Christchurch City Council

PRK_3555_BLDG_005 EQ2
Diamond Harbour Playcentre / Scouts Den
1 J Waipapa Avenue

QUALITATIVE ASSESSMENT REPORT

FINAL

- Rev B
- 04 February 2013

Christchurch City Council

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Contents

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1. Executive Summary

1.1. Background

A Qualitative Assessment was carried out on the building located at 1 J Waipapa Avenue, Diamond Harbour. The building located on this site is comprised of an original structure built as a school in approximately 1920 and an addition to the playcentre built in 1997. Half of the original structure was renovated at the time of the construction of the addition to have modern Gib board ceiling and wall linings. The Scouts Den is run out of the unrenovated west room of the building with the playcentre in the east. The unrenovated west area is lined in tongue and groove boarding. The building is founded on timber piles. An aerial photograph illustrating the location of the building is shown below in Figure 1. Detailed descriptions outlining the buildings age and construction type are given in Section 5 of this report.

- **Figure 1 Aerial Photograph of 1 J Waipapa Avenue, Diamond Harbour**

The qualitative assessment includes a summary of the building damage as well as an initial assessment of the current seismic capacity compared with current seismic code loads using the Initial Evaluation Procedure (IEP).

This Qualitative report for the building structure is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011, visual inspections on 12/04/12, available architectural drawings for the extension and Gib bracing calculations for the relining of the eastern most room of the original building.

1.2. Key Damage Observed

Key damage observed includes:-

- A pile has broken to the east of the main north entry 50mm above ground level.
- Rot to weatherboard cladding and in places around window frames which may allow water ingress. This damage is not related to the earthquakes.
- Slope of the floor in the west of the building > 1/50 likely requiring re-levelling by jacking and pile packing
- Significant cracking through the mass concrete steps at the main entry to the building.

1.3. Critical Structural Weaknesses

The building has no critical structural weaknesses

1.4. Indicative Building Strength (from IEP and CSW assessment)

Based on the information available, and using the NZSEE Initial Evaluation Procedure, the buildings original capacity has been assessed to be in the order of 68%NBS and post earthquake capacity in the order of 68%NBS. The buildings post earthquake capacity excluding critical structural weaknesses is in the order of 68%NBS. This assessment has been made without structural drawings and is accordingly limited.

The building has been assessed to have a seismic capacity in the order of 68% NBS and is therefore not potentially earthquake prone.

Please note that structural strengthening is required by law for buildings that are confirmed to have a seismic capacity of less than 34% NBS.

1.5. Recommendations

It is recommended that:

a) The current placard status of the building of green 1 remain as is.
b) A level survey should be carried out to determine the need for relevelling. If relevelling is required it is recommended that pile ties are retrofitted to ensure increased compliance with current code.
c) We consider that barriers around the building are not necessary.

2. Introduction

Sinclair Knight Merz was engaged by Christchurch City Council to prepare a qualitative assessment report for the building located at 1 J Waipapa Avenue following the magnitude 6.3 earthquake which occurred in the afternoon of the 22nd of February 2011 and the subsequent aftershocks.

The Qualitative Assessment uses the methodology recommended in the Engineering Advisory Group document "Guidance on Detailed Engineering Evaluation of Earthquake affected Non-residential Buildings in Canterbury" (part 2 revision 5 dated 19/07/2011 and part 3 draft revision dated 13/12/2011). The qualitative assessment includes a summary of the building damage as well as an initial assessment of the likely current Seismic Capacity compared with current seismic code requirements.

A qualitative assessment involves inspections of the building and a desktop review of existing structural and geotechnical information, including existing drawings and calculations, if available.

The purpose of the assessment is to determine the likely building performance and damage patterns, to identify any potential critical structural weaknesses or collapse hazards, and to make an initial assessment of the likely building strength in terms of percentage of new building standard (%NBS).

This report describes the structural damage observed during our inspection and indicates suggested remediation measures. The inspection was undertaken from floor levels and was a visual inspection only. Our report reflects the situation at the time of the inspection and does not take account of changes caused by any events following our inspection.

The NZ Society for Earthquake Engineering (NZSEE) Initial Evaluation Procedure (IEP) was used to assess the likely performance of the building in a seismic event relative to the New Building Standard (NBS). 100% NBS is equivalent to the strength of a building that fully complies with current codes. This includes a recent increase of the Christchurch seismic hazard factor from 0.22 to 0.3[1].

At the time of this report, no intrusive site investigation, detailed analysis, or modelling of the building structure had been carried out. Construction drawings were not available. The building description below is based on a review of the architectural drawings of the extension and our visual inspections.

[1] http://www.dbh.govt.nz/seismicity-info

3. Compliance

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

3.1. Canterbury Earthquake Recovery Authority (CERA)

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

Section 38 – Works

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

Section 51 – Requiring Structural Survey

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

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

The qualitative assessment is a desk-top and site inspection assessment. It is based on a thorough visual inspection of the building coupled with a review of available documentation such as drawings and specifications. The quantitative assessment involves analytical calculation of the buildings strength and may require non-destructive or destructive material testing, geotechnical testing and intrusive investigation.

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

- The importance level and occupancy of the building
- The placard status and amount of damage
- The age and structural type of the building
- Consideration of any critical structural weaknesses

- The extent of any earthquake damage

3.2. Building Act

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

3.2.1. Section 112 – Alterations

This section requires that an existing building complies with the relevant sections of the Building Code to at least the extent that it did prior to any alteration. This effectively means that a building cannot be weakened as a result of an alteration (including partial demolition).

3.2.2. Section 115 – Change of Use

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

3.2.3. Section 121 – Dangerous Buildings

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

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

3.2.4. Section 122 – Earthquake Prone Buildings

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

3.2.5. 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.

3.2.6. Section 131 – Earthquake Prone Building Policy

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

3.3. Christchurch City Council Policy

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

The 2010 amendment includes the following:

- A process for identifying, categorising and prioritising Earthquake Prone Buildings, commencing on 1 July 2012;
- A strengthening target level of 67% of a new building for buildings that are Earthquake Prone. Council recognises that it may not be practicable for some repairs to meet that target. The council will work closely with building owners to achieve sensible, safe outcomes;
- A timeframe of 15-30 years for Earthquake Prone Buildings to be strengthened; and,
- Repair works for buildings damaged by earthquakes will be required to comply with the above.

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

We anticipate that any building with a capacity of less than 34%NBS (including consideration of critical structural weaknesses) will need to be strengthened to a target of 67%NBS of new building standard as recommended by the Policy.

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

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

3.4. 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.

After the February Earthquake, on 19 May 2011, Compliance Document B1: Structure was amended to include increased seismic design requirements for Canterbury as follows:

a) Hazard Factor increased from 0.22 to 0.3 (36% increase in the basic seismic design load)
b) Serviceability Return Period Factor increased from 0.25 to 0.33 (80% increase in the serviceability design loads when combined with the Hazard Factor increase)

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

4. 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 new building standard load requirements have been determined in accordance with the current earthquake loading standard (NZS 1170.5:2004 Structural design actions - Earthquake actions - New Zealand).

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

The New Zealand Society for Earthquake Engineering has proposed a way for classifying earthquake risk for existing buildings in terms of %NBS and this is shown in Figure 2 below.

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

■ **Figure 2: NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE Guidelines**

Table 1 below provides an indication of the risk of failure for an existing building with a given percentage NBS, relative to the risk of failure for a new building that has been designed to meet current Building Code criteria (the annual probability of exceedance specified by current earthquake design standards for a building of 'normal' importance is 1/500, or 0.2% in the next year, which is equivalent to 10% probability of exceedance in the next 50 years).

- **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

5. Building Details

5.1. Building description

The building located on this site is comprised of an original structure built as a school in approximately 1920 and an addition to the playcentre built 1997. The building located on this site is comprised of an original structure built as a school in approximately 1920 and an addition to the playcentre built in 1997. Half of the original structure was renovated at the time of the construction of the addition to have modern Gib board ceiling and wall linings. The Scouts Den is run out of the unrenovated west room of the building with the playcentre in the east. The unrenovated west area is lined in tongue and groove boarding. The building is founded on timber piles. The building is founded on timber piles.

Our evaluation was based on architectural drawings for the buildings extension and partial renovation dated March 1997 by Designshop Architectural Services (architects) and partial bracing calculations for the renovations. Structural drawings were not available.

The original building was constructed around 1920.

5.2. Gravity Load Resisting system

Gravity load to the roofs are transferred through the roof purlins and trusses to the light timber framed walls. The floors throughout are timber and transfer loads into timber bearers and 200x200 mm piles.

5.3. Seismic Load Resisting system

For the purposes of this report the longitudinal direction of the building is defined as being the east-west direction and the transverse direction is defined as being in the north-south direction.

Lateral load on the building in both the longitudinal and transverse directions are transferred into the light timber framed walls and carried via shear resistance in the Gib or tongue and groove linings. Wall and floor loads are carried by the piles via cantilever bending.

5.4. Geotechnical Conditions

A geotechnical desktop study was carried out for this site. The main conclusions from this report are:

- Due to the buildings location on a ridgeline the site has been assessed as NZS1170.5 Class C (Shallow soil) from surface geology and estimates as to the depth to rock.
- It is expected that the allowable bearing capacity of a shallow pad footing on this site will be in the region of 200 kPa. We estimate a conservative ultimate bearing capacity to be in the order of 400 kPa. However, these may be revised by a site specific investigation.

- Liquefaction risk is low at this site.

Unless a change of use is intended for the site we do not believe that any further geotechnical investigations are required. Specific ground investigation should be undertaken if significant alterations or new structures are proposed. If any excavations are required on the site further investigation of the potential for contamination should be undertaken. The full geotechnical desktop study can be found in Appendix 4 – Geotechnical Desktop Study

6. Damage Summary

SKM undertook inspections on the 12th of April 2012 and 6th of September 2012. The following areas of damage were observed during the time of inspection:

1) A pile has broken to the east of the main north entry 50mm below ground level.
2) Rot to weatherboard cladding and in places around window frames over the west end of the building which may allow water ingress. This damage is not earthquake damage.
3) Slope of the floor in the west of the building > 1/50 likely requiring re-levelling by jacking and pile packing
4) No connection visible between bearers and piles. One bearer appears to have shifted off centre of the piles. See photo 31
5) Significant cracking through the mass concrete steps at the main entry to the building.

Photos of the above damage can be found in Appendix 1 – Photos.

7. Initial Seismic Evaluation

7.1. The Initial Evaluation Procedure Process

This section covers the initial seismic evaluation of the building as detailed in the NZSEE 'Assessment and Improvement of the Structural Performance of Buildings in Earthquakes'. The IEP grades buildings according to their likely performance in a seismic event. The procedure is not yet recognised by the NZ Building Code but is widely used and recognised by the Christchurch City Council as the preferred method for preliminary seismic investigations of buildings[2].

The IEP is a coarse screening process designed to identify buildings that are likely to be earthquake prone. The IEP process ranks buildings according to how well they are likely to perform relative to a new building designed to current earthquake standards, as shown in Table 2. The building grade is indicated by the percent of the required New Building Standard (%NBS) strength that the building is considered to have. A building is earthquake prone for the purposes of this Act if, having regard to its condition and to the ground on which it is built, and because of its construction, the building—

a) will have its ultimate capacity exceeded in a moderate earthquake (as defined in the regulations); and
b) would be likely to collapse causing—
    i. injury or death to persons in the building or to persons on any other property; or
    ii. damage to any other property.

A moderate earthquake is defined as 'in relation to a building, an earthquake that would generate shaking at the site of the building that is of the same duration as, but that is one-third as strong as, the earthquake shaking (determined by normal measures of acceleration, velocity and displacement) that would be used to design a new building at the site.'

An earthquake prone building will have an increased risk that its strength will be exceeded due to earthquake actions of approximately 10 times (or more) than that of a building having a capacity in excess of 100% NBS (refer Table 1)[3]. Buildings in Christchurch City that are identified as being earthquake prone are required by law to be followed up with a detailed assessment and strengthening work within 30 years of the owner being notified that the building is potentially earthquake prone[4].

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[2] http://resources.ccc.govt.nz/files/EarthquakeProneDangerousAndInsanitaryBuildingsPolicy2010.pdf
[3] NZSEE June 2006, *Assessment and Improvement of the Structural Performance of Buildings in Earthquakes,* p 2-13
[4] http://resources.ccc.govt.nz/files/EarthquakeProneDangerousAndInsanitaryBuildingsPolicy2010.pdf

Table 2: IEP Risk classifications

Description	Grade	Risk	%NBS	Structural performance
Low risk building	A+	Low	> 100	Acceptable. Improvement may be desirable.
	A		100 to 80	
	B		80 to 67	
Moderate risk building	C	Moderate	67 to 33	Acceptable legally. Improvement recommended.
High risk building	D	High	33 to 20	Unacceptable. Improvement required.
	E		< 20	

The IEP is a simple desktop study that is useful for risk management. No detailed calculations are done and so it relies on an inspection of the building and its plans to identify the structural members and describe the likely performance of the building in a seismic event. A review of the plans is also likely to identify any critical structural weaknesses. The IEP assumes that the building was properly designed and built according to the relevant codes at the time of construction. The IEP method rates buildings based on the code used at the time of construction and some more subjective parameters associated with how the building is detailed and so it is possible that %NBS derived from different engineers may differ.

This assessment describes only the likely seismic Ultimate Limit State (ULS) performance of the building. The ULS is the level of earthquake that can be resisted by the building without collapse or other forms of failure. The IEP does not attempt to estimate Serviceability Limit State (SLS) performance of the building, or the level of earthquake that would start to cause damage to the building[5]. This assessment concentrates on matters relating to life safety as damage to the building is a secondary consideration.

The NZ Building Code describes that the relevant codes for determining %NBS are primarily:

- AS/NZS 1170 Structural Design Actions
- NZS 3101:2006 Concrete Structures Standard
- NZS 3404:1997 Steel Structures Standard
- NZS4230:2004 Design of Reinforced Concrete Masonry Structures
- NZS 3603:1993 Timber Structures Standard
- NZS 3604:2011 Timber Framed Buildings

[5] NZSEE 2006, *Assessment and Improvement of the Structural Performance of Buildings in Earthquakes,* p2-9

7.2. Design Criteria and Limitations

Following our inspections on the 12th of April and 6th of September 2012, SKM carried out a preliminary structural review. The structural review was undertaken using the available information which was as follows:

- SKM site measurements and inspection findings of the building. Intrusive investigations were undertaken on the 6th of September 2012.
- Structural drawings were not available

The design criteria used to undertake the assessment include:

- Standard design assumptions for typical office and factory buildings as described in AS/NZS1170.0:2002
  - 50 year design life, which is the default NZ Building Code design life.
  - Structure importance level 2. This level of importance is described as 'normal' with medium or considerable consequence of failure.
  - Ductility level of 1.25, based on our assessment and code requirements at the time of design.
  - Site hazard factor, Z = 0.3, NZBC, Clause B1 Structure, Amendment 11 effective from 1 August 2011

This IEP was based on our visual inspection of the building and a review of the available structural drawings. Since it is not a full design and construction review, it has the following limitations:

- It is not likely to pick up on any original design or construction errors (if they exist)
- Other possible issues that could affect the performance of the building such as corrosion and modifications to the building will not be identified
- The IEP deals only with the structural aspects of the building. Other aspects such as building services are not covered.
- The IEP does not involve a detailed analysis or an element by element code compliance check.

7.3. Survey

Due to the sloping section of floor in the western most room a level survey is recommended to determine if re-levelling via jacking and packing of the piles is necessary in accordance with the DBH guidelines for non-residential buildings.

7.4. Critical Structural Weaknesses

The building has no critical structural weaknesses

7.5. Qualitative Assessment Results

The building has had its capacity assessed using the Initial Evaluation Procedure based on the information available. The buildings capacity excluding critical structural weaknesses and the capacity of any identified weaknesses are expressed as a percentage of new building standard (%NBS) and are in the order of that shown below in Table 3. These capacities are subject to confirmation by a quantitative analysis.

Table 3: Qualitative Assessment Summary

Item	%NBS
Building excluding CSW's	68

Our qualitative assessment found that the building is likely to be classed as a 'Low Risk Building' (capacity greater than 66% of NBS). The full IEP assessment form is detailed in Appendix 2 – IEP Reports.

Further investigation is required to confirm our initial findings and establish possible strengthening concepts.

8. Further Investigation

A level survey of the west end of the building to determine whether relevelling is required in accordance with the DBH guidelines for non-residential buildings.

9. Conclusion

A qualitative assessment was carried out on the building located at 1 J Waipapa Avenue, Diamond Harbour. The building has sustained minor damage to internal linings and hairline cracking to concrete elements, settlement along the west end of the building and a pile which has snapped above ground level.

The building has been assessed to have a seismic capacity in the order of 68% NBS and is therefore not potentially earthquake prone and is likely to be classified as a ‘Low Risk Building’ (capacity greater than 67% of NBS).

No Critical Structural Weaknesses have been identified.

Further investigation is required to confirm our initial findings and to establish possible strengthening concepts. A level survey of the west room should be completed to determine if the sloping section of floor is less than 100mm and can be jacked and packed on top of the piles

It is our opinion that the building may continue to be used without restriction on access.

It is recommended that:

a) The current placard status of the building of green1 remain as is.
b) A level survey should be carried out to determine the need for relevelling. If relevelling is required it is recommended that pile ties are retrofitted to ensure increased compliance with current code.
c) We consider that barriers around the building are not necessary.

10. Limitation Statement

This report has been prepared on behalf of, and for the exclusive use of, SKM’s client, and is subject to, and issued in accordance with, the provisions of the contract between SKM and the Client. It is not possible to make a proper assessment of this report without a clear understanding of the terms of engagement under which it has been prepared, including the scope of the instructions and directions given to, and the assumptions made by, SKM. The report may not address issues which would need to be considered for another party if that party's particular circumstances, requirements and experience were known and, further, may make assumptions about matters of which a third party is not aware. No responsibility or liability to any third party is accepted for any loss or damage whatsoever arising out of the use of or reliance on this report by any third party.

Without limiting any of the above, in the event of any liability, SKM's liability, whether under the law of contract, tort, statute, equity or otherwise, is limited in as set out in the terms of the engagement with the Client.

It is not within SKM’s scope or responsibility to identify the presence of asbestos, nor the responsibility of SKM to identify possible sources of asbestos. Therefore for any property pre-dating 1989, the presence of asbestos materials should be considered when costing remedial measures or possible demolition.

There is a risk of further movement and increased cracking due to subsequent aftershocks or settlement.

Should there be any further significant earthquake event, of a magnitude 5 or greater, it will be necessary to conduct a follow-up investigation, as the observations, conclusions and recommendations of this report may no longer apply Earthquake of a lower magnitude may also cause damage, and SKM should be advised immediately if further damage is visible or suspected.

11. Appendix 1 – Photos

	
Photo 1: Eastern end of the building - Playcentre	Photo 2: West end of the building - Scouts Den
	
Photo 3: View looking west along the north face of the original and unrenovated 1920s building section	Photo 4: Cracking to the concrete steps and concrete slabs around the entry to the building

	
Photo 5: Cracking to the bulk concrete steps	Photo 6: Cracking up to 40mm wide through steps
	
Photo 7: Eastern end of the building at the location of the sloping section	Photo 8: Light timber framed walls with weatherboard cladding.

Photo 9: The buildings weather boards are becoming rotten, especially to the east.

Photo 10: Rotting of the timber window framing

Photo 11: Wall dividing renovated playcentre left of shot and the original scouts den right of shot.

Photo 12: 1920's playcentre main room renovated in 1997

Photo 13: Un-renovated 1920's scouts den looking west

Photo 14: Ditto looking east

Photo 15: Roof lining damage in the NE corner of the scouts den

Photo 16: Close up of damage pictured photo 15

Photo 17: significant slope towards the end wall in the west of the scouts den

Photo 18: Slope approx 1/30

Photo 19: Bearer off centre of pile along the north side of the building

Photo 20: Settled west end of the building.

Photo 21: Pile broken approx 50mm below ground level

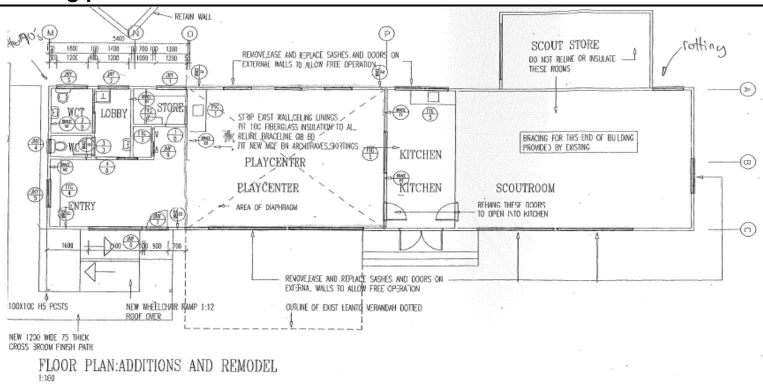
12. Appendix 2 – IEP Reports

Building Name:	Diamond Harbour Play Centre / Scouts Den	Ref.	ZB01276.059
Location:	1 J Waipapa Avenue, Diamond Harbour	By	AFL
		Date	4/02/2013

Step 1 - General Information

1.1 Photos (attach sufficient to describe building)

1.2 Sketch of building plan



1.3 List relevant features

The building located on this site is comprised of an original structure built as a school in approximately 1920 and an addition to the playcentre built in 1997. Half of the original structure was renovated at the time of the construction of the addition to have modern Gib board ceiling and wall linings. The Scouts Den is run out of the unrenovated west room of the building with the playcentre in the east. The unrenovated west area is lined in tongue and groove boarding. The building is founded on timber piles.

1.4 Note information sources

Tick as appropriate

Visual Inspection of Exterior	✓	
Visual Inspection of Interior	✓	
Drawings (note type)	✓	Arch
Specifications		
Geotechical Reports		
Other (list)	✓	

GIB Bracing calculations from 1997 for the east end of the building to NZS 3604 1990. Assuming west end contributes nothing to the bracing system the building is at 66% by current standards. If the 200mm x 200mm square subfloor piles can be considered to act as modern piles the subfloor reaches 100%. One Pile is damage and will need repair / replacement.

Building Name:	Diamond Harbour Play Centre / Scouts Den	Ref.	ZB01276.059
Location:	1 J Waipapa Avenue, Diamond Harbour	By	AFL
Direction Considered:	**Longitudinal & Transverse**	Date	4/02/2013

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

Step 2 - Determination of (%NBS)b

2.1 Determine nominal (%NBS) = (%NBS)nom

Pre 1935			○	See also notes 1, 3
1935-1965			○	
1965-1976	Seismic Zone;	A	○	
		B	○	
		C	○	See also note 2
1976-1992	Seismic Zone;	A	○	
		B	◉	
		C	○	
1992-2004			○	

b) Soil Type

From NZS1170.5:2004, Cl 3.1.3

A or B Rock	○
C Shallow Soil	◉
D Soft Soil	○
E Very Soft Soil	○

From NZS4203:1992, Cl 4.6.2.2 (for 1992 to 2004 only and only if known)

a) Rigid	○	N-A
b) Intermediate	○	

c) Estimate Period, T

building Ht = 5 meters

Ac = (Longitudinal) (Transverse) m2

Can use following:

		Longitudinal		Transverse	
$T = 0.09h_n^{0.75}$	for moment-resisting concrete frames	○	MRCF	○	MRCF
$T = 0.14h_n^{0.75}$	for moment-resisting steel frames	○	MRSF	○	MRSF
$T = 0.08h_n^{0.75}$	for eccentrically braced steel frames	○	EBSF	○	EBSF
$T = 0.06h_n^{0.75}$	for all other frame structures	◉	Others	◉	Others
$T = 0.09h_n^{0.75}/A_c^{0.5}$	for concrete shear walls	○	CSW	○	CSW
T <= 0.4sec	for masonry shear walls	○	MSW	○	MSW

Where hn = height in m from the base of the structure to the uppermost seismic weight or mass.

Ac = ΣAi(0.2 + Lwi/hn)2

Ai = cross-sectional shear area of shear wall i in the first storey of the building, in m2

lwi = length of shear wall i in the first storey in the direction parallel to the applied forces, in m with the restriction that lwi/hn shall not exceed 0.9

Longitudinal	Transverse	
0.2	0.2	Seconds

d) (%NBS)nom determined from Figure 3.3

Longitudinal	21	$(\%NBS)_{nom}$
Transverse	21	$(\%NBS)_{nom}$

			Factor
Note 1:	For buildings designed prior to 1965 and known to be designed as public buildings in accordance with the code of the time, multiply (%NBS)nom by 1.25.	No	1
	For buildings designed 1965 - 1976 and known to be designed as public buildings in accordance with the code of the time, multiply (%NBS)nom by 1.33 - Zone A or 1.2 - Zone B	No	1
Note 2:	For reinforced concrete buildings designed between 1976 -1984 (%NBS)nom by 1.2	No	1
Note 3:	For buildings designed prior to 1935 multiply (%NBS)nom by 0.8 except for Wellington where the factor may be taken as 1.	No	1

Longitudinal	21.0	$(\%NBS)_{nom}$
Transverse	21.0	$(\%NBS)_{nom}$

Continued over page

Building Name:	Diamond Harbour Play Centre / Scouts Den	Ref.	ZB01276.059
Location:	1 J Waipapa Avenue, Diamond Harbour	By	AFL
Direction Considered:	**Longitudinal & Transverse**	Date	4/02/2013

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

2.2 Near Fault Scaling Factor, Factor A

If T < 1.5sec, Factor A = 1

a) Near Fault Factor, N(T,D) 1
(from NZS1170.5:2004, Cl 3.1.6)

b) Near Fault Scaling Factor = 1/N(T,D) **Factor A** 1.00

2.3 Hazard Scaling Factor, Factor B

Select Location: Christchurch

a) Hazard Factor, Z, for site
(from NZS1170.5:2004, Table 3.3)

Z = 0.3
Z 1992 = 0.8

Auckland	0.6	Palm Nth	1.2
Wellington	1.2	Dunedin	0.6
Christchurch	0.8	Hamilton	0.67

b) Hazard Scaling Factor

For pre 1992 = 1/Z
For 1992 onwards = Z 1992/Z

(Where Z 1992 is the NZS4203:1992 Zone Factor from accompanying Figure 3.5(b))

Factor B 3.33

2.4 Return Period Scaling Factor, Factor C

a) Building Importance Level 2
(from NZS1170.0:2004, Table 3.1 and 3.2)

b) Return Period Scaling Factor from accompanying Table 3.1 **Factor C** 1.00

2.5 Ductility Scaling Factor, D

a) Assessed Ductility of Existing Structure, μ
(shall be less than maximum given in accompanying Table 3.2)

Longitudinal 1.25 μ Maximum = 6
Transverse 1.25 μ Maximum = 6

b) Ductility Scaling Factor

For pre 1976 = k_μ
For 1976 onwards = 1
(where k_μ is NZS1170.5:2005 Ductility Factor, from accompanying Table 3.3)

Longitudinal	**Factor D**	1.00
Transverse	**Factor D**	1.00

2.6 Structural Performance Scaling Factor, Factor E

Select Material of Lateral Load Resisting System

Longitudinal Timber
Transverse Timber

a) Structural Performance Factor, S_p
from accompanying Figure 3.4

Longitudinal Sp 0.93
Transverse Sp 0.93

b) Structural Performance Scaling Factor

Longitudinal $1/S_p$ **Factor E** 1.08
Transverse $1/S_p$ **Factor E** 1.08

2.7 Baseline %NBS for Building, $(\%NBS)_b$

(equals $(\%NSB)_{nom}$ x A x B x C x D x E)

Longitudinal	75.7	(%NBS)b
Transverse	75.7	(%NBS)b

Table IEP-3 Initial Evaluation Procedure – Step 3

(Refer Table IEP - 1 for Step 1; Table IEP - 2 for Step 2, Table IEP - 4 for Steps 4, 5 and 6)

Building Name:	Diamond Harbour Play Centre / Scouts Den	Ref.	ZB01276.059
Location:	1 J Waipapa Avenue, Diamond Harbour	By	AFL
Direction Considered:	**a) Longitudinal**	Date	4/02/2013

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

Step 3 - Assessment of Performance Achievement Ratio (PAR)

(Refer Appendix B - Section B3.2)

Critical Structural Weakness | **Effect on Structural Performance** (Choose a value - Do not interpolate) | **Building Score**

3.1 Plan Irregularity

	Severe	Significant	Insignificant		
Effect on Structural Performance	○	○	◉	**Factor A**	1
Comment					

3.2 Vertical Irregularity

	Severe	Significant	Insignificant		
Effect on Structural Performance	○	○	◉	**Factor B**	1
Comment					

3.3 Short Columns

	Severe	Significant	Insignificant		
Effect on Structural Performance	○	○	◉	**Factor C**	1
Comment					

3.4 Pounding Potential

(Estimate D1 and D2 and set D = the lower of the two, or =1.0 if no potential for pounding)

a) Factor D1: - Pounding Effect

Select appropriate value from Table

Note:
Values given assume the building has a frame structure. For stiff buildings (eg with shear walls), the effect of pounding may be reduced by taking the co-efficient to the right of the value applicable to frame buildings.

Factor D1 1

Table for Selection of Factor D1	Severe	Significant	Insignificant
Separation	0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Alignment of Floors within 20% of Storey Height	○ 0.7	○ 0.8	◉ 1
Alignment of Floors not within 20% of Storey Height	○ 0.4	○ 0.7	○ 0.8

b) Factor D2: - Height Difference Effect

Select appropriate value from Table

Factor D2 1

Table for Selection of Factor D2	Severe	Significant	Insignificant
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

Factor D 1

(Set D = lesser of D1 and D2 or..
set D = 1.0 if no prospect of pounding)

3.5 Site Characteristics - (Stability, landslide threat, liquefaction etc)

	Severe	Significant	Insignificant		
Effect on Structural Performance	○ 0.5	○ 0.7	◉ 1	**Factor E**	1

3.6 Other Factors

For < 3 storeys - Maximum value 2.5,

otherwise - Maximum value 1.5. No minimum. **Factor F** 0.9

Record rationale for choice of Factor F:

Adjustment as per bracing calcs 1.06 * approximated 0.85 due to broken pile (not likley EQ damage) = 1.06*0.85 ~= 0.9

3.7 Performance Achievement Ratio (PAR)
(equals A x B x C x D x E x F) **PAR** 0.9

(Refer Table IEP - 1 for Step 1; Table IEP - 2 for Step 2, Table IEP - 4 for Steps 4, 5 and 6)

Building Name:	Diamond Harbour Play Centre / Scouts Den	Ref.	ZB01276.059
Location:	1 J Waipapa Avenue, Diamond Harbour	By	AFL
Direction Considered:	**b) Transverse**	Date	4/02/2013

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

Step 3 - Assessment of Performance Achievement Ratio (PAR)

(Refer Appendix B - Section B3.2)

Critical Structural Weakness

Effect on Structural Performance (Choose a value - Do not interpolate) — **Building Score**

3.1 Plan Irregularity

Effect on Structural Performance	Severe	Significant	Insignificant	
	○	○	◉	**Factor A** 1
Comment				

3.2 Vertical Irregularity

Effect on Structural Performance	Severe	Significant	Insignificant	
	○	○	◉	**Factor B** 1
Comment				

3.3 Short Columns

Effect on Structural Performance	Severe	Significant	Insignificant	
	○	○	◉	**Factor C** 1
Comment				

3.4 Pounding Potential

(Estimate D1 and D2 and set D = the lower of the two, or =1.0 if no potential for pounding)

a) Factor D1: - Pounding Effect

Select appropriate value from Table

Note:
Values given assume the building has a frame structure. For stiff buildings (eg with shear walls), the effect of pounding may be reduced by taking the co-efficient to the right of the value applicable to frame buildings.

Factor D1 1

Table for Selection of Factor D1

	Severe	Significant	Insignificant
Separation	0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Alignment of Floors within 20% of Storey Height	○ 0.7	○ 0.8	◉ 1
Alignment of Floors not within 20% of Storey Height	○ 0.4	○ 0.7	○ 0.8

b) Factor D2: - Height Difference Effect

Select appropriate value from Table

Factor D2 1

Table for Selection of Factor D2

	Severe	Significant	Insignificant
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

Factor D 1

(Set D = lesser of D1 and D2 or..
set D = 1.0 if no prospect of pounding)

3.5 Site Characteristics - (Stability, landslide threat, liquefaction etc)

Effect on Structural Performance	Severe	Significant	Insignificant	
	○ 0.5	○ 0.7	◉ 1	**Factor E** 1

3.6 Other Factors

For < 3 storeys - Maximum value 2.5,

otherwise - Maximum value 1.5. No minimum. **Factor F** 1.06

Record rationale for choice of Factor F:

Adjustment to informative bracing calcs 1.06

3.7 Performance Achievement Ratio (PAR)
(equals A x B x C x D x E x F) **PAR** 1.06

Table IEP-4

Initial Evaluation Procedure – Steps 4, 5 and 6

(Refer Table IEP - 1 for Step 1; Table IEP - 2 for Step 2, Table IEP - 3 for Step 3)

Building Name:	Diamond Harbour Play Centre / Scouts Den	Ref.	ZB01276.059
Location:	1 J Waipapa Avenue, Diamond Harbour	By	AFL
Direction Considered:	**Longitudinal & Transverse**	Date	4/02/2013

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

Step 4 - Percentage of New Building Standard (%NBS)

	Longitudinal	Transverse
4.1 Assessed Baseline (%NBS)$_b$ (from Table IEP - 1)	75	75
4.2 Performance Achievement Ratio (PAR) (from Table IEP - 2)	0.90	1.06
4.3 PAR x Baseline (%NBS)$_b$	68	80
4.4 Percentage New Building Standard (%NBS) (Use lower of two values from Step 4.3)		68

Step 5 - Potentially Earthquake Prone?
(Mark as appropriate)

%NBS ≤ 33 — NO

Step 6 - Potentially Earthquake Risk?

%NBS < 67 — NO

Step 7 - Provisional Grading for Seismic Risk based on IEP

Seismic Grade — B

Evaluation Confirmed by

[signature] Signature

Nick Calvert — Name

242062 — CPEng. No

Relationship between Seismic Grade and % NBS :

Grade:	A+	A	B	C	D	E
%NBS:	> 100	100 to 80	80 to 67	67 to 33	33 to 20	< 20

13. Appendix 3 – CERA Standardised Report Form

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Diamond Harbour Hall Playcentre Scouts Den
Building Address:	Unit: / No: 1J / Street: Waipapa Avenue
Legal Description:	
GPS south:	Degrees / Min / Sec:
GPS east:	
Building Unique Identifier (CCC):	
Reviewer:	Nick Calvert
CPEng No:	242062
Company:	Sinclair Knight Merz
Company project number:	ZB01276.059
Company phone number:	027 320 7967
Date of submission:	4/02/2013
Inspection Date:	6/09/2012
Revision:	B
Is there a full report with this summary?	yes

Site

Site slope:	slope < 1in 10
Soil type:	
Site Class (to NZS1170.5):	C
Proximity to waterway (m, if <100m):	
Proximity to clifftop (m, if < 100m):	90
Proximity to cliff base (m,if <100m):	
Max retaining height (m):	
Soil Profile (if available):	
If Ground improvement on site, describe:	
Approx site elevation (m):	50.00

Building

No. of storeys above ground:	1 (single storey = 1)
Ground floor split?	no
Storeys below ground	0
Foundation type:	timber piles
Building height (m):	5.00
Floor footprint area (approx):	148
Age of Building (years):	93
Ground floor elevation (Absolute) (m):	50.00
Ground floor elevation above ground (m):	0.30
if Foundation type is other, describe:	
height from ground to level of uppermost seismic mass (for IEP only) (m):	5
Date of design:	Pre 1935
Strengthening present?	
If so, when (year)?	1997
And what load level (%g)?	
Brief strengthening description:	Timber building addition and half of the building relined
Use (ground floor):	educational
Use (upper floors):	
Use notes (if required):	
Importance level (to NZS1170.5):	IL2

Gravity Structure

Gravity System:	load bearing walls
Roof:	timber framed
Floors:	timber
Beams:	
Columns:	
Walls:	
rafter type, purlin type and cladding	100x50, 75x50 purlins, profiled metal roof cladding
joist depth and spacing (mm)	120/x50 @ 500 crs

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	lightweight timber framed walls	note typical wall length (m)	24
Ductility assumed, μ:	1.25		
Period along:	0.20 (0.00)	estimate or calculation?	estimated
Total deflection (ULS) (mm):	20	estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	20	estimate or calculation?	estimated
Lateral system across:	lightweight timber framed walls	note typical wall length (m)	6
Ductility assumed, μ:	1.25		
Period across:	0.30 (0.00)	estimate or calculation?	estimated
Total deflection (ULS) (mm):	30	estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	30	estimate or calculation?	estimated

Separations:

leave blank if not relevant

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

Non-structural elements

Stairs:			
Wall cladding:	other light	describe	Timber weatherboards
Roof Cladding:	Metal	describe	Corrugated steel
Glazing:	timber frames		
Ceilings:	fibrous plaster, fixed		
Services(list):			

Available documentation

Architectural	partial	original designer name/date	Designshop architectural services 1997. addition and partial renovation
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:	Damage to a central pile along the north. Settlement of the west end, may be pre existing
Settlement:	25-100m	notes (if applicable):	West end of scouts room only
Differential settlement:		notes (if applicable):	
Liquefaction:	none apparent	notes (if applicable):	
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	moderate to substantial (1 in 5)	notes (if applicable):	Stoddard Cottage and Godley House have sustained hea

Building:

Current Placard Status:	green		
Along — Damage ratio:	0%	Describe how damage ratio arrived at:	Cracked pile and settlement unlikely to effect wider building capacity
Describe (summary):			
Across — Damage ratio:	0%		
Describe (summary):			
Diaphragms — Damage?:	no	Describe:	
CSWs: — Damage?:	no	Describe:	
Pounding: — Damage?:	no	Describe:	
Non-structural: — Damage?:	yes	Describe:	external concrete areas and steps

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

Recommendations

Level of repair/strengthening required:	minor structural	Describe:	Pile repair / replacement and jacking of the bearers to the west to releve
Building Consent required:	no	Describe:	
Interim occupancy recommendations:	full occupancy	Describe:	
Along — Assessed %NBS before:	68%	%NBS from IEP below	
Assessed %NBS after:	68%	If IEP not used, please detail assessment methodology:	GIB Ezybrace spreadsheet in conjunction with 1997 bracing calcs from renovatior
Across — Assessed %NBS before:	80%	%NBS from IEP below	
Assessed %NBS after:	80%		

14. Appendix 4 – Geotechnical Desktop Study

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Christchurch City Council - Structural Engineering Service

Geotechnical Desk Study

SKM project number	ZB01276
SKM project site number	059
Address	Diamond Harbour Playcentre/Scout Den 1J Waipapa Avenue
Report date	12 June 2012
Author	Ananth Balachandra
Reviewer	Leah Bateman
Approved for issue	Yes

1. Introduction

This report outlines the geotechnical information that Sinclair Knight Merz (SKM) has been able to source from our database and other sources in relation to the property listed above. We understand that this information will be used as part of an initial qualitative DEE, and will be supplemented by more detailed information and investigations to allow detailed scoping of the repair or rebuild of the building.

2. Scope

This geotechnical desk top study incorporates information sourced from:

- Published geology
- Publically available borehole records
- Liquefaction records
- Aerial photography
- Council files
- A preliminary site walkover

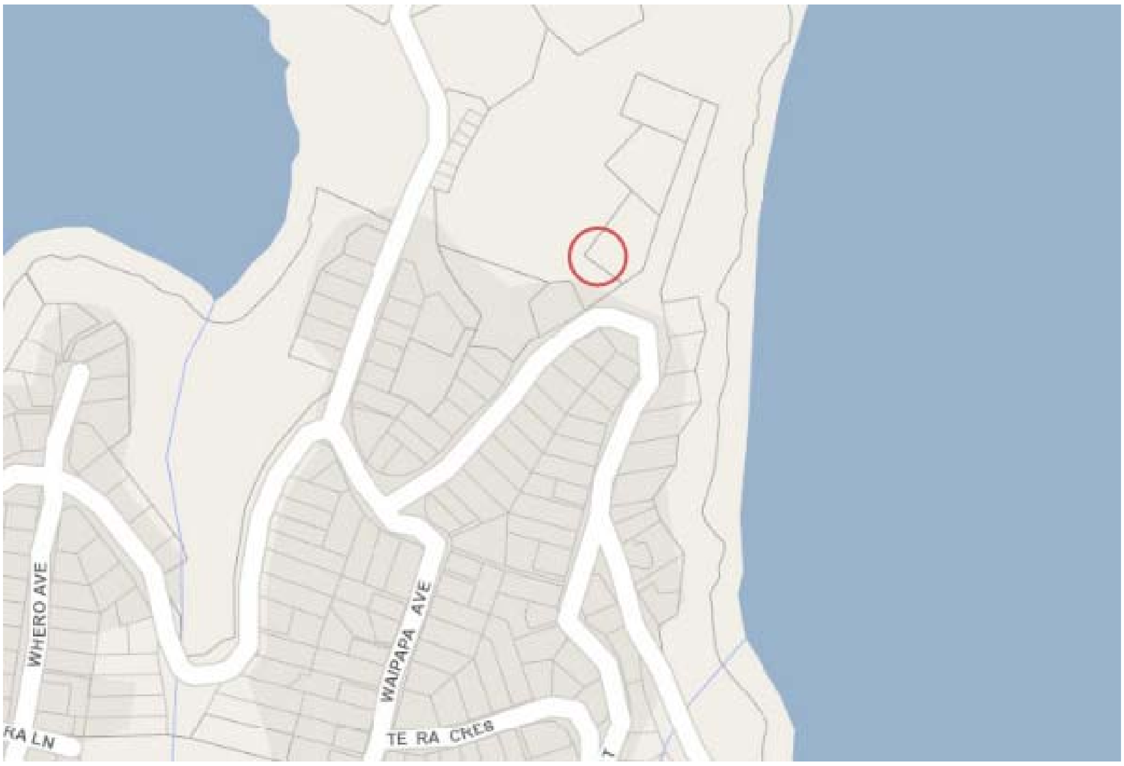
3. Limitations

This report was prepared to address geotechnical issues relating to the specific site in accordance with the scope of works as defined in the contract between SKM and our Client. This report has been prepared on behalf of, and for the exclusive use of, our Client, and is subject to, and issued in accordance with, the provisions of the contract between SKM and our Client. The findings presented in this report should not be applied to another site or another development within the same site without consulting SKM.

The assessment undertaken by SKM was limited to a desktop review of the data described in this report. SKM has not undertaken any subsurface investigations, measurement or testing of materials from the site. In preparing this report, SKM has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by our Client, and from other sources as described in the report. Except as otherwise stated in this report, SKM has not attempted to verify the accuracy or completeness of any such information.

This report should be read in full and no excerpts are to be taken as representative of the findings. It must not be copied in parts, have parts removed, redrawn or otherwise altered without the written consent of SKM.

4. Site location

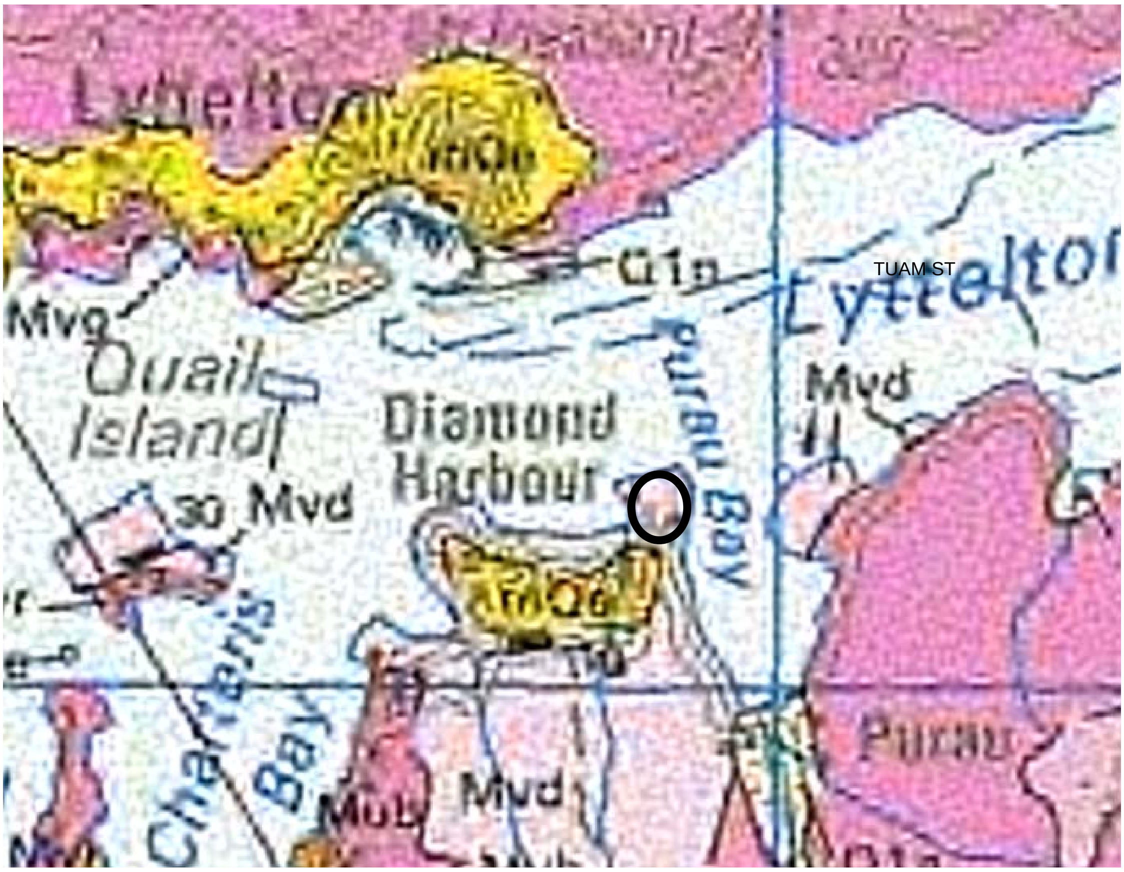


- **Figure 1 – Site location (courtesy of LINZ http://viewers.geospatial.govt.nz)**

These structures are located on 1J Waipapa Avenue at grid reference 1579159 E, 5169622 N (NZTM).

5. Review of available information

5.1 Geological maps



- **Figure 2 – Regional geological map (Forsyth et al, 2008). Site marked in black.**

From the regional geological map, the site is shown to be underlain by basaltic lava flows, dikes, silts, vent plugs and a dome. Additionally, there is minor presence of breccia, conglomerate, sandstone and carbonaceous mudstone.

5.2 Liquefaction map

Following the 22 February 2011 event drive through reconnaissance was undertaken from 23 February until 1 March by M Cubrinovsko and M Taylor of Canterbury University. However, the reconnaissance did not extend to this area.

Due to the presence of mainly basaltic lava flows, the area is unlikely to be susceptible to liquefaction.

5.3 Aerial photography

Aerial photography of the Christchurch region following the 22nd February earthquakes available on viewers.geospatial.govt.nz website did not extend to the location of the site.

5.4 CERA classification

A review of the LINZ website (http://viewers.geospatial.govt.nz/) shows that the site is:

- Zone: Green
- DBH Technical Category: N/A (Port Hills and Banks Peninsula)

5.5 Historical land use

Historical land use for the site was not available during the preparation of the desk study.

5.6 Existing ground investigation data

No usable ground investigation data near the site was available.

5.7 Council property files

Council files were not available for the site at the time of writing this report.

5.8 Site walkover

An external inspection of the site was conducted by a SKM engineer in the week commencing 9 April 2012.

The Diamond Harbour playcentre and scout den buildings were observed to be timber constructions supported on perimeter ring beam and internal timber piles. The building was located on a flat crest of a rolling hill. There was no visible sign of liquefied material ejected at surface or evidence of land damage during the external inspection of the site.

6. Conclusions and recommendations

6.1 Site geology

An inference of the site geology has not been made in this desk study due to the lack of geotechnical investigation data.

However, it is expected that beneath a top soil layer, the site is likely to be underlain by volcanic sediments and volcanic rock. Additional, investigations are required to confirm the geology.

6.2 Seismic site subsoil class

The site has been assessed as being either Class B (rock) or Class C (shallow soil) as described in NZS1170.5. Further investigation would be needed to confirm the depth of the surface soil. Until such investigations have been undertaken, Class C should be used as a conservative seismic site subsoil class.

As described in NZS1170, the preferred site classification method is from site periods based on four times the shear wave travel time through material from the surface to the underlying rock. The next preferred methods are from borelogs including measurement of geotechnical properties or by evaluation of site periods from Nakamura ratios or from recorded earthquake motions. Lacking this information, classification may be based on boreholes with descriptors but no geotechnical measurements. The least preferred method is from surface geology and estimates of the depth to underlying rock.

As no borehole information was available near site, the least preferred method has been used to assess the seismic site subsoil class. Further site specific study could result in a revision to the assessed site subsoil class.

6.3 Building performance

The performance to date suggests that the existing foundations of the structure are adequate for their current purpose.

6.4 Ground performance and properties

Liquefaction risk appears to be low for this site. The basaltic lava flows underlying the site inferred from the regional geological map is not susceptible to liquefaction. However, further investigation is needed to determine the composition and depth of the surface material in order to confirm the above liquefaction assessment.

Design parameter recommendations have not been made for this site as no historical ground investigation data was available near the site.

6.5 Further investigations

In order to confirm the sub-soil class, provide material characteristics or evaluate liquefaction potential, further ground investigations are required. These may be required as part of the building consent for any repair or strengthening works. Additional investigations recommended are:

- Two trial pits to a depth of up to 5m to assess surface soil composition and to determine if underlying rock is present at shallow depth
- If rock layer is not encountered at a depth of 5m, one borehole to a depth of 15m or into 3m of competent rock maybe required. However, this investigation would not be necessary if a borehole investigation had already been conducted near the neighbouring Diamond Harbour Community Building

7. References

Brown LJ, Weeber JH, 1992. Geology of the Christchurch urban area. Scale 1:25,000. Institute of Geological & Nuclear Sciences geological map 1.

Cubrinovski & Taylor, 2011. Liquefaction map summarising preliminary assessment of liquefaction in urban areas following the 2010 Darfield Earthquake.

Forsyth PJ, Barrell DJA, Jongens R, 2008. Geology of the Christchurch area. Institute of Geological & Nuclear Sciences geological map 16.

Land Information New Zealand (LINZ) geospatial viewer (http://viewers.geospatial.govt.nz/)

EQC Project Orbit geotechnical viewer (https://canterburyrecovery.projectorbit.com/)

15. Conceptual calculations to inform IEP

SKM

Job No. ZB01276.59
Calc. Series Qualitative

Client Christchurch City Council — Page 01

Job Name Diamond Harbour Playcentre/Scouts Den — By AFL

Calcs Title Bracing check — Date 10/01/13

Renovation of the Playcentre in March 97 included replacing half the buildings linings and adding an addition to the east.

The GIB calculations next page are for the Playcentre only and do not include the scouts room.

The unrenovated scouts den walls are tongue & groove and will contribute to the bracing resistance.

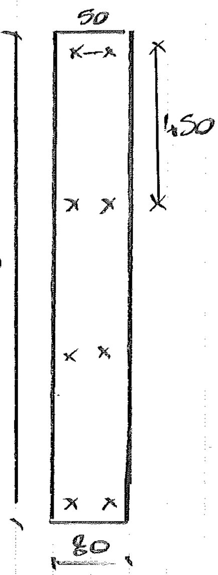
In the transverse direction the length of T & G walls is 5m on the west wall and 5 m along the partition

From the NZSEE "Assessment & improvement of the structural performance of buildings in earthquakes."

Appendix 11D.1 Timber shear wall strength

Tongue & groove friction assumed negligable

$$V = \frac{Fn \cdot S \cdot B}{b \, l}$$



where

B = Length of wall = 5+5 = 10m
b = width of board = 80 mm
S = spacing between nail lines = 50 mm
l = height between nail groups = (1350 − 450) = 900mm
Fn = Nail capacity in shear
= 0.631 for a 3.15mm Ø nail × nails
= 0.631 × 2
= 1.262 KN

$$V = \frac{1.262^{KN} \times 0.05\,m \times 10m}{(1.35 - 0.45) \times 0.08m}$$

= 8.76 KN

BU = V × 20 BU/KN

= 8.76 × 20

= 175.3 BU

(Bracing design calcs from 1997 renovation)

WIND BRACING CALCULATIONS FROM NZS 3604 1990

PROJECT DIAMOND HARBOR PLAYCENTER

BRACE LOCATION	WIND ZONE:	EQ ZONE	ROOF WT:	ROOF DEG:	WALL WEIGHT	HEIGHTS: ROOF	OVERALL	STUD:
SINGLE	HIGH	B	LITE	27.5	LITE	2	5	2.4 & 3.0

ASSUMPTION:SCOUTRROOM END OF BUILDING IS ADEQUATE BY HISTORICAL PERFORMANCE AND IS NOT BEING AFFECTED BY ALTERATIONS. PLAYCENTER & ADDITION DESIGNED TO NZS3604 1990

BRACELINE DIAPHRAGM OVER PLAYCENTRE MAX DIMENSION />7500

BRACE ELEMENTS ON LINE 0,P HAVE BEEN ADJUSTED BY 0.8 TO ALLOW FOR 3M STUD HEIGHT

EQ LOAD M2	AREA M2	BLDG DIM →	WIND/M →	BLDG DIM ↓	WIND/M ↓
2	77	12.7	64	6.1	64

	BRACE LINE LABEL	MIN B/U REQD	LGTH (M)	TYPE REFER MNFR DATA	RATE/M EQUAKE BU	WIND BU	TOTAL BU EQUAKE BU	WIND BU
BRACE DIRECTION →	A1	126	1.4	BR5 1.2>2.4	85	115	119	161
	A2		1.5	BR5 1.2>2.4	85	115	127.5	172.5
	B1	70	1.8	BR6 1.2>2.4	110	150	198	270
	C1	126	1.6	BR5 1.2>2.4	85	115	136	184
	C2		1.6	BR5 1.2>2.4	85	115	136	184
	TOTAL ACHEIVED						**716.5**	**971.5**
	TOTAL REQUIRED						**154**	**390.4**

	BRACE LINE LABEL	MIN B/U REQD	LGTH (M)	TYPE REFER MNFR DATA	RATE/M EQUAKE BU	WIND BU	TOTAL BU EQUAKE BU	WIND BU
BRACE ↓	M1	61	1.8	GB1 1.8>2.4	50	55	90	99
	N1	70	2.7	GIB2 >2.4	70	80	189	216
	O1	70	2.7	GIB2 >2.4	70	80	151.2	172.8
	P1	70	1.7	BR6 1.2>2.4	110	150	149.6	204
	P2		1.2	BR6 1.2>2.4	110	150	105.6	144
	TOTAL ACHEIVED						**685.4**	**835.8**
	TOTAL REQUIRED						**154**	**812.8**

Bracing current demand

03

GIB EzyBrace® 2011 Software

GIB

Demand Calculation Sheet

single storey

V06/11

Job Details

Name	Diamond Harbour Playcentre / Scouts Den
Street and Number	1J Waipapa Avenue
Lot and DP Number	
City/Town/District	Diamond Harbour, Canterbury
Designer	A Langsford
Company Name	Sinclair Knight Merz
Date	9/01/2013

BRANZ Appraised
Appraisal No.294 [2011]

Select Lining Option: 10 or 13 mm GIB® Plasterboard

Building Specification

Number of storeys	single
Floor Loading	3kPa
Foundation Type	subfloor
Cladding Weight (subfloor)	medium

	Single Floor	Complete Single Floor Column only
Cladding Weight	light	
Roof Weight	light	
Room in Roof Space	no	
Roof Pitch (degrees)	28	25
Roof height above eaves (m)	1.0	1.0
Building height to apex (m)	5.0	
Ground to lower floor level (m)	0.3	
		3.0
Stud Height (m)	3.0	2.4
Building Length (m)	24.3	20.0
Building Width (m)	6.1	10.0
Building Plan Area (m2)	148	200

Building Location

Wind Zone	***High***
Select by Building Consent Authority Map or Preference	High
Wind Region	Preference selected
Lee Zone	Preference selected
Ground Roughness	Preference selected
Site Exposure	Preference selected
Topographic Class	Preference selected

Earthquake Zone: 2

Soil Type: C (shallow)

Annual exceedance probability: 1/500 (NZS3604:2011 default)

Bracing Units required for Wind

Demand W (BU)	subfloor	Walls single
along	709	383
across	2305	1167

Bracing Units required for Earthquake

Demand along / across E (BU)	
subfloor	Walls single
1205	1072

Diamond Harbour Playcentre / Scouts Den A Langsford

GIB EzyBrace® 2011 Software

Subfloor Bracing Calculation Sheet					**Subfloor Along**		V06/11
Along							
Bracing Line		*Bracing Elements provided*				*Wind*	*Earthq.*
1	2	3	4	5	6	8W	9EQ
Line Label	Minimum BUs Req/Ach	Bracing Element No.	Supplier	Bracing Type	Number or Length L (m)	BUs Achieved	BUs Achieved
a	*line totals*	1	NZS3604	cantilever pile	16	1120	480
W	1120	2					
EQ	480	3					
b	*line totals*	1	NZS3604	cantilever pile	16	1120	480
W	1120	2					
EQ	480	3					
c	*line totals*	1	NZS3604	cantilever pile	16	1120	480
W	1120	2					
EQ	480	3					
	line totals		NZS3604	cantilever pile			
W							
EQ							
	line totals		NZS3604	cantilever pile			
W							
EQ							
	line totals		NZS3604	cantilever pile			
W							
EQ							
	line totals		NZS3604	cantilever pile			
W							
EQ							
	line totals		NZS3604	cantilever pile			
W							
EQ							
	line totals		NZS3604	cantilever pile			
W							
EQ							
	line totals		NZS3604	cantilever pile			
W							
EQ							

						Wind	Earthq.
Totals Achieved						3360	1440
						OK	*OK*
Totals Required (from Sheet A)						709	1205

Diamond Harbour Playcentre / Scouts Den A Langsford

GIB EzyBrace® 2011 Software

Subfloor Bracing Calculation Sheet					**Subfloor Across**		V06/11
Along							
Bracing Line		*Bracing Elements provided*				*Wind*	*Earthq.*
1	2	3	4	5	6	8W	9EQ
Line Label	Minimum BUs Req/Ach	Bracing Element No.	Supplier	Bracing Type	Number or Length L (m)	BUs Achieved	BUs Achieved
m	*line totals*	1	NZS3604	cantilever pile	16	1120	480
W	1120	2					
EQ	480	3					
n	*line totals*	1	NZS3604	cantilever pile	16	1120	480
W	1120	2					
EQ	480	3					
o	*line totals*	1	NZS3604	cantilever pile	16	1120	480
W	1120	2					
EQ	480	3					
	line totals						
W							
EQ							
	line totals						
W							
EQ							
	line totals						
W							
EQ							
	line totals						
W							
EQ							
	line totals						
W							
EQ							
	line totals						
W							
EQ							
	line totals						
W							
EQ							

		Wind	Earthq.
Totals Achieved		3360	1440
		OK	*OK*
Totals Required (from Sheet A)		2305	1205

SKM

Job No.	ZB01276.SP
Calc. Series	Qualitative
Client	Christchurch City Council
Page	06
Job Name	Diamond Harbour Playcentre/Scouts Den
By	AFL
Calcs Title	Bracing check
Date	10/01/13

Walls

From page 03

The earthquake demand for the walls is 1072 BU

Capacity = Renovated capacity + Original area capacity

= 685.4 from page 02 + 175.3 from page 01

= 860.7 BU

% NBS = $\frac{\text{Capacity}}{\text{Demand}} \times 100$

= $\frac{860.7}{1072} \times 100$

≈ 80%

Subfloor

From page 03 subfloor demand is 1205 BU

Based on 3 rows of piles x 16 piles per row (piles spaced @ 1250 mm x 1250 mm)

Capacity along = 1440 BU from page 4

Across = 1440 BU from page 5

Subfloor NBS = $\frac{1440}{1205} \times 100$ => 100%