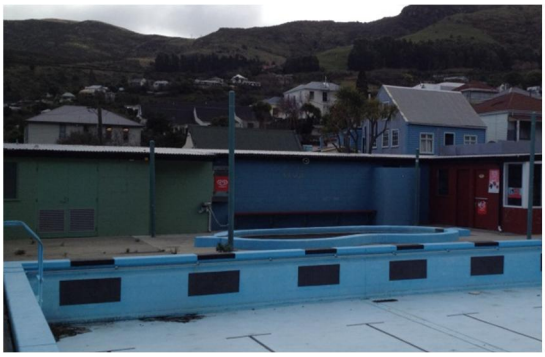
Norman Kirk Memorial Pool - Men's Change Room Detailed Engineering Evaluation
BU 3513-003 EQ2
Qualitative Report

Prepared for Christchurch City Council (CCC)

By Beca Carter Hollings & Ferner Ltd (Beca)

12 July 2013



Revision History

Revision Nº	Prepared By	Description	Date
A	Andrew Franklin	Draft for CCC review	11 October 2012
B	Andrew Franklin	Final	12 July 2013

Document Acceptance

Action	Name	Signed	Date
Prepared by	Andrew Franklin		12 July 2013
Reviewed by	Nicholas Charman		12 July 2013
Approved by	David Whittaker		12 July 2013
on behalf of	Beca Carter Hollings & Ferner Ltd		

Norman Kirk Memorial Pool
Men's Change Room
BU 3513-003 EQ2

Detailed Engineering Evaluation
Qualitative Report – SUMMARY
Version 1

Address
54 Oxford St
Lyttelton

Background

This is a summary of the Qualitative report for the building structure, and is based on the document 'Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury – Part 2 Evaluation Procedure' (draft) issued by the Engineering Advisory Group (EAG) on 19 July 2011.

The Men's Change Room is located at the Norman Kirk Memorial Pool at 54 Oxford St, Lyttelton. It was built in 1973 and has an approximate floor area of 74m^2 internally. The main structural system consists of concrete masonry walls, with the roof consisting of timber rafters and lightweight metal sheeting. No architectural or structural drawings were available and no calculations were carried out.

The Norman Kirk Memorial Pool site has a number of concrete masonry block walls/fences and retaining walls of varying construction type.

Key Damage Observed

Visual inspections on 7 August 2012 indicate the building has suffered substantial damage. The key damage observed includes:

- Cracking in concrete masonry blocks and mortar of internal and external walls throughout.
- Significant crack in Men's Change Room floor slab.
- Cracked and dislodged concrete masonry blocks outside Men's Change Room and within Plant Room.
- Cracking to concrete retaining wall on western side (beneath main building superstructure).
- Tilting of privacy masonry wall to disabled toilet.

Critical Structural Weaknesses (CSW)

No Critical Structural Weaknesses were identified for the Men's Change Room main building structure, however the entrance privacy wall appears to be of unreinforced concrete masonry construction.

Indicative Building Strength (from Initial Evaluation Procedure and CSW assessment)

The building has been assessed to have an undamaged seismic capacity of 26%NBS and a post-earthquake capacity of approximately 18%NBS using the NZSEE Initial Evaluation Procedure (IEP) and is therefore classified as potentially Earthquake Prone and Seismic Grade E.

Recommendations

In order that the owner can make an informed decision about the ongoing use and occupancy of their building the following information is presented in line with the Department of Building and Housing document '*Guidance for engineers assessing the seismic performance of non-residential and multi-unit residential buildings in greater Christchurch*', June 2012.

The building is considered to be potentially earthquake prone, having an assessed capacity less than 33%NBS. The risk of collapse of an earthquake prone building is considered to be 10 to 25 times greater than that of an equivalent new building.

For greater Christchurch the definition of a "dangerous" building in the Building Act has been extended (by the Canterbury Earthquake (Building Act) Order 2011) to include buildings at risk of collapsing in a moderate earthquake, that is earthquake prone buildings with a capacity at or below 33%NBS. Where council requires a dangerous building or an earthquake prone building to be upgraded, it may prohibit the use of the building until the works are carried out.

The building has suffered damage to the seismic or gravity load resisting system that is sufficient to impair or significantly reduce the ability to resist further loads, it is in a condition under which further deterioration may be expected in future aftershocks.

With consideration to the earthquake damage and the existing hazards observed, in its current state the building is not capable of resisting a moderate earthquake without collapse (its assessed capacity is less than 33%NBS) and it should not be used until it is repaired. Access should be limited to restricted occupancy for damage assessment or removal of essential items only.

It is recommended that:

- Barricades be installed to cordon off access to damaged structures on the western portion of the Norman Kirk Memorial Pool site including walls/fences and buildings. No occupancy restrictions exist for the Main Plant Room or the Nursery Building and we understand the Nursery is currently occupied. Access to these two building should be restricted to routes that do not require entering cordoned areas of the site.
- Repairs that would bring the building back to an "as new" condition are typically entitled under typical replacement insurance policies. We suggest you consult with your insurance advisor as to how you wish to proceed. Note that a number of recommendations below are dependent on the outcome of this consultation and your agreed remediation strategy for the building. We believe the building in its current state is not reasonably repairable and further investigations may not be warranted.
- Further efforts are made to obtain structural drawings.
- A verticality and level survey could be carried out to determine the extent of settlement of the building, and differential settlement across the site, for insurance purposes.
- A quantitative %NBS analysis of the building should be completed.

- Intrusive investigations are carried out to determine the lateral load resisting system of the plasterboard lined timber framed section of wall on top of the western block wall.
- An investigation is undertaken to determine the structural integrity of the retaining wall supporting the western wall.

Table of Contents

Appendices

1 Background

Beca Carter Hollings & Ferner Ltd (Beca) has been engaged by Christchurch City Council (CCC) to undertake a qualitative Detailed Engineering Evaluation (DEE) of the Men's Change Rooms located at the Norman Kirk Memorial Pool at 54 Oxford St, Lyttelton.

This report is a Qualitative Assessment of the building structure, and is based on the document 'Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury – Part 2 Evaluation Procedure' (draft) issued by the Engineering Advisory Group (EAG) on 19 July 2011.

A qualitative assessment involves inspections of the building, a desktop review of existing structural and geotechnical information, including existing drawings and calculations, if available and an assessment of the level of seismic capacity against current code using the Initial Evaluation Procedure (IEP).

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).

At the time of this report, no intrusive site investigation, detailed analysis, or modelling of the building structure has been carried out. The building description below is based only on our visual inspection as drawings were not available.

The format and content of this report follows a template provided by CCC, which is based on the EAG document.

2 Compliance

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

2.1 Canterbury Earthquake Recovery Authority (CERA)

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

Section 38 – Works

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

Section 51 – Requiring Structural Survey

This section enables the chief executive to require a building owner, insurer or mortgagee 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 understood that CERA is adopting the Detailed Engineering Evaluation Procedure document (draft) issued by the Engineering Advisory Group on 19 July 2011, which sets out a methodology for both qualitative and quantitative assessments. We understand this report will be used in response to CERA Section 51.

The qualitative assessment includes a thorough visual inspection of the building coupled with a desktop review of available documentation such as drawings, specifications and IEP's. The quantitative assessment involves analytical calculation of the building's 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 that was assigned during the state of emergency following the 22 February 2011 earthquake
- The age and structural type of the building
- Consideration of any Critical Structural Weaknesses
- The extent of any earthquake damage

2.2 Building Act

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

Section 112 – Alterations

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

Section 115 – Change of Use

This section requires that the territorial authority (in this case Christchurch City Council (CCC)) 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.

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.

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.

Section 124 – Powers of Territorial Authorities

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

Section 131 – Earthquake Prone Building Policy

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

2.3 Christchurch City Council Policy

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

It is understood 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.

2.4 Building Code

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

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

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.

3 Earthquake Resistance Standards

For this assessment, the building's Ultimate Limit State 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).

No consideration has been given at this stage to checking the level of compliance against the increased Serviceability Limit State requirements.

The likely ultimate 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 building's 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 3.1 below.

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

Figure 3.1: NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE Guidelines

Table 3.1 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. on average 0.2% in any year). It is noted that the current seismic risk in Christchurch results in a 6% risk of exceedance in the next year.

Table 3.1: %NBS compared to relative risk of failure

Building Grade	Percentage of New Building Standard (*%NBS*)	Approx. Risk Relative to a New Building
A+	>100	<1
A	80-100	1-2 times
B	67-80	2-5 times
C	33-67	5-10 times
D	20-33	10-25 times
E	<20	>25 times

4 Building Description

4.1 General

Summary information about the building is given in the following table.

Table 4.1: Building Summary Information

Item	Details	Comment
Building name	Norman Kirk Memorial Pool - Men's Change Room.	
Street Address	54 Oxford St, Lyttelton.	
Age	39 years. Constructed in 1973.	Advised by CCC.
Description	Single story concrete masonry block building. Consists of several facilities including bathrooms, change rooms, plant room and office.	
Building Footprint / Floor Area	Approximately 74m^2. Approximately 16m x 4m + a 4m x 2.9m wing.	Dimensions based on photos and site observations. No drawings available.
No. of storeys / basements	1 storey / no basement.	
Occupancy / use	Change rooms / bathrooms / plant room / office.	Importance Level 2.
Construction	Concrete masonry block walls with timber framed roof. The upper section of the western wall is timber framed and plasterboard lined. The ceiling is plasterboard.	No drawings available. Based on visual inspection. Based on the age of the building, the block work is assumed to be lightly reinforced and partially filled, however some block work could be unreinforced and unfilled.

Item	Details	Comment
Gravity load resisting system	Metal roof on timber rafters which are supported by concrete masonry block load bearing walls. The loads from the timber rafters on the western side are supported by a timber framed and plasterboard lined wall on top of the masonry block load bearing walls.	No drawings available.
Seismic load resisting system	Lateral loads in both directions are resisted by concrete masonry block shear walls. The western longitudinal wall does not span the full height between the floor and ceiling, and has a timber framed plasterboard lined wall extending to the ceiling.	No drawings available. It is assumed that adequate diaphragm action can be achieved in the plasterboard lined timber framed wall on the west elevation to transfer lateral loads to the masonry block shear wall below. The entrance privacy walls do not have a roof diaphragm and are essentially stand-alone wall structures. It is unknown if any bracing exists to transfer lateral roof loads to the walls. There is a fixed plasterboard ceiling which may act as a diaphragm, however its connections to the walls are unknown.
Foundation system	Unknown but assumed to be shallow foundations with a concrete slab on grade.	The western masonry wall of the building sits on top of a concrete retaining wall that runs along the western perimeter of the site. The footpath below the retaining wall slopes from north to south, with the retaining wall height at the southern end approximately 2m.
Stair system	No stairs.	
Other notable features	Unreinforced concrete masonry privacy walls at entrance doors. Men's change room forms part of a larger 'C' shaped building including the Ladies Change Room which is of similar construction.	
External works	Concrete pavement to the east of the building, Retaining wall (below masonry walls) to the west. In ground concrete swimming pool located in the centre of the site.	

Item	Details	Comment
Construction information	Visual inspection only.	No drawings available.
Likely design standard	NZS 1900 Chapter 8: 1965.	Inferred from age of building.
Heritage status	No heritage status.	
Other		

4.2 Structural 'Hot-spots'

- Unreinforced masonry block walls.
- Connections between concrete masonry walls, concrete floor and roof.
- Structural adequacy of timber framed plasterboard lined wall on top of the western masonry wall, and the connection between the two elements.
- Structural integrity of retaining wall on beneath the western wall of the building.
- Shear capacity of concrete masonry walls.
- Flexural capacity of concrete masonry walls.

5 Site Investigations

5.1 Previous Assessments

The building had a level 2 rapid assessment undertaken following the February 2011 and June 2011 earthquake events (refer to Appendix C).

5.2 Level 4 Damage Inspection

Visual inspections as part of the level 4 damage assessment were undertaken on 7 August 2012.

6 Damage Assessment

6.1 Damage Summary

The table below provides a summary of damage observed during our inspection. Refer to Appendix A for photographs of the observed damage.

Table 6.1: Damage Summary

Damage type	Unknown	Minor	Moderate	Major	Comment
settlement of foundations	ü				None observed during visual inspection. Level survey may be required to confirm.
tilt of building			ü		Separation and tilt of masonry privacy entrance wall to Disabled Bathroom. No tilting of main building structure was observed.
liquefaction					None observed during visual inspection.

Damage type	Unknown	Minor	Moderate	Major	Comment
settlement of external ground			ü		Some differential settlement noted. Pavement slopes from the pool to the south.
lateral spread / ground cracks		ü			Ground cracks in concrete pavement were observed nearby.
frame					Not applicable.
masonry walls				ü	Significant cracking to masonry blocks and mortar joints. The entrance privacy wall to the Disabled Toilet has failed.
cracking to concrete floors			ü		Ground slab crack in Men's Change Rooms observed. The crack coincides with cracking in the concrete masonry block walls and concrete retaining wall along western perimeter of the site.
bracing	ü				Unknown, no bracing observed during visual inspection, due to wall and ceiling linings.
precast flooring seating					Not applicable.
stairs					Not applicable.
cladding /envelope					No damage observed during visual inspection. Refer above for concrete masonry walls.
internal fit out		ü			Dislodged blocks to internal partition in plant room.
building services	ü				No inspection of services was carried out.
other			ü		Cracking in retaining wall beneath west wall of building.

6.2 Surrounding Buildings

The Men's Change Rooms is part of a larger building that also houses the Ladies' Change Room block (BU 3513-002 EQ2). The two buildings together form a 'C' shaped building, with the Men's Change Room forming the long wing. Within the Men's Change Room block is the Office Building, Disabled Bathroom, Plant Room, and Men's Change Room. The Disabled Bathroom is immediately adjacent to, and shares a wall with, the Ladies' Change Room. The entire building is of similar construction hence pounding is not an issue.

To the north side of the pool is a concrete retaining wall approximately 2m high with a 2m high concrete masonry block fence on top that is significantly damaged (refer Photo 15 and Photo 16 in Appendix A). The block fence section appears to be very lightly reinforced and has minimal fill. It appears likely that the block fence will need to be demolished and reconstructed with an appropriately engineered replacement.

6.3 Residual Displacements and General Observations

No evidence of permanent settlement and displacements to the main Men's Change Room structure was observed during our visual inspection. Some evidence of permanent settlement and displacements was observed in other areas of the site however. A global settlement survey may reveal movement that could be described as damage under insurance entitlement.

6.4 Implication of Damage

The main building structure has suffered structural damage which has likely diminished its structural capacity. We have assumed that the capacity is reduced by around 30% due to the damage. Intrusive investigations and quantitative analysis would be required to better estimate the structural capacity and effects of the damage.

The unreinforced concrete masonry privacy wall structure has not been assessed and likely requires complete demolition and reconstruction.

7 Generic Issues

The following generic issues referred to in Appendix A of the EAG guideline document have been identified as applicable to the Men's Change Room:

Partially Filled Concrete Masonry

- Inadequate flexural strength.
- Inadequate shear strength.
- Connection between roof diaphragms and walls not adequate.

8 Critical Structural Weaknesses

No Critical Structural Weaknesses were identified for the main building structure.

The privacy wall structure appears to be of unreinforced concrete masonry construction.

9 Geotechnical Consideration

No geotechnical information was available for this site. During the inspection, any damage to the surrounding pavement was noted and any affect to the structure was considered.

10 Survey

There was some evidence of settlement and lateral spread across the site that was observed during our inspection however no level or vertical surveys were carried out. CCC may wish to undertake level and verticality surveys as part of insurance entitlement considerations.

11 Initial Capacity Assessment

11.1 %NBS Assessment

The building has had its seismic capacity assessed using the Initial Evaluation Procedure based on the information available. The building's capacity is expressed as a percentage of New Building Standard (%NBS) and is in the order of that shown below in Table 11.1. These capacities are subject to confirmation by a quantitative analysis which is more detailed. The post-damage capacity is considered to be less than the original capacity, subject to further investigations and quantitative analysis.

Table 11.1: Indicative Building Capacities

System	Direction	Seismic Performance in *%NBS*	Notes
Partially filled Concrete Masonry Units	Longitudinal	Undamaged: 26% Damaged: 18%	NZSEE Initial Evaluation Procedure. IL 2, Z=0.3.
Partially filled Concrete Masonry Units	Transverse	Undamaged: 26% Damaged: 18%	NZSEE Initial Evaluation Procedure. IL 2, Z=0.3.

11.2 Seismic Parameters

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

- Site soil class: C – NZS 1170.5:2004, Clause 3.1.3.
- Site hazard factor, Z = 0.3 – NZBC, Clause B1 Structure, Amendment 11 effective from 19 May 2011.
- Return period factor Ru = 1 – NZS 1170.5:2004, Table 3.5, Importance level 2 structure with a 50 year design life.
- Near fault factor N(T,D) = 1 – NZS 1170.5:2004, Clause 3.1.6, Distance more than 20 km from fault line.

11.3 Expected Structural Ductility Factor

The lateral load resisting system in both directions is partially filled and lightly reinforced concrete masonry shear walls which have been assumed to have a ductility factor of 1.25 for the IEP assessment.

11.4 Discussion of results

Based on the IEP results, the Men's Change Room is considered potentially Earthquake Prone and seismic grade E as the IEP result is less than 33%NBS. This assessment is qualitative and based on the NZSEE IEP only. The dimensions have been approximated by visual inspection and it is assumed that the masonry blocks are partially filled and lightly reinforced, with some unreinforced concrete masonry in the entrance privacy wall.

12 Initial Conclusions

- Significant earthquake damage was observed and unreinforced masonry was observed.
- The building has been assessed to have an undamaged seismic capacity of 26%NBS and a post-earthquake capacity of approximately 18%NBS and is therefore potentially Earthquake Prone.
- No Critical Structural Weaknesses have been identified for the main building structure.
- Collapse hazards have been identified at the Norman Kirk Memorial Pool site and these require cordoning off.

13 Recommendations

13.1 Occupancy

In order that the owner can make an informed decision about the ongoing use and occupancy of their building the following information is presented in line with the Department of Building and Housing document '*Guidance for engineers assessing the seismic performance of non-residential and multi-unit residential buildings in greater Christchurch*', June 2012.

The building is considered to be potentially earthquake prone, having an assessed capacity less than 33%NBS. The risk of collapse of an earthquake prone building is considered to be 10 to 25 times greater than that of an equivalent new building.

For greater Christchurch the definition of a "dangerous" building in the Building Act has been extended (by the Canterbury Earthquake (Building Act) Order 2011) to include buildings at risk of collapsing in a moderate earthquake, that is earthquake prone buildings with a capacity at or below 33%NBS. Where council requires a dangerous building or an earthquake prone building to be upgraded, it may prohibit the use of the building until the works are carried out.

The building has suffered damage to the seismic or gravity load resisting system that is sufficient to impair or significantly reduce the ability to resist further loads, it is in a condition under which further deterioration may be expected in future aftershocks.

With consideration to the earthquake damage and the existing hazards observed, in its current state the building is not capable of resisting a moderate earthquake without collapse (its assessed capacity is less than 33%NBS) and it should not be used until it is repaired. Access should be limited to restricted occupancy for damage assessment or removal of essential items only.

13.2 Further Investigations, Survey or Geotechnical Work

It is recommended that:

- Barricades be installed to cordon off access to damaged structures on the western portion of the Norman Kirk Memorial Pool site including walls/fences and buildings. No occupancy restrictions exist for the Main Plant Room or the Nursery Building and we understand the Nursery is currently occupied. Access to these two building should be restricted to routes that do not require entering cordoned areas of the site.
- Further efforts are made to obtain structural drawings.
- A verticality and level survey could be carried out to determine the extent of settlement of the building, and differential settlement across the site, for insurance purposes.
- A quantitative %NBS analysis of the building should be completed.
- Intrusive investigations are carried out to determine the lateral load resisting system of the plasterboard lined timber framed section of wall on top of the western block wall.

- An investigation is undertaken to determine the structural integrity of the retaining wall supporting the western wall.

13.3 Damage Reinstatement

Repairs that would bring the building back to an “as new” condition are typically entitled under typical replacement insurance policies. We suggest you consult with your insurance advisor as to how you wish to proceed.

Note that a number of recommendations above in 13.2 are dependent on the outcome of this consultation and your agreed remediation strategy for the building. We believe the building in its current state is not reasonably repairable and further investigations may not be warranted.

14 Design Features Report

Repairs will be required to reinstate the existing structural system. No additional load paths are expected. A repair methodology has not been prepared at this stage.

15 Limitations

The following limitations apply to this engagement:

- Beca and its employees and agents are not able to give any warranty or guarantee that all defects, damage, conditions or qualities have been identified.
- Inspections are primarily limited to visible structural components. Appropriate locations for invasive inspection, if required, will be based on damage patterns observed in visible elements, and review of the construction drawings and structural system. As such, there will be concealed structural elements that will not be directly inspected.
- The inspections are limited to building structural components only.
- Inspection of building services, pipework, pavement, and fire safety systems is excluded from the scope of this report.
- Inspection of the glazing system, linings, carpets, claddings, finishes, suspended ceilings, partitions, tenant fit-out, or the general water tightness envelope is excluded from the scope of this report.
- The preliminary assessment of the lateral load capacity of the building is limited by the completeness and accuracy of the drawings provided. Assumptions have been made in respect of the geotechnical conditions at the site and any aspects or material properties not clear on the drawings. Where these assumptions are considered material to the outcome further investigations may be recommended. It is noted the assessment has not been exhaustive, our analysis and calculations have focused on representative areas only to determine the level of provision made. At this stage we have not undertaken any checks of the gravity system, wind load capacity, or foundations.
- The information in this report provides a snapshot of building damage at the time the detailed inspection was carried out. Additional inspections required as a result of significant aftershocks are outside the scope of this work.

This report is of defined scope and is for reliance by CCC only, and only for this commission. Beca should be consulted where any question regarding the interpretation or completeness of our inspection or reporting arises.

Appendix A

Photographs

Figure 1: Site Layout.

Photo 1: Men's Change Room Block. The Plant Room is on the left (green), the Men's Change Room is in the centre (blue) and the Office is on the right (red).

Photo 2: Office Building (Wing of Men's Change Room Block).

Photo 3: Plant Room.

Photo 4: External view of Men's Change Room (view from west).

Photo 5: External masonry/rendering at office building.

Damage Description: Cracking/spalling to external rendering.

Photo 6: Internal concrete masonry block wall of Plant Room.

Damage Description: Concrete masonry and mortar cracking.

Photo 7: External concrete masonry wall of Plant Room.

Damage Description: Cracking of concrete masonry mortar.

Photo 8: Internal concrete masonry wall in Men's Change Room.

Damage Description: Stepped mortar cracking.

Photo 9: Internal concrete masonry wall of Men's Change Room.
Damage Description: Concrete masonry and mortar cracking.

Photo 10: Ground slab in Men's Change Room.
Damage Description: Cracking to ground slab.

Photo 11: External concrete masonry block wall outside of Men's Change Room.
Damage Description: Cracked and dislodged concrete masonry unit.

Photo 12: Concrete masonry block wall and concrete retaining wall on western side.
Damage Description: Cracking in concrete masonry and mortar, and concrete retaining wall.

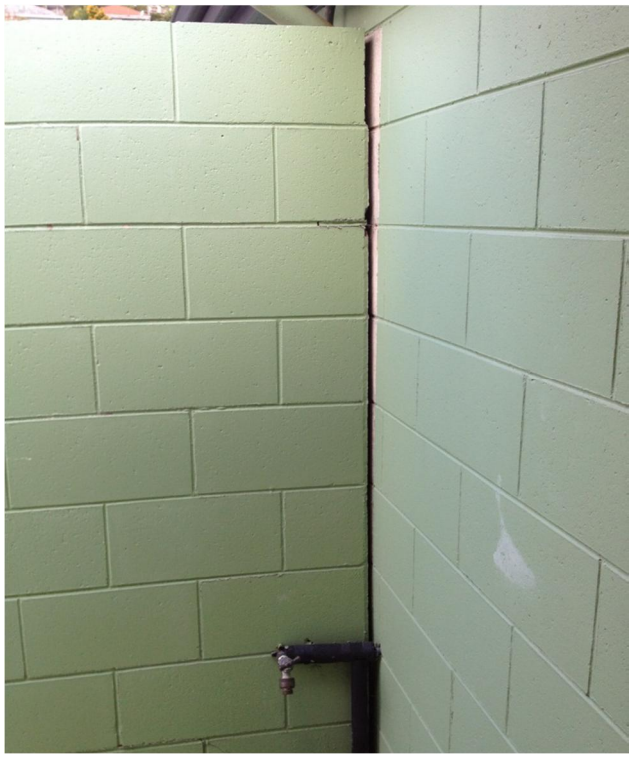


Photo 13: Privacy entrance wall to Disabled Bathroom (view from east).
Damage Description: Separation and tilting of adjacent concrete masonry walls.

Photo 14: Privacy entrance wall to Disabled Bathroom (view from north).
Damage Description: Mortar cracking, lateral movement and tilting of concrete masonry wall.

Photo 15: Concrete retaining wall and concrete masonry block fence to the north of the pool (view from south-east).

Damage Description: Cracking and differential settlement of concrete masonry block wall.

Photo 16: Concrete masonry fence to the north of the pool.

Damage Description: Cracked and dislodged concrete masonry units.

Appendix B

CERA DEE Summary Data

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Mens' Change Room			Reviewer:	David Whittaker
	Unit	No:	Street	CPEng No:	123089
Building Address:	Norman Kirk Memorial Pool	54	Oxford St, Lyttelton	Company:	Beca
Legal Description:				Company project number:	5323355
				Company phone number:	033663521
	Degrees	Min	Sec		
GPS south:				Date of submission:	12/07/2013
GPS east:				Inspection Date:	7/08/2012
				Revision:	1
Building Unique Identifier (CCC):	BU 3513-003 EQ2			Is there a full report with this summary?	yes

Site

Site slope:	slope < 1in 5	Max retaining height (m):	2
Soil type:		Soil Profile (if available):	
Site Class (to NZS1170.5):	C		
Proximity to waterway (m, if <100m):		If Ground improvement on site, describe:	
Proximity to cliff top (m, if < 100m):			
Proximity to cliff base (m,if <100m):	50	Approx site elevation (m):	32

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m):	32
Ground floor split?	no		Ground floor elevation above ground (m):	
Storeys below ground	0			
Foundation type:	other (describe)		if Foundation type is other, describe:	Unknown. Shallow foundations assumed.
Building height (m):	3		height from ground to level of uppermost seismic mass (for IEP only) (m):	3
Floor footprint area (approx):	74			
Age of Building (years):	39		Date of design:	1965-1976
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	other (specify)		Brief strengthening description:	
Use (upper floors):				
Use notes (if required):	Change Rooms / Toilets / Plant Room / Office			
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber framed	rafter type, purlin type and cladding	Timber purlins & rafters. Lightweight metal sheeting.
Floors:	concrete flat slab	slab thickness (mm)	Unknown
Beams:			
Columns:			
Walls:	partially filled concrete masonry	thickness (mm)	190

Lateral load resisting structure

			Note: Define along and across in detailed report!		
Lateral system along:	other (note)			describe system	partially filled CMU and top part with plasterboard wall linings in areas.
Ductility assumed, μ:	1.25				
Period along:	0.4	0.00		estimate or calculation?	estimated
Total deflection (ULS) (mm):				estimate or calculation?	
maximum interstorey deflection (ULS) (mm):				estimate or calculation?	
Lateral system across:	partially filled CMU			note total length of wall at ground (m):	20
Ductility assumed, μ:	1.25			wall thickness (m):	190
Period across:	0.4	0.40	from parameters in sheet	estimate or calculation?	estimated
Total deflection (ULS) (mm):				estimate or calculation?	
maximum interstorey deflection (ULS) (mm):				estimate or calculation?	

Separations:

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

Non-structural elements

Stairs:			
Wall cladding:	exposed structure	describe	No cladding
Roof Cladding:	Metal	describe	Lightweight metal sheeting
Glazing:			
Ceilings:	fibrous plaster, fixed		
Services(list):	Water, Electricity		

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:	Site performance:	Ground cracks and differential settlement	Describe damage:	Ground, mortar and blockwork cracking, settlement
(refer DEE Table 4-2)				
	Settlement:	none observed	notes (if applicable):	
	Differential settlement:	0-1:350	notes (if applicable):	Ground around pool slopes to the south
	Liquefaction:	none apparent	notes (if applicable):	
	Lateral Spread:	none apparent	notes (if applicable):	
	Differential lateral spread:	none apparent	notes (if applicable):	
	Ground cracks:	0-20mm/20m	notes (if applicable):	pavement cracks throughout site
	Damage to area:	slight	notes (if applicable):	

Building:

	Current Placard Status:	Red		
Along	Damage ratio:	30%	Describe how damage ratio arrived at:	based on level of damage observed
	Describe (summary):	Shear cracks		
Across	Damage ratio:	30%	$Damage\_Ratio = \frac{(\%NBS\ (before) - \%NBS\ (after))}{\%NBS\ (before)}$	
	Describe (summary):	shear cracks		
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	no	Describe:	

Recommendations

	Level of repair/strengthening required:	significant structural		Describe:	Cracking in walls and slab. Settlement.
	Building Consent required:			Describe:	
	Interim occupancy recommendations:	do not occupy		Describe:	
Along	Assessed %NBS before:	26%	26% %NBS from IEP below	If IEP not used, please detail assessment methodology:	
	Assessed %NBS after:	18%			
Across	Assessed %NBS before:	26%	26% %NBS from IEP below		
	Assessed %NBS after:	18%			

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

Period of design of building (from above): 1965-1976 — h_n from above: 3m

Seismic Zone, if designed between 1965 and 1992: B — not required for this age of building / not required for this age of building

	along	across
Period (from above):	0.4	0.4
(%NBS)nom from Fig 3.3:	6.3%	6.3%
Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0		1.00
Note 2: for RC buildings designed between 1976-1984, use 1.2		1.0
Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0)		1.0
Final $(\%NBS)_{nom}$:	**6%**	**6%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, cl 3.1.6: 1

	along	across
Near Fault scaling factor (1/N(T,D), **Factor A**:	1	1

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3: 0.30

Z_{1992}, from NZS4203:1992: 0.7

Hazard scaling factor, **Factor B:** 3.333333333

2.4 Return Period Scaling Factor

Building Importance level (from above): 2

Return Period Scaling factor from Table 3.1, **Factor C**: 1.00

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	1.25	1.25
Ductility scaling factor: =1 from 1976 onwards; or =k_μ, if pre-1976, fromTable 3.3:	1.14	1.14
Ductility Scaling Factor, **Factor D**:	1.14	1.14

2.6 Structural Performance Scaling Factor:

Sp:	0.925	0.925
Structural Performance Scaling Factor **Factor E**:	1.081081081	1.081081081

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

$\%NBS_b$: **26%** **26%**

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

3.1. Plan Irregularity, factor A: insignificant 1

3.2. Vertical irregularity, Factor B: insignificant 1

3.3. Short columns, Factor C: insignificant 1

3.4. Pounding potential

Pounding effect D1, from Table to right: 1

Height Difference effect D2, from Table to right: 1

Therefore, Factor D: 1

3.5. Site Characteristics insignificant 1

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

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

3.6. Other factors, Factor F

	Along	Across
For ≤ 3 storeys, max value =2.5, otherwise max valule =1.5, no minimum	1.0	1.0
Rationale for choice of F factor, if not 1		

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)

List any: Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

3.7. Overall Performance Achievement ratio (PAR) **1.00** **1.00**

4.3 PAR x (%NBS)b: PAR x Baselline %NBS: **26%** **26%**

4.4 Percentage New Building Standard (%NBS), (before) **26%**

Official Use only:

Accepted By:

Date:

Appendix C

Previous Reports and Assessments

(1)

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	M W F	Date	21-6-11	Final Posting (e.g. UNSAFE)	UNSafe
Territorial Authority	Christchurch City	Time	11:00		

Building Name: Norman Kirk Main Pool Ladies, Mens, Nursery + Lean to Bldg
Short Name:
Address: 54 Oxford St Lyttelton
GPS Co-ordinates: S° E°
Contact Name: Bruce Thompson
Contact Phone: 027 449 2937

Storeys at and above ground level: 1
Below ground level: N/A
Total gross floor area (m²):
Year built:
No of residential Units:

Photo Taken: Yes (No)

Type of Construction
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☐ Concrete frame
- ☐ RC frame with masonry infill
- ☐ Concrete shear wall
- ☑ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☐ Other:

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☐ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☑ Other Pool Bldgs

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☐	☐	☑	Block walls will require partial/ complete demolition. Floor
Building or storey leaning	☑	☐	☐	sunk. Slab moved 20mm
Wall or other structural damage	☐	☐	☐	from pool. Significant
Overhead falling hazard	☐	☐	☑	damage
Ground movement, settlement, slips	☐	☑	☐	
Neighbouring building hazard	☐	☐	☑	On to driveway - south side from
Electrical, gas, sewerage, water, hazmats	☐	☐	☐	Not known lean to. This drive gives access to 54a Oxford St

Record any existing placard on this building:

Existing Placard Type (e.g. UNSAFE): Unsafe

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED			RESTRICTED USE		UNSAFE		
GREEN	G1	G2	YELLOW	Y1	Y2	RED	R1	R2	R3

Record any restriction on use or entry:

Further Action Recommended:

Need to design/detail new walls & investigate foundation conditions

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☑ Detailed engineering evaluation recommended
  - ☑ Structural
  - ☑ Geotechnical
  - ☐ Other:
- ☐ Other recommendations:

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☐	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☑	100 %	☐

Sign here on completion

Date & Time: 21-6-11 12:00

ID: Murray Frost SKM 021 402 180

PROPT:

Inspection ID: _____ *(Office Use Only)*

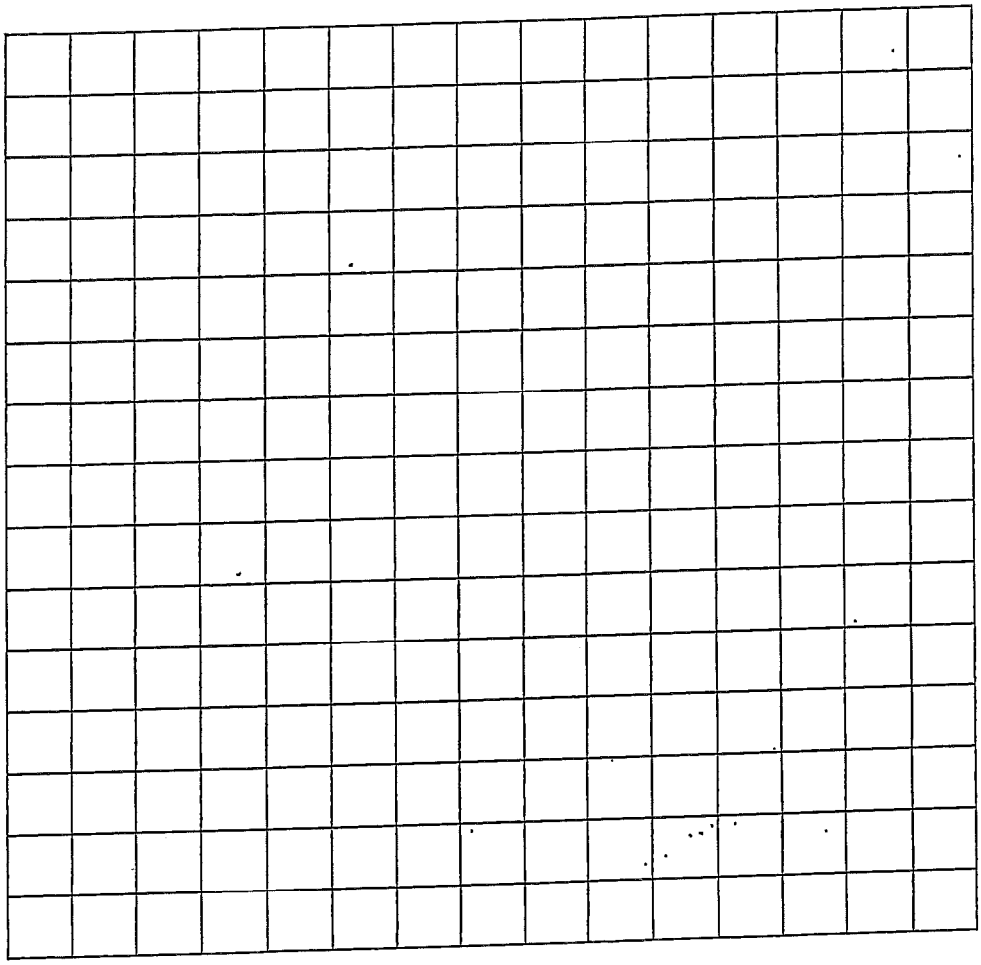
Structural Hazards/ Damage	Minor/None	Moderate	Severe	Comments
Foundations	☐	☑	☐	
Roofs, floors (vertical load)	☑	☐	☐	
Columns, pilasters, corbels	☑	☐	☐	
Diaphragms, horizontal bracing	☐	☐	☐	
Pre-cast connections	☐	☐	☐	
Beam	☐	☐	☐	
Non-structural Hazards / Damage				
Parapets, ornamentation	☐	☐	☐	
Cladding, glazing	☐	☐	☑	
Ceilings, light fixtures	☑	☐	☐	
Interior walls, partitions	☐	☐	☑	
Elevators	☐	☐	☐	N/A
Stairs/ Exits	☑	☐	☐	
Utilities (eg. gas, electricity, water)	☐	☐	☐	Not Known
Other	☐	☐	☐	
Geotechnical Hazards / Damage				
Slope failure, debris	☑	☐	☐	None
Ground movement, fissures	☑	☑	☐	Minor
Soil bulging, liquefaction	☑	☐	☐	None

General Comment ______________________________

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	Put danger tape along south wall of 12m to (along drive to 54a Oxford st) & across all access to other areas.
		R2. Severe damage: demolition likely	Block wing
		R3. At risk from adjacent premises or from ground failure	Walls cracked (5mm) & Walls badly damaged.

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.



Recommendations for Repair and Reconstruction or Demolition (Optional)

Detailed investigation & inspection required.

This could be a significant claim for CCC to the Insurance Company although danger to public is limited due to the Security arrangements around the pool.

Ring Tin Driver – Removed to 4TC by gas bottles from cabinet – wall in danger of collapse. City care to called. Two cylinders lying flat on ground by childs paddling pool.