South Brighton Motor Camp – Camp Building 1
Detailed Engineering Evaluation
BU 1359-007 EQ2
Qualitative Report

Prepared for Christchurch City Council

By Beca Carter Hollings & Ferner Ltd (Beca)

14 June 2013

Revision History

Revision Nº	Prepared By	Description	Date
A	Vini Moelianto	Draft for CCC review	12 November 2012
B	Vini Moelianto	Draft for CCC review	12 April 2013
C	Vini Moelianto	Final	14 June 2013

Document Acceptance

Action	Name	Signed	Date
Prepared by	Vini Moelianto	[signature]	14 June 2013
Reviewed by	Jonathan Barnett	[signature]	14 June 2013
Approved by	David Whittaker	[signature]	14 June 2013
on behalf of	Beca Carter Hollings & Ferner Ltd		

South Brighton Motor Camp – Camp Building 1

BU 1359-007 EQ2

Detailed Engineering Evaluation
Qualitative Report – SUMMARY
Revision C

Address
59 Halsey Street
South New Brighton
Christchurch

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 Camp building 1 is located at 59 Halsey Street, South New Brighton, Christchurch and constructed sometime between 1964 and 1976 according to historic aerial photographs. The building is a lightly reinforced concrete masonry block construction with an approximate floor area of 220 m^2 internally. No architectural or structural drawings were available at the time of this assessment.

Key Damage Observed

Visual inspection on 20 June 2012 indicates the building has suffered moderate damage. The key damage observed includes:

- Ground movement and settlement along the west side of the building and associated damage to the building. This is likely due to liquefaction during the earthquake event.
- Widespread cracking to concrete slab along the west side likely due to settlement and lateral spreading caused by liquefaction of the ground during the earthquake event.
- Separation between slab on grade and concrete pavement at the perimeter of the building. Separation at the west side is more severe than the other side.
- Cracking to thickened slab supporting the masonry walls.
- Widespread diagonal cracking to masonry blocks, typically 'stepped' through mortar joints.
- Widened construction joint of concrete pavement at the perimeter of the building.

Critical Structural Weaknesses (CSW)

The following potential Critical Structural Weaknesses have been identified:

- Site characteristics, due to widespread liquefaction observed in the surrounding area considered to be severe in this area.

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

The building has been assessed to have an undamaged seismic capacity of approximately 39%NBS and a post-earthquake capacity of 31%NBS using the NZSEE Initial Evaluation Procedure, and is therefore classified as potentially Earthquake Prone and Seismic Grade D.

Recommendations

In order that the owner can make an informed decision about the on-going 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 earthquake prone, having an assessed capacity in its damaged state of 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 "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. The building should be secured or demolished as soon as possible.

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 emergency purposes or damage assessment only.

It is recommended that:

- No further investigation or survey is recommended at this time as significant damage has resulted from the earthquake shaking. The level of damage suggests that this building may be uneconomic to be repaired. Demolition and replacement with a similar building may be considered appropriate.
- Repairs that would bring the building back to an "as new" condition are typically entitled under typical replacement insurance policies. However the damage is significant and it may be uneconomic to repair; demolition and replacement with a similar building may be considered appropriate. We suggest you consult with your insurance advisor as to how you wish to proceed.

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Appendices

1 Background

Beca Carter Hollings & Ferner Ltd (Beca) has been engaged by the Christchurch City Council (CCC) to undertake a qualitative Detailed Engineering Evaluation (DEE) of the South Brighton Motor Camp – Camp Building 1 located at 59 Halsey Street, South New Brighton, Christchurch.

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 on our visual inspection.

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 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. 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	South Brighton Motor Camp – Camp Building 1	
Street Address	59 Halsey Street South New Brighton Christchurch	
Age	1964-1976 construction is assumed.	No drawings available, the construction date is assumed between 1964 and 1976 based on the aerial photograph.
Description	Single storey amenities area	
Building Footprint / Floor Area	Approx. 220m^2 internally	
No. of storeys / basements	1 storey / no basement	
Occupancy / use	Kitchen, laundry and toilet	Importance Level 2 assumed
Construction	Lightly reinforced concrete masonry walls with timber roof rafters.	No drawings available. According to limited investigation using cover meter, there is vertical reinforcement every 1200mm. No horizontal reinforcement was found during limited investigation. It was not possible to check the bond beam reinforcement due to access.
Gravity load resisting system	Timber roof rafters and lightly reinforced masonry walls. There are some timber columns to support the roof along the west	

Item	Details	Comment
	face.	
Seismic load resisting system	Lightly reinforced masonry walls with timber roof sarking as the roof diaphragm.	
Foundation system	Slab on grade with thickening below the masonry wall.	No drawings available.
Stair system	Not applicable	
Other notable features	None	
External works	Concrete pavement at the perimeter of the building.	
Construction information	None	No drawings available
Likely design standard	NZSS 1900, Chapter 8:1965	Inferred from assumed age of building.
Heritage status	No heritage status	
Other		

4.2 Structural 'Hot-spots'

- Timber nailed connection between timber rafters and masonry wall.
- Spreading and fracturing of structural elements due to lateral spread and liquefaction.

5 Site Investigations

5.1 Previous Assessments

We have no previous level 1 or 2 assessment for this building. No historical reports or calculations relating to this structure were available.

5.2 Level 4 Damage Inspection

Visual inspections as part of the level 4 damage assessment were undertaken on 20 June 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			✓		Cracking to thickened slab supporting the masonry walls and the damage to main structure indicate there is a moderate settlement of foundation especially at the western end of the building. The damage to the masonry walls and slab at the western side is worse. This may indicate differential settlement. Elevation difference using Light Detection and Ranging (LiDAR) from post September 2010 and post December 2011 shows that the earthquakes caused more than 900 mm settlement in this region.
tilt of building		✓			Limited investigation and visual observation indicate the building is on a minor tilt. No verticality survey has been carried out.
liquefaction				✓	The aerial reconnaissance photograph from 24^{th} Feb 2011 indicates extensive liquefaction occurred on this site and in immediate surrounds.
settlement of external ground			✓		The joint opening of the external concrete apron and separation between external concrete apron and slab edge thickening may indicate settlement of external ground.
lateral spread / ground cracks			✓		Separation between external concrete apron and slab edge thickening may indicate lateral spread of external ground. The cracking and separation between the internal wall and slab may also indicate lateral spread throughout the building.
Frame damage	✓				N/A
masonry wall damage			✓		Widespread stepped cracking to masonry block walls with cracking width varying from 0.2mm to 5mm were observed. This damage may suggest the reinforcement has been damaged.
cracking to concrete floors			✓		Widespread cracking to concrete slab indicates the building has suffered differential settlement. Most of the cracking was observed at the western side of the building. The joint opening of the external concrete apron was also observed during visual inspection.
Bracing damage					Not applicable

Damage type	Unknown	Minor	Moderate	Major	Comment
precast flooring seating damage					Not applicable
Stairs damage					Not applicable
cladding /envelope damage			✓		Widespread stepped cracking to masonry wall at the perimeter of the building. Separation between timber window framing and masonry block.
internal fit out damage			✓		Widespread cracking to masonry block internal fit out. Separation between masonry block units joint also observed. The internal fit out at western side of the building indicates worse damage than the other part of the building.
building services damage	✓				No inspections of services were carried out.
Other damage		✓			Corrosion to the steel connection between timber column supporting the roof at the west end and the concrete pavement.

6.2 Surrounding Buildings

There are no adjacent buildings that are close enough that may affect this building during an earthquake.

6.3 Residual Displacements and General Observations

Some significant residual displacement and general ground movement were observed during visual inspections. Elevation difference using Light Detection and Ranging (LiDAR) from post September 2010 and post December 2011 shows that the earthquakes caused more than 900 mm settlement in this region.

6.4 Implication of Damage

The building has suffered structural damage which may have diminished the structural capacity. We have assumed a damage ratio of 20% in IEP. The damage is severe and it may be uneconomic to repair.

7 Generic Issues

The following generic issues referred to in Appendix A of the EAG guideline document have been identified as applicable to the Camp Building 1:

Partially filled concrete masonry

- Inadequate shear strength due to lightly reinforced masonry walls,
- Inadequate foundation due to widespread and major extent of liquefaction,

- Inadequate connections of floor and roof diaphragm to the walls likely due to ground movement and lateral spread which may affect the connection between primary structures.

8 Critical Structural Weaknesses

8.1 Site Characteristics

Liquefaction occurred on surrounding site, and was considered significant to the building performance. Therefore a site characteristic factor of 0.7 is used to assess the %NBS in the IEP of the building.

9 Geotechnical Consideration

No geotechnical information was available for this site. Cracking to thickened slab supporting the masonry walls and damage to the main structure indicate settlement potentially due to liquefaction of the ground. Damage to the west side of the building and cracking to the concrete slab indicate differential settlement and lateral spread.

10 Survey

Settlement was observed during our inspections. A level and verticality survey may be undertaken to confirm the extent of settlement Reinstatement of building settlement may be a significant cost and considered likely to exceed the cost of demolition and replacement.

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. A factor of 1.5 has been selected for the F factor. These capacities are subject to confirmation by a quantitative analysis which is more detailed. The post-damage capacity has been taken as 80% of the undamaged value to reflect the level of observed foundation and structural damage.

Table 11.1: Indicative Building Capacities

System	Direction	Seismic Performance in *%NBS*	Notes
Partially filled concrete masonry (undamaged state/damaged state)	Both directions	39% Undamaged 31% Damaged	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: D – NZS 1170.5:2004, Clause 3.1.3, Soft Soil

- 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 building comprises partially filled concrete masonry as the lateral load resisting system. This building is considered to be somewhere between a nominally ductile and brittle structure. For the purpose of assessment and based on the evidence of vertical reinforcement at regular intervals, a structural ductility of 2.0 has been used.

11.4 Discussion of results

Based on the IEP results, the Camp Building 1 is considered potentially Earthquake Prone and seismic grade D as its estimated seismic performance score allowing for damage is less than 34%NBS. This assessment is qualitative and based on the NZSEE IEP only. A quantitative assessment would not likely result in a significant change to the assessed capacity.

12 Initial Conclusions

- The original state of the building has been assessed to have a seismic capacity in the order of 39%NBS in its undamaged state and 31%NBS in its current, damaged condition, and is therefore potentially Earthquake Prone.
- Critical Structural Weaknesses have been identified as liquefaction potential at the site.
- Significant structural damage has resulted from the earthquake shaking.

13 Recommendations

13.1 Occupancy

In order that the owner can make an informed decision about the on-going 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 Earthquake Prone, having an assessed capacity of less than 34%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 "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. The building should be secured or demolished.

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 emergency purposes or damage assessment only

13.2 Further Investigations, Survey or Geotechnical Work

It is recommended that:

- No further investigation or survey is recommended at this time as significant damage has resulted from the earthquake shaking. The level of damage suggests that this building may be uneconomic to be repaired. Demolition and replacement with a similar building may be considered appropriate.

13.3 Damage Reinstatement

Repairs that would bring the building back to an “as new” condition are typically entitled under typical replacement insurance policies. However the damage is severe and it may be uneconomic to repair; demolition and replacement with a similar building may be considered appropriate. We suggest you consult with your insurance advisor as to how you wish to proceed.

14 Design Features Report

If it were possible to repair this structure economically then significant strengthening would also be required. At this stage, no strengthening is proposed as it is likely more economical to demolish and replace with a similar building.

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.

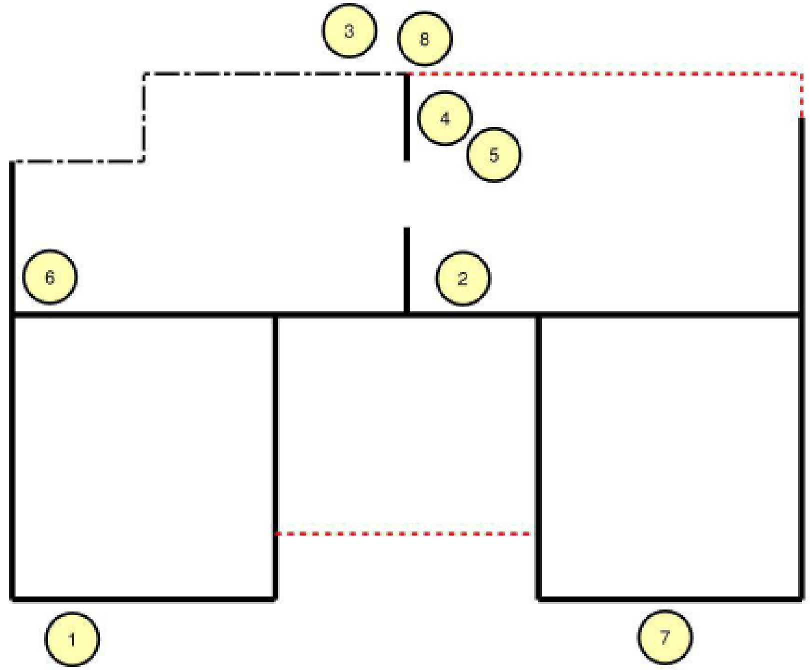
- The information in this report provides a snapshot of building damage at the time the detailed inspection was carried out. Additional inspections required as a result of significant aftershocks are outside the scope of this work.

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

Aerial photograph of site showing the building



HALF HEIGHT MASONRY WALL

GLAZING/DOOR OPENING

MASONRY WALL

XX PHOTO REFERENCE NUMBER

PROJECT TITLE:	SOUTH BRIGHTON MOTOR CAMP - CAMP BUILDING 1		
DRAWING TITLE:	BUILDING MAP		
Beca	DRAWN: [illegible]	CHECK: [illegible]	
	ISSUED DATE: [illegible]	APPD: [illegible]	
	SCALE AT A1 SIZE: [illegible]	SCALE AT A3 SIZE: [illegible]	
	BECA DRG No: 5323355 - 124 (JOB No)	SK-01 (SHT No)	REV: [illegible]

Photo 1: Typical Cracking and separation between slab edge thickening and external concrete apron

Damage description: Cracking and separation between slab edge thickening and external concrete apron indicate the building has likely suffered ground movement.

Photo 2: Typical cracking to thickened slab and separation between internal wall and thickened slab

Damage description: Widespread cracking and separation between internal wall and thickened slab especially at the western end of the building imply there is differential settlement and lateral spread of ground.

Photo 3: Widened construction joint of external concrete apron

Damage description: Widened construction joint of external concrete apron indicate there is external ground settlement.

Photo 4: The widest cracking to masonry block

Damage description: The significant cracking at the west end of the building with 5mm cracking width indicate the building has suffered significant displacement or differential settlement.

Photo 5: Typical cracking to concrete slab

Damage description: The cracking to concrete slab with approximately 0.4mm width observed likely due to settlement caused by earthquake shaking. The cracking to concrete slab was observed predominantly in the west end of the building.

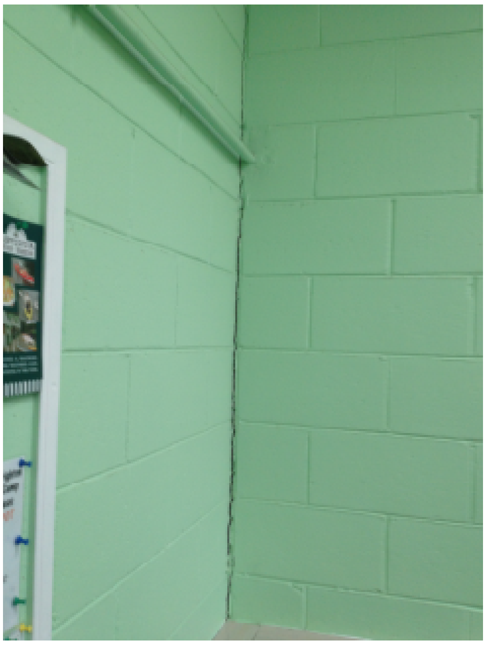


Photo 6: Typical separation of masonry block joint

Damage description: Separation between masonry block units at their joints is extensive especially at the western side of the building.

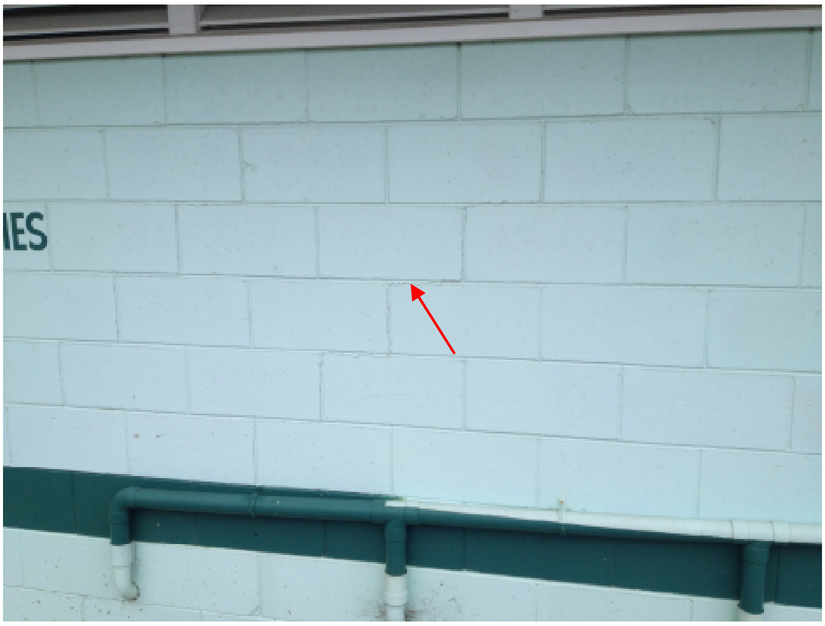


Photo 7: Typical stepped cracking to masonry wall

Damage description: Widespread stepped cracking to masonry wall are potentially due to differential settlement caused by earthquake shaking.

Photo 8: Separation between timber window framing and masonry block

Damage description: Separation between timber window framing and masonry block at the northwest of the building indicate the building has suffered ground settlement. This damage is consistent with other damage which also implies the ground movement at the western side of the building.

Appendix B

CERA DEE Summary Data

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Camp Building 1	Reviewer:	David Whittaker
Unit / No: / Street	59 Halsey Street	CPEng No:	123089
Building Address:	South Brighton Camping Ground	Company:	Beca
Legal Description:	BU 1359-007 EQ2	Company project number:	5323355
		Company phone number:	03 366 3521
GPS south (Degrees / Min / Sec):		Date of submission:	10/05/2013
GPS east:		Inspection Date:	20/06/2012
		Revision:	C
Building Unique Identifier (CCC):		Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:		Soil Profile (if available):	Unknown, no geotechnical report available
Site Class (to NZS1170.5):	D		
Proximity to waterway (m, if <100m):		If Ground improvement on site, describe:	None
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	

Building

No. of storeys above ground:	1	single storey = 1	
		Ground floor elevation (Absolute) (m):	
Ground floor split?	no	Ground floor elevation above ground (m):	0.00
Storeys below ground	0		
Foundation type:	strip footings	if Foundation type is other, describe:	unknown, assumed based on visual inspection
Building height (m):	2.50	height from ground to level of uppermost seismic mass (for IEP only) (m):	2.5m eaves and 3.5 apex
Floor footprint area (approx):	220		
Age of Building (years):	40	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):	Kitchen, laundry and toilet		
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber framed	rafter type, purlin type and cladding	Timber roof sarking
Floors:	concrete flat slab	slab thickness (mm)	Unknown
Beams:	none	overall depth x width (mm x mm)	
Columns:			
Walls:	partially filled concrete masonry	thickness (mm)	200

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	partially filled CMU		note total length of wall at ground (m):	26m of CMU, it is lightly reinforced CMU
Ductility assumed, μ:	2.00		wall thickness (m):	
Period along:	0.40	##### enter height above at H31	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):	33m of CMU, it is lightly reinforced CMU
Ductility assumed, μ:	2.00		wall thickness (m):	
Period across:	0.40	##### enter height above at H31	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:	other (specify)	describe	No stair
Wall cladding:	exposed structure	describe	Painted CMU
Roof Cladding:	Metal	describe	
Glazing:	timber frames		
Ceilings:	none		
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:	Widespread liquefaction on site	Describe damage:	Lateral spread and differential settlement
Settlement:	more than 200mm	notes (if applicable):	Geotechnical report is required to confirm
Differential settlement:	1:250-1:150	notes (if applicable):	Geotechnical report is required to confirm
Liquefaction:	5-10 m²/100m³	notes (if applicable):	Geotechnical report is required to confirm
Lateral Spread:	0-50mm	notes (if applicable):	Geotechnical report is required to confirm
Differential lateral spread:	0-1:400	notes (if applicable):	Geotechnical report is required to confirm
Ground cracks:	0-20mm/20m	notes (if applicable):	Geotechnical report is required to confirm
Damage to area:	moderate to substantial (1 in 5)	notes (if applicable):	Ground crack, settlement potentially due to liquefaction

Building:

	Current Placard Status:	green		
Along	Damage ratio:	20%	Describe how damage ratio arrived at:	
	Describe (summary):			
Across	Damage ratio:	20%		
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	yes	Describe:	Liquefaction
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	no	Describe:	

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

Recommendations

	Level of repair/strengthening required:	significant structural	Describe:	Reinstatement and relevel foundations, rebuild damage w
	Building Consent required:	yes	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before:	39%	39% %NBS from IEP below	If IEP not used, please detail assessment methodology:
	Assessed %NBS after:	31%		
Across	Assessed %NBS before:	39%	39% %NBS from IEP below	
	Assessed %NBS after:	31%		

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: 2.5m eaves and 3.5 apexm

Seismic Zone, if designed between 1965 and 1992:

not required for this age of building
not required for this age of building

	along	across
Period (from above):	0.4	0.4
(%NBS)nom from Fig 3.3:	5.0%	5.0%

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

	along	across
Final $(\%NBS)_{nom}$:	**5%**	**5%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, cl 3.1.6: 1.00

	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	1.0
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)	2.00	2.00
Ductility scaling factor: =1 from 1976 onwards; or $=k_\mu$, if pre-1976, fromTable 3.3:	1.57	1.57
Ductiity Scaling Factor, **Factor D**:	1.57	1.57

2.6 Structural Performance Scaling Factor:

	along	across
Sp:	0.700	0.700
Structural Performance Scaling Factor **Factor E**:	1.428571429	1.428571429

	along	across
2.7 Baseline %NBS, $(NBS\%)_b = (\%NBS)_{nom}$ x A x B x C x D x E — **$\%NBS_b$:**	**37%**	**37%**

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		1.0
Height Difference effect D2, from Table to right		1.0
Therefore, Factor D:		1
3.5. Site Characteristics	significant	0.7

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 value =1.5, no minimum	1.5	1.5
Rationale for choice of F factor, if not 1	Based on investigations indicates reinforcement to the walls	

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

	along	across
3.7. Overall Performance Achievement ratio (PAR)	**1.05**	**1.05**
4.3 PAR x (%NBS)b: — PAR x Baselline %NBS:	**39%**	**39%**
4.4 Percentage New Building Standard (%NBS), (before)		**39%**