CHRISTCHURCH CITY COUNCIL

PRO 1017 B001
Opawa Children's Library
Louisson Place, Opawa

QUANTITATIVE ASSESSMENT REPORT

FINAL

- Rev C
- 11 February 2014

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Sinclair Knight Merz
142 Sherborne Street
Saint Albans
PO Box 21011, Edgeware
Christchurch, New Zealand
Tel: +64 3 940 4900
Fax: +64 3 940 4901
Web: www.skmconsulting.com

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Approval

	Signature	Date	Name	Title
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1. Executive Summary

1.1. Background

A Quantitative Assessment was carried out on the Opawa Children's Library located on Ford Road, Opawa. This building is a small single story timber framed structure. An aerial photograph illustrating the buildings location is shown below in Figure 1. Detailed descriptions outlining the buildings age and construction type is given in Section 5 of this report.

- Figure 1 Aerial Photograph of Opawa Children's Library

This Quantitative report for the building structure is based on the Engineering Advisory Group's "Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings" (draft) July 2011, visual inspections on 29th March 2012, intrusive investigations 15th August 2012, 4th December 2012, 5th February 2013 and survey drawings prepared by SKM.

1.2. Key Damage Observed

Key damage observed includes:-

- External hairline cracks around the weatherboard joints, fascia board joints and soffit lining joints
- Internal hairline cracks around the tongue and groove joints, ceiling lining joints and mitre joints.

A more detailed account of the damage can be found in section 5.

1.3. Critical Structural Weaknesses

No critical structural weaknesses for the building were observed during our visual inspection.

1.4. Indicative Building Strength

As described in the Engineering Advisory Group's "Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings" (draft) July 2011, we have assessed the capacity of the building as a percentage new building standard seismic resistance using the quantitative method. Our assessment included consideration of geotechnical conditions, existing earthquake damage to the building and structural engineering calculations to assess both strength and ductility/resilience.

The assessments were based on the following:

- On-site investigation to assess the extent of existing earthquake damage including limited intrusive investigation.
- Qualitative assessment of critical structural weaknesses (CSWs) based on review of available structural drawings and inspection where drawings were not available.
- No intrusive geotechnical investigation has been undertaken. We have based this report on our desktop geotechnical investigation.
- Assessment of the strength of the existing structures taking account of the current condition.

Any building that is found to have a seismic capacity less than 33% of the New Building Standard (NBS) is required to be strengthened up to a capacity of at least 67%NBS in order to comply with Christchurch City Council (CCC) policy - Earthquake-prone dangerous & insanitary buildings policy 2010

The building's original capacity has been assessed to be 34%NBS and post earthquake capacity 34%NBS. This assessment has been made without original structural drawings and is accordingly limited.

The building has a seismic capacity in the order of 34% NBS and is therefore considered a Grade C, Moderate risk building. It is important to note that 34% NBS is very close to 33% NBS which would make it earthquake prone. The quantitative assessment is a post-construction assessment and, although it is more accurate than the qualitative assessment, it is still imperfect. The client may wish to consider this building as earthquake prone for the purposes of planning strengthening works.

1.5. Recommendations

Based on the findings of this quantitative assessment indicating the building is in the order of 34% NBS, no strengthening is required in order to comply with Christchurch City Council (CCC) policy - Earthquake-prone dangerous & insanitary buildings policy 2010.

However, given that the result is borderline earthquake prone and due to the post-construction assessment being imperfect, the client may wish to consider this building as earthquake prone. We recommend that strengthening options to bring the building to a target of 67% are investigated.

It is recommended that:

a) No placard was displayed on the building however we recommend that the current placard status of the building be Green 2.

b) We consider that barriers around the building are not necessary.

c) Options to bring the building to a target of 67% are investigated.

2. Introduction

Sinclair Knight Merz were engaged by Christchurch City Council to carry out a Quantitative Assessment of the seismic performance of Opawa Childrens Library located at Ford Road.

The scope of this quantitative analysis includes the following:

- Analysis of the seismic load carrying capacity of the building compared with current seismic loading requirements or New Buildings Standard (NBS). It should be noted that this analysis considers the building in its damaged state where appropriate.
- Identify any critical structural weaknesses which may exist in the building and include these in the assessed %NBS of the structure.
- Preparation of a summary report outlining the areas of concern in the building as well as identifying strengthening concepts to 67%NBS for any areas which have insufficient capacity if the building is found to be an earthquake prone building.

The recommendations from the Engineering Advisory Group[1] were followed to assess the likely performance of the structures 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[2].

At the time of this report, an intrusive site investigation had been carried out on the 15th August and the 4th December. Construction drawings were not made available, and these have been considered in our evaluation of the building. The building description below is based on our visual and intrusive inspections.

[1] EAG 2011, *Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury - Draft*, p 10
[2] 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	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).

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- **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

This building is a small single storey structure that is used as a Children's Library. The walls are constructed from timber framing and are externally clad with timber weatherboards. The internal linings to both the wall and the ceiling are predominately tongue and groove, with a toilet area on the side of the building lined with gypsum. The roof structure consists of timber framing and steel corrugated cladding. The ground floor is also a timber structure that is supported on concrete piles.

5.2. Gravity Load Resisting System

Our evaluation was based on our site investigations conducted on the 15th August 2012. This investigation allowed us to verify the structural system of the building.

The roof structure consists of timber purlins and roof trusses which are supported on the timber framed walls. The ground floor consists of timber framing that is supported on concrete piles. Due to the architecture of this building it is assumed that it was constructed sometime in the 1940's.

5.3. Seismic Load Resisting System

For the lateral analysis of this building the 'across direction' has been taken as east-west whereas the 'along direction' has been taken as north-south.

Lateral loads acting across and along the building will be resisted by the timber ceiling and the tongue and groove wall linings. These loads will then be transferred to the timber floor structure which will then be then be supported by the concrete piles, resisting the overturning force.

5.4. Building Damage

SKM undertook inspections on the 29th March 2012. The following areas of damage were observed during the time of inspection:

General

1) No visual evidence of settlement was noted at this site. Therefore a level survey is not required at this stage of assessment.

External Damage

1) Vertical hairline cracking present at weatherboard joints, (typical) (PHOTO 3 & 16).
2) Hairline cracking along the timber trim and fascia board joint present on the north wall. Damage in the NW corner is most likely existing damage that has been exacerbated by the earthquake (PHOTO 5).

3) Hairline cracking present along the soffit lining and fascia board joint on the north wall. Some of the damage appears to be existing damage that has been exacerbated by the earthquake (PHOTO 7).
4) Hairline cracking present around the window architrave and weatherboard joint. Occurs on the two northern windows on the east wall and the window on the south wall (PHOTO 9).
5) Existing cracking in the weatherboard joints in the SE and SW corner appear to have been exacerbated by the earthquake (PHOTO 11).

   Hairline cracks present at the soffit lining joints on the south wall and at the mitre joint in the SE corner (PHOTO 13 & 14).

Internal Damage

1) Hairline cracks present at the tongue and groove joints in the library (PHOTO 18).
2) Hairline cracks present along the scotia and ceiling lining joint in the toilet area (PHOTO 20).
3) Mitre joints on the window architraves in the toilet area have opened up (PHOTO 21).

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

6. Available Information and Assumptions

6.1. Available Information

Following our inspections on the 29th March 2012, intrusive investigations on 15th August 2012 and 4th December 2012, SKM carried out a seismic review on the structure. This review was undertaken using the available information which was as follows:

- Geotechnical desktop study dated 27th March 2012
- SKM survey drawing of the structure which used information from the inspection findings

6.2. Survey

No visual evidence of settlement was noted at this site. Therefore a level survey was not undertaken

6.3. Design Criteria and Assumptions

The following design criteria and assumptions made in undertaking the assessment include:

- We have reviewed the building and from our visual inspection the structure appears to be built in accordance with good practice at the time.
- The soil on site is class D as described in AS/NZS1170.5:2004, Clause 3.1.3, Soft Soil. This assumption is based from adjacent borehole logs. The ultimate bearing capacity on site is 300kPa based on the results of the desktop study. Liquefaction risk is moderate at this site.
- Standard design criteria for typical small community 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 for loss of human life, or considerable economic, social or environmental consequence of failure.
- The building has a short period of around 0.4 seconds.
- Site hazard factor, Z = 0.3, NZBC, Clause B1 Structure, Amendment 11 effective from 1 August 2011
- The seismic demand of the building was calculated using NZS1170.5 using a ductility of μ=2 and a floor loading of 3kPa. The ductility of 2 was used due to the typical inherent ductility of timber buildings.
- The concrete piles have shallow concrete footings. The dimensions of the footings in our calculations have been taken from an intrusive investigation carried out on 5/2/2013.
- The following material properties were used in the analyses:

- **Table 2: Material Properties**

Material	Material Property	Reference
Friction between Tongue and Groove board edges	222 N/m	Appendix 11D, NZSEE Assessment and Improvement of the Structural Performance of Buildings in Earthquakes, June 2006
Lateral load capacity of nails (2mm shank diameter)	268 N	Table 4.3 NZS3603
Friction angle of Soil	$\varphi = 35^{o}$	SKM desktop geotechnical investigation
Unit weight of soil	γ = 18kN/m3	SKM desktop geotechnical investigation
Gypsum wall lining	Shear capacity = 2.1 kN/m	Table 11.1, NZSEE Assessment and Improvement of the Structural Performance of Buildings in Earthquakes, June 2006

The detailed engineering analysis is a post construction evaluation therefore it has the following limitations:

- It is not likely to pick up on any concealed construction errors (if they exist)
- Other possible issues that could affect the performance of the building such as corrosion and modifications to the structure will not be identified unless they are visible and have been specifically mentioned in this report.
- The detailed engineering evaluation deals only with the structural aspects of the structure. Other aspects such as building services are not covered.

6.4. The Detailed Engineering Evaluation (DEE) process

The DEE is a procedure written by the Department of Building and Housing's Engineering Advisory Group and 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[3].

The procedure of the DEE is as follows:

1) Qualitative assessment procedure
    a. Determine the building's status following any rapid assessment that have been done

[3] http://resources.ccc.govt.nz/files/EarthquakeProneDangerousAndInsanitaryBuildingsPolicy2010.pdf

b. Review any existing documentation that is available. This will give the engineer an understanding of how the building is expected to behave. If no documentation is available, site measurements may be required

c. Review the foundations and any geotechnical information available. This will include determining the zoning of the land and the likely soil behaviour, a site investigation may be required

d. Investigate possible Critical Structural Weaknesses (CSW) or collapse hazards

e. Assess the original and post earthquake strength of the building (this assessment is subsequently superseded by the quantitative assessment)

2) Quantitative procedure

a. Carry out a geotechnical investigation if required by the qualitative assessment

b. Analyse the building according to current building codes and standards. Analysis accounts for damage to the building.

The DEE assessment 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 3. The building rank is indicated by the percent of the required New Building Standard (%NBS) strength that the building is considered to have. Earthquake prone buildings are defined as having less than 34 %NBS strength which correlates to an increased risk of approximately 20 times that of 100% NBS[4]. Buildings that are identified to be earthquake prone are required by law to be strengthened within 30 years of the owner being notified that the building is potentially earthquake prone[5].

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[4] NZSEE 2006, *Assessment and Improvement of the Structural Performance of Buildings in Earthquakes*, p 2-2

[5] http://resources.ccc.govt.nz/files/EarthquakeProneDangerousAndInsanitaryBuildingsPolicy2010.pdf

- **Table 3: DEE 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 DEE method rates buildings based on the plans (if available) and other information known about the building 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 catastrophic failure. The DEE does also consider Serviceability Limit State (SLS) performance of the building and or the level of earthquake that would start to cause damage to the building but this result is secondary to the ULS performance.

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

7. Results and Discussions

7.1. Critical Structural Weaknesses

The building has no critical structural weaknesses

7.2. Analysis Results

The equivalent static force method was used to analyse the seismic capacity of the building. The results of the analysis are reported in the following table as %NBS. The results below are calculated for the building in its damaged state. The building results have been broken down into their seismic resisting elements.

(%NBS = probable strength / new building standards)

- **Table 4: DEE Results**

Seismic Resisting Element	Action	Seismic Rating %NBS
Subfloor	Overturning	34%
Lined walls – Along	Shear	59%
Lined walls - Across	Shear	69%

The table shows the subfloor in overturning action is the seismic resisting element governing the building's %NBS of 34%. The walls of the building resist the lateral seismic force from the internal wall linings. The difference in the amount of wall lining and the type has equated to 59% and 69% NBS for lined walls in the along direction and across direction respectively. If the building is to be strengthened so the overall capacity is greater than 67%, the elements that will need to be strengthened is the subfloor and lined walls in the along direction. This could be done relatively easily by installing braces between the piles and relining some of the walls with Gib lining, this will need to be further investigated if the client wishes to strengthen the building.

7.3. Recommendations

The quantitative assessment carried out on Opawa Children's Library indicates that the building has a seismic capacity between 33% and 67% of NBS and is therefore classed as being in the category of 'Moderate Risk Building'. It is important to note that 34% NBS is very close to 33% NBS which would make it earthquake prone. The quantitative assessment is a post-construction assessment and, although it is more accurate than the qualitative assessment, it is still imperfect.

The client may wish to consider this building as earthquake prone for the purposes of planning strengthening works.

While not required to be strengthened under the Christchurch City Council (CCC) policy - Earthquake-prone dangerous & insanitary buildings policy 2010, it is recommended the building be strengthened to a target of at least 67%.

8. Conclusion

SKM carried out a quantitative assessment on Opawa Childrens Library located at Louisson Place, Opawa. This assessment concluded that the building is classified not Earthquake Prone. It is important to note that 34% NBS is very close to 33% NBS which would make it earthquake prone. The quantitative assessment is a post-construction assessment and although it is more accurate than the qualitative assessment it is still imperfect. The client may wish to consider this building as earthquake prone for the purposes of planning strengthening works.

- **Table 5: Quantitative assessment summary**

Description	Grade	Risk	%NBS	Structural Performance
Opawa Childrens Library	C	Moderate	34	Acceptable legally, Improvement recommended

While not required to be strengthened under the Christchurch City Council (CCC) policy - Earthquake-prone dangerous & insanitary buildings policy 2010, it is recommended the building be strengthened to a target of at 67%.

It is recommended that:

a) No placard was displayed on the building however we recommend that the current placard status of the building be Green 2.

b) We consider that barriers around the building are not necessary.

c) Options to bring the building to a target of 67% are investigated.

9. 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.

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.

10. Appendix 1 – Photos

	
Photo 1: Children's Library – Looking South	Photo 2: North West Corner
	
Photo 3: Hairline Cracking at Weatherboard Joints (typical)	Photo 4: North West Corner

	
Photo 5: Hairline Cracking along Timber Trim & Facia Board Joint (Damage in NW end appears to be existing damage that has been exacerbated by the EQ)	Photo 6: Hairline Cracking along Soffit Lining and Fascia Board Joint
	
Photo 7: Close up of Photo 7	Photo 8: Windows along East Wall

	
Photo 9: Hairline Cracking along the Window Architrave and the Weatherboard Joints	Photo 10: South East Corner
	
Photo 11: Existing Damage in the South East corner Exacerbated by EQ (SW Corner Similar)	Photo 12: Hairline Crack along the Soffit Lining Mitre Joint

	
Photo 13: Close up of Photo 12	Photo 14: Hairline Cracking along Soffit Lining Joints on the South Wall
	
Photo 15: West Wall	Photo 16: Hairline Cracks along Weatherboard Joints on the West Wall (typical)

	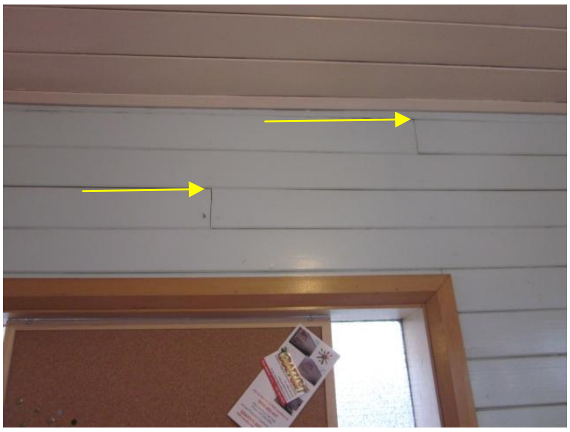
Photo 17: Internal Photo – Looking South	Photo 18: Hairline Cracks along Tongue & Groove Joints
	
Photo 19: Hairline Cracks along the Scotia and Ceiling Lining Joint	Photo 20: Close up of Photo 19

Photo 21: Mitre Joints on the Window Architrave in the toilet Area have Opened up

11. Appendix 2 – CERA Standardised Report Form

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	BU 1017-001 EQ2	Reviewer:	Nick Calvert
Unit / No: / Street		CPEng No:	242062
Building Address:	Opawa Childrens Library / Louisson Place	Company:	SKM
Legal Description:		Company project number:	ZB01276.006
		Company phone number:	09 940 4900
Degrees / Min / Sec			
GPS south:		Date of submission:	11-Feb
GPS east:		Inspection Date:	latest inspection 5/2/2013
		Revision:	C
Building Unique Identifier (CCC):		Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:		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):	

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m):	0.00
Ground floor split?	no		Ground floor elevation above ground (m):	0.00
Storeys below ground	0			
Foundation type:	driven precast piles		if Foundation type is other, describe:	concrete piles with shallow footings
Building height (m):	4.00		height from ground to level of uppermost seismic mass (for IEP only) (m):	4.00
Floor footprint area (approx):				
Age of Building (years):	70		Date of design:	1935-1965
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	other (specify)		Brief strengthening description:	
Use (upper floors):	other (specify)			
Use notes (if required):	Childrens Library			
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	load bearing walls			
Roof:	timber truss		truss depth, purlin type and cladding	100x35 timber truss members, 100x35 timber purlins and corrugated iron roof cladding
Floors:	timber		joist depth and spacing (mm)	250x50 timber joists ar 450 crs
Beams:	none		overall depth x width (mm x mm)	
Columns:				
Walls:		Walls are load bearing timber frame		

Lateral load resisting structure

Lateral system along:	lightweight timber framed walls	Note: Define along and across in detailed report!	note typical wall length (m)	11
Ductility assumed, μ:	2.00			
Period along:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):	20		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	0		estimate or calculation?	
Lateral system across:	lightweight timber framed walls		note typical wall length (m)	5.5
Ductility assumed, μ:	2.00			
Period across:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):	20		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	0		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	weatherboard cladding
Roof Cladding:	Metal	describe	corrugated steel cladding
Glazing:	timber frames		
Ceilings:	strapped or direct fixed		
Services(list):	lighting		

Available documentation

Architectural	none	original designer name/date	
Structural	partial	original designer name/date	Survey drawings based on intrusive investigations. SKM, May 2012
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:	1	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:	0%	Describe how damage ratio arrived at:	damage observed does not deminish the capacity of the structure
	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:	Minor hairline cracking to wall and ceiling linings. Damage to weatherboard cladding

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

Recommendations

	Level of repair/strengthening required:	minor structural	Describe:	sealing up of cracks
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before:	34% %NBS	If IEP not used, please detail assessment methodology:	SKM calculations
	Assessed %NBS after:	34%		
Across	Assessed %NBS before:	34% %NBS		
	Assessed %NBS after:	34%		

Official Use only:

Accepted By	
Date:	