, cl 3.1.6: | | 1.00 |
| Near Fault scaling factor (1/N(T,D), **Factor A**: | 1 | 1 |

**2.3 Hazard Scaling Factor**

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

**2.4 Return Period Scaling Factor**

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

**2.5 Ductility Scaling Factor**

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

**2.6 Structural Performance Scaling Factor:**

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

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

| | along | across |
|---|---|---|
| **$\%NBS_b$:** | **#DIV/0!** | **#DIV/0!** |

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

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

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

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

**3.6. Other factors, Factor F**

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

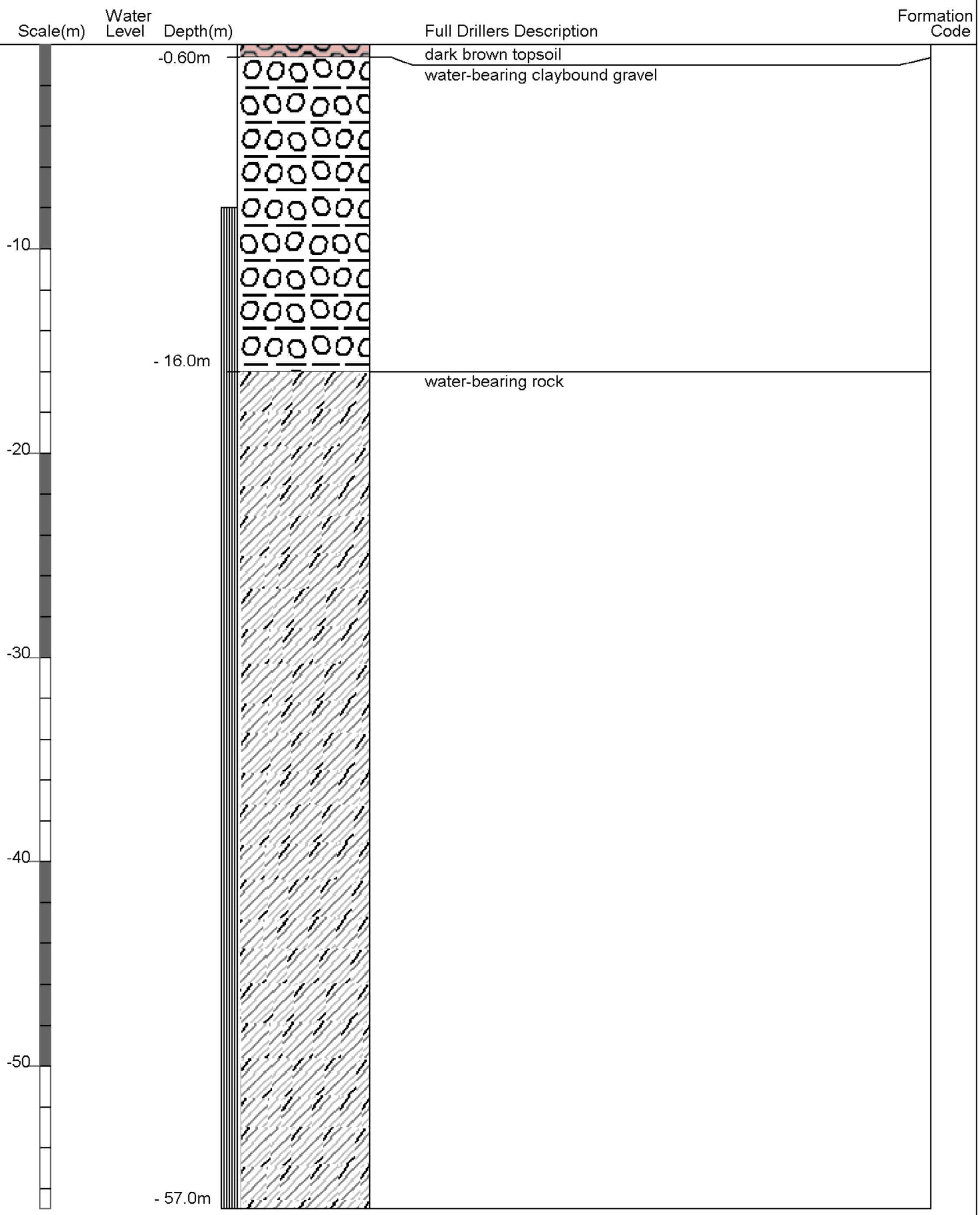
Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)
List any: Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

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

# Appendix D – Borehole Log

## Borelog for well N36/0075

Gridref: N36:9452-2707 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 17.41 +MSD
Driller : Giltrap Drilling
Drill Method : Rotary Rig
Drill Depth : -57m Drill Date : 20/07/2005



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