Christchurch City Council
PRK_1497_BLDG_002 EQ2
Kainga Hall Public Toilets
161 Kainga Road

QUANTITATIVE REPORT
FINAL

- Rev B
- 06 May 2013

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QUANTITATIVE ASSESSMENT REPORT

FINAL

- Rev B
- 06 May 2013

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Contents

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1. Executive Summary

1.1. Background

A Quantitative Assessment was carried out on the building located at 161 Kainga Road. The building located on this site comprises of two structures joining across a shared wall, these are the Kainga Hall Toilets and the Kainga Hall. Although the Hall is not operated by the council the structure has been included in the quantitative report due to the structural dependence of the buildings on a shared wall. The Kainga Toilets are located at the front of the property and the Hall is located directly behind. The hall appears to have been built in at least two stages but neither structural or architectural drawings were available to confirm building details or timeline. An aerial photograph illustrating these areas is shown below in Figure 1 Aerial Photograph of 161 Kainga Road. Detailed descriptions outlining the buildings age and construction type is given in Section 5 of this report.

- **Figure 1 Aerial Photograph of 161 Kainga Road**

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 6th and 7th of August 2012, and calculations. No structural drawings were available.

1.2. Key Damage Observed

Key damage observed includes:-

1) Cracking to the concrete slab on grade foundations extending from penetrations. These have reopened where they have previously been in filled. See photos 9-12.
2) Hall internal timber columns are out of plumb
3) Non earthquake related rot to the external weatherboard cladding

1.3. Critical Structural Weaknesses

- The building has no critical structural weaknesses

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.
- Qualitative assessment of critical structural weaknesses (CSWs) based on inspection where drawings were not available.
- Geotechnical assumptions have been based on our geotechnical desktop study.
- 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 target capacity of at least 67%NBS in order to comply with Christchurch City Council (CCC) policy - Earthquake-prone dangerous & insanitary buildings policy 2010.

Based on the information available, and using the Quantitative Assessment Procedure, the buildings original capacity has been assessed to be in the order of 7%NBS and post earthquake capacity in the order of 7%NBS.

The building has been assessed to have a seismic capacity in the order of 7% NBS and is therefore 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 33% NBS.

1.5. Recommendations

Based on the findings of this assessment indicating the building is in the order of 7 %NBS, strengthening is required in order to comply with Christchurch City Council (CCC) policy – Earthquake-prone dangerous & insanitary buildings policy 2010.

It is recommended that:

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

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

c) A level and verticality survey should be carried out to inform the repair.

2. Introduction

Sinclair Knight Merz were engaged by Christchurch City Council to carry out a Quantitative Assessment of the seismic performance of Kainga Hall Public Toilets located at 161 Kainga 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.

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].

This assessment identified that the seismic capacity of the building was likely to be less than 33% of the new building standard (NBS). A quantitative assessment was recommended to confirm the initial assessment findings and to determine a more accurate seismic rating of the building.

At the time of this report, no intrusive site investigation had been carried out. As construction drawings were not available the building description below is based on our visual inspections of the building and subfloor.

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[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 brief 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 33%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: NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE Guidelines 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: %NBS compared to relative risk of failure below compares the percentage NBS to the relative risk of the building failing in a seismic event with a 10% risk of exceedance in 50 years (i.e. 0.2% in the next year). It is noted that the current seismic risk in Christchurch results in a 6% risk of exceedance in the next year.

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

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

5. Building Details

5.1. Building description

The building is located at 161 Kainga Road. The building located on this site comprises of two separate structural areas, these are the Kainga Hall Toilets and the Kainga Hall. The hall is assumed to have been built in the period between 1935 and 1965. The hall consists of light timber trussed roofing with hardboard clad light timber perimeter walls. Internally the roof is supported by a light timber framed wall to the south and by a timber support beam and timber columns to the north. The floors to the main hall are timber particle board on timber joists and bearers supported by concrete foundations. Perimeter foundations are shallow concrete piles with internal foundations being concrete pads. The building extensions to the east and west are founded on concrete slab on grade foundations. The toilet block to the east end of the building is light timber framed clad in weatherboard and lined with tongue and groove boards. The toilet shares a wall with the original hall. The roofs are pitched with light timber framed rafters supported at the apex, changes in pitch and the eaves by perpendicular timber members.

5.2. Gravity Load Resisting system

Our evaluation was based on our site inspections and mark-ups as structural drawings were not available to confirm details.

Gravity loads to the roof are transferred through the light timber framed trusses of the central hall span to the internal light timber framed wall on the south and to the internal support beam on the north which transfers load down timber columns into the concrete strip foundations through bearing. The wings to the north and south of the main hall appear to have been built onto the hall as additions. Gravity loads to the roof are transferred to the external walls and either the internal wall (south) or timber frame (north). The perimeter walls are supported on timber bearers on timber connections to shallow concrete piles. Internal walls are supported by timber joists and bearers founded on concrete pad foundations. The storage area to the west of the building consists of light timber framed walls and roofing founded on concrete pad foundations. Gravity loads to the toilet block are transferred into the timber rafters and out to the perpendicular timber supports which transfer load into the light timber framed walls. The light timber framed walls transfer load to the ground through the concrete slab on grade foundation.

5.3. Seismic Load Resisting system

In the longitudinal direction the lateral loads are transferred out to the timber frame members and lined light timber framed wall through shear in the trusses and diaphragm action of the ceiling members and lining. The light timber framed wall transfers load to the subfloor via diaphragm action of the light timber framed members and hardboard lining. The timber frame transfers loads through axial force into the lined light timber framed walls at the beams ends. Loads to the building additions transfer load into the subfloor through diaphragm action of the lined walls. In the longitudinal direction subfloor loads from walls, and floor loading, are transferred through shear in the joists and axial loads in the timber bearers and into the ground through connection to the concrete pad or pile foundations.

5.4. Building Damage

5.4.1. Kainga Toilets

1) Cracking to the concrete slab on grade foundations extending from penetrations. These have reopened where they have previously been in filled. See photos 9-12.

5.4.2. Kainga Hall

2) Hall internal timber columns are out of plumb. See Photo 28
3) Non earthquake related rot to the external weatherboard cladding. See photos 22, 25-27

6. Available Information and Assumptions

6.1. Available Information

Following our inspections on the 6th, 7th of August 2012, SKM carried out a seismic review on the structures. This review was undertaken using the available information which was as follows:

- SKM site measurements and inspection findings.
- Visual inspection of the subfloor
- Structural drawings of the building were not available.

6.2. Survey

A building survey has not been completed on the building and is unlikely to alter the outcome of this assessment given the calculated percentage NBS. A survey should be undertaken to determine the level and verticality within the building to inform the repair methodology for the building.

6.3. Assumptions

The assumptions made in undertaking the assessment include:

- The building was built according to 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 is a conservative assumption based on our experience of soils around Christchurch and a geotechnical desktop study of the surrounding area of Kainga. The ultimate bearing capacity on site is assumed 300kPa, we believe that this assumption is reasonable. Liquefaction risk for the site is low given the underlying soil makeup..
- 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 for loss of human life, or considerable economic, social or environmental consequence of failure.
- The building has a short period less than 0.4 seconds.
- Site hazard factor, Z = 0.3, NZBC, Clause B1 Structure, Amendment 11 effective from 1 August 2011
- The lateral resistance of the shear panels has been calculated based on the assumption of minimal hardboard panel nail spacing of 800mm and may be higher than the values stated in table 5.

- The following ductility criteria used in the building:
- **Table 2: Assumed Building Ductility**

Building	Ductility of Building in Current State	Ductility of Building in Strengthened State
Hall and Toilets	3.5	3.5

Ductility of 3.5 has been used as the buildings load resisting systems are lined timber framing in both the longitudinal and transverse directions. This is the ductility assumed by the Gib ezybrace spreadsheet which accounts for inherent damping of timber structures.

- The following material properties were used in the analyses:
- **Table 3: Material Properties**

Material	Nominal Strength	Structural Performance
Concrete	f_c' = 25MPa	S_p = 1.0
Timber - assumed No.1 Framing	f_b = 10MPa & f_c = 15MPa	S_p = 1.0
Hardboard	f_p = 38MPa	S_p = 1.0

The detailed engineering analysis is a post construction evaluation. Since SKM did not complete a full design or construction monitoring, 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

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

a. Determine the building's status following any rapid assessment that have been done
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 4. 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 33 %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 4: 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 NBS are primarily:

- AS/NZS 1170 parts 0, 1 and 5 Structural Design Actions
- NZS 3101:2006 Concrete Structures Standard
- NZS 3404:1997 Steel Structures Standard
- NZS 2606:1993 Timber Structures Standard
- NZS 4230:1990 Design of Reinforced Concrete Masonry Structures

7. Results and Discussions

7.1. Critical Structural Weaknesses

The building has no critical structural weaknesses:

7.2. Analysis Results

The GIB EzyBrace 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. 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 target capacity of at least 67%NBS in order to comply with Christchurch City Council (CCC) policy - Earthquake-prone dangerous & insanitary buildings policy 2010.

(%NBS = the reliable strength / new building standards)

- **Table 5: DEE Results**

Building	Seismic Resisting Element	Action	Seismic Rating %NBS
Kainga Hall and Toilets	Lined bracing element walls - transverse	Shear	≥7%
	Lined bracing element walls - transverse	Shear	≥11%
	Subfloor - perimeter piles only (as interior pad connections between timber elements could not be verified)	Shear	38%

The greater than signs above indicate that the capacities shown are likely to be the minimum capacity that can be achieved by that part of the structure on the basis of structural details that are yet to be confirmed. The capacitoies above may increase once the following is confirmed:

- Spacing, diameter and length of nails in the hardboard linings

7.3. Recommendations

The quantitative assessment carried out on the Kainga hall and toilets indicates that the building has a seismic capacity less than 34% of NBS and is therefore classed as being in the category of 'High Risk Buildings'. Strengthening of the building is required in order to comply with current CCC policy.

If it is determined that the building should be repaired there are a number of issues which will need to be investigated and associated documents prepared in order to submit a building consent application. These issues will need to be considered during the initial phase of strengthening works. Listed below are the likely items the council may require to be explored:

- A fire report will be required and all necessary upgrades to egress routes, emergency lighting and specified systems will need to be undertaken.
- An emergency lighting design will be required to meet the provisions noted in the fire report.
- A disabled access summary will be required including provision for disabled facilities.
- The site amenities (toilets and the like) will need to be reviewed to ensure that there are sufficient facilities for the expected number of people on site.
- Landscaping will need to be considered although we do not anticipate that any modifications will be required since you will not be adjusting the footprint area of buildings on site and will likely only be required for the new build option.

8. Conclusion

SKM carried out a quantitative assessment on PRK_1497_BLDG_002 EQ2 located at 161 Kainga Road. This assessment concluded that the building is classified as Earthquake Prone.

Table 6: Quantitative assessment summary

Description	Grade	Risk	%NBS	Structural performance
Kainga hall and toilets	E	High	≥7	Unacceptable. Improvement required.

The lateral resistance of the shear panels has been calculated based on the assumption of minimal hardboard panel nail spacing of 800mm and may be higher than the 7% stated in Table 6: Quantitative assessment summary depending on the actual length diameter and spacing of nails.

Strengthening is required on the building to bring the seismic capacity up to at a minimum of 67% of NBS.

It is recommended that:

a) We consider that barriers around the building are not necessary.
b) Options to bring the building to a target of 67% are investigated in addition to determining the length diameter and spacing of nailing to the hardboard linings.
c) A level and verticality survey should be carried out to inform the repair.

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: Photo looking south west at structure showing step between toilets front and Hall rear	Photo 2: View west along North wall of rear hall
	
Photo 3: Roof extends at same level as the hall on south side of building	Photo 4: Timber framing of timber eave typical of roof framing within the public toilets. 100mm x 50mm beams on timber bearing beams at eaves roof pitch transition and apex

Photo 5: Support beam pictured (right) beneath light timber framed rafters

Photo 6: View looking at toilet apex

Photo 7: Replacement of roof panel or skylight with plywood

Photo 8: View of rafters and support beam at apex

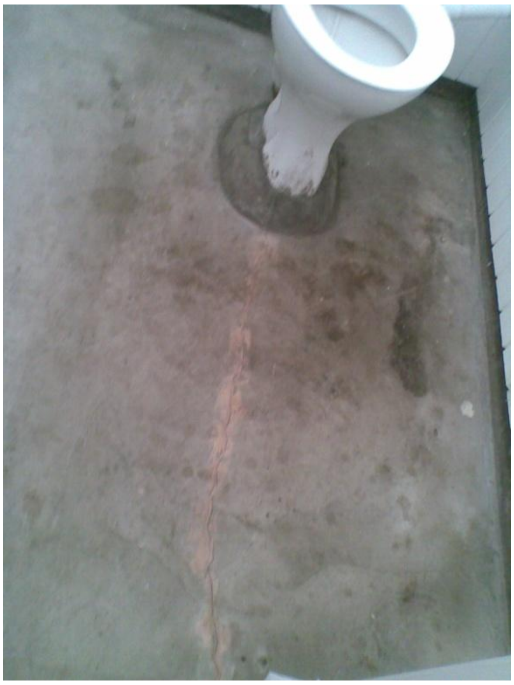	
Photo 9: Typical cracking to slab foundation extending from floor penetration	Photo 10: Crack extending to change in floor at wall support
	
Photo 11: Floor slab cracking in the toilets	Photo 12: Cracks have been filled but have reopened

Photo 13: Chimney over the Kainga hall which lost an estimated 400mm of height

Photo 14:Building transition from hall to toilets

Photo 15: Bricks from Chimney piled by the Kainga toilets

Photo 16: View west along the North wall of the building

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<tr><td>Photo 17: View west along the south wall of the building</td><td>Photo 18: Perimeter foundation consisting of concrete pads</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Photo 19: Kainga toilets (left), and Kainga Hall (right)</td><td>Photo 20: Rotten timber weatherboarding at the hall entry</td></tr>
</table>

	
Photo 21: North west corner of the building addition where foundation transitions to slab on grade with perimeter concrete piles	Photo 22: Slab on grade with perimeter concrete piles
	
Photo 23: South west corner storage room with concrete slab on grade foundation without concrete perimeter piles	Photo 24: View east along the south wall

	
Photo 25: South west corner of the original hall perimeter foundations are concrete pad	Photo 26: Timber rot around the window framing
	
Photo 27: Square concrete piles on the south side of the bulding	Photo 28: Internal timber columns noticably out of plumb

	
Photo 29: View looking east along the north wall of the hall	Photo 30: North wall of the hall, with columns at the change in roof pitch supporting the roof beam
	
Photo 31: Timber framing of rear storage area of the hall	Photo 32: Timber framing of rear storage area of the hall

Photo 33: Timber connection between bearer and top of concrete pile

Photo 34: Particle board floor on timber joists and bearers supported by concrete pad foundations. Connection between bearer and pad could not be verified. Background - internal discrete pile supporting beaer and pad foundations

Photo 35: Pad foundation rows along the lines of the bearers

Photo 36: Subfloor looking north beneath the building. Combination of discrete piles and concrete pads

Photo 37: Subfloor looking north beneath the building. Combination of discrete piles and concrete pads

Photo 38: Shallow concrete pile encased with steel tin as formwork

Photo 39: Foreground concrete piles, background piles and concrete pads

Photo 40: 200x200mm square concrete piles beneath the south east of the building

11. Appendix 2 – CERA Standardised Report Form

Location

Building Name:	Kainga Hall Hall and Public Toilets	Reviewer:	Nick Calvert
	Unit / No: 161 / Street: Kainga Rd	CPEng No:	242062
Building Address:	161 Kainga Rd	Company:	Sinclair Knight Merz
Legal Description:		Company project number:	ZB01276.179
		Company phone number:	273207967
GPS south: (Degrees / Min / Sec)		Date of submission:	6-May
GPS east:		Inspection Date:	6/08/2012
		Revision:	B
Building Unique Identifier (CCC):	PRK_1497_BLDG_002	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):	2.00

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m): 2.00
Ground floor split?	no		Ground floor elevation above ground (m): 0.00
Storeys below ground	0		
Foundation type:	mat slab		if Foundation type is other, describe:
Building height (m):	3.50		height from ground to level of uppermost seismic mass (for IEP only) (m):
Floor footprint area (approx):	270		
Age of Building (years):	75		Date of design: 1935-1965
Strengthening present?	no		If so, when (year)?
			And what load level (%g)?
Use (ground floor):	public		Brief strengthening description:
Use (upper floors):			
Use notes (if required):			
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber framed	rafter type, purlin type and cladding	100x 100 Rafters, 100 x 50 timber purlins, corrugated metal and plastic
Floors:	other (note)	describe sytem	Differs throughout, concrete slab on grade for toilets and storage areas. Main hall, timber floor on concrete strips and pile foundations
Beams:			
Columns:	timber	typical dimensions (mm x mm)	150x150 (2x 150x75 back to back members throughbolted)
Walls:			

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	lightweight timber framed walls		note typical wall length (m)	8
Ductility assumed, μ:	2.00			
Period along:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):	10		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	10		estimate or calculation?	estimated
Lateral system across:	lightweight timber framed walls		note typical wall length (m)	8
Ductility assumed, μ:	2.00			
Period across:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):	10		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	10		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	Weather board
Roof Cladding:	Profiled composite materials	describe	Metal and clear plastic cladding
Glazing:			
Ceilings:			
Services(list):			

Available documentation

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

Damage

Site:
(refer DEE Table 4-2)

Site performance:		Describe damage:	None apparent
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:	slight	notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	Damage does not affect 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:	Slab cracking

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

Recommendations

Level of repair/strengthening required:	minor structural	Describe:	Crack repair of the ground slab for durability. Subfloor connection strengthening. Internal wall lining replacement.
Building Consent required:	yes	Describe:	
Interim occupancy recommendations:	do not occupy	Describe:	The Kainga toilet block shares a wall with the Kainga Hall which is an approximately 70+ year old building. The assessment of %NBS has been based on the combined structure due to the age of the shared wall. Collapse of the hall would lead to collapse of the toilet block.

Along	Assessed %NBS before:	11%	%NBS from IEP below	If IEP not used, please detail assessment methodology:	Quantitative calculations
	Assessed %NBS after:	11%			
Across	Assessed %NBS before:	7%	%NBS from IEP below		
	Assessed %NBS after:	7%			