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South New Brighton Park – North Toilets
PRK 1944 BLDG 008

Detailed Engineering Evaluation

Qualitative Report

Version FINAL

74 Beatty Street, New Brighton

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

South New Brighton Park – North Toilets
PRK 1944 BLDG 008

Detailed Engineering Evaluation
Qualitative Report
Version FINAL

74 Beatty Street, New Brighton

Christchurch City Council

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Date
9 July 2013

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South New Brighton Park – North Toilets

PRK 1944 BLDG 008

Detailed Engineering Evaluation

Qualitative Report - SUMMARY

Version FINAL

74 Beatty Street, New Brighton

Background

This is a summary of the Qualitative report for the building structure, and is based in part on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011 and visual inspections on 14 September 2012.

Building Description

The building is located at South New Brighton Park, 74 Beatty Street, New Brighton. The building was constructed in 1972 and is used solely as a public toilet.

The roof of the structure is formed by two 150mm thick cast-in-situ reinforced concrete slabs. The reinforced concrete slabs span in the longitudinal direction of the building. Each slab is supported along the two short ends by reinforced concrete downstands which are tied into the supporting concrete masonry walls. In the centre of each roof slab is a large diameter precast concrete pipe which is bolted to the reinforced concrete roof slab to provide an opening in the slab. The 190 mm thick concrete masonry walls consist of partially filled masonry units with 12mm vertical reinforcing and a bond beam reinforced with 2 no. 10mm longitudinal bars in the top course of each concrete masonry wall. The foundations of the structure consist of linked reinforced concrete ground beams beneath the concrete masonry walls and a reinforced concrete slab-on-grade.

Key Damage Observed

No residual displacements of the structure were observed during inspection of the building. Some cracking in the concrete floor slab was observed at the eastern entrance to the building.

Critical Structural Weaknesses

For an earthquake occurring in the longitudinal direction of the building, there is no obvious load path in the structure to transfer seismic loads from the reinforced concrete roof slab to the lateral load resisting concrete masonry walls in the plane of loading.

The absence of a reliable load path in the longitudinal direction of the building has been assessed as a ‘significant’ vertical irregularity Critical Structural Weakness in accordance with the NZSEE guidelines.

- Vertical Irregularity 10% NBS

The 190mm thick concrete masonry partition walls are unrestrained along the top edge (see Photograph 5). These unrestrained masonry walls may be susceptible to collapse from out-of-plane seismic actions. The unrestrained concrete masonry panels are not expected to have an adverse effect on overall structural performance; however, they do have implications for possible threat to life if they collapse.

Indicative Building Strength (from IEP and CSW assessment)

Based on the information available, and using the NZSEE Initial Evaluation Procedure, the original capacity of the building has been assessed to be in the order of 10% NBS and post-earthquake capacity also in the order of 10% NBS. The buildings post-earthquake capacity excluding critical structural weaknesses is in the order of 14% NBS.

The building has been assessed to have a seismic capacity in the order of 10% NBS and is therefore potentially Earthquake Prone.

Recommendations

It is recommended that a quantitative assessment of the building be undertaken to determine the seismic capacity and to develop potential strengthening concepts.

1. Background

GHD has been engaged by the Christchurch City Council (CCC) to undertake a detailed engineering evaluation of the North Toilets at South New Brighton Park.

This report is a Qualitative Assessment of the building structure, and is based in part on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011.

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

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

At the time of this report, no intrusive site investigation, detailed analysis, or modelling of the building structure had been carried out. Construction drawings have been made available. The building description below is based on our visual inspections and a review of the available drawings.

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 anticipated that CERA will adopt the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011. This document sets out a methodology for both qualitative and quantitative assessments.

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

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

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

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.

2.2.1 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.

We anticipate that any building with a capacity of less than 33% NBS (including consideration of critical structural weaknesses) will need to be strengthened to a target of 67% NBS of new building standard as recommended by the Policy.

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

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

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.

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

- Hazard Factor increased from 0.22 to 0.3 (36% increase in the basic seismic design load)
- 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 earthquake resistance is compared with the current New Zealand Building Code requirements for a new building constructed on the site. This is expressed as a percentage of new building standard (%NBS). The new building standard load requirements have been determined in accordance with the current earthquake loading standard (NZS 1170.5:2004 Structural design actions - Earthquake actions - New Zealand).

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

The New Zealand Society for Earthquake Engineering has proposed a way for classifying earthquake risk for existing buildings in terms of %NBS and this is shown in Figure 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 1 NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE

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

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

Table 1 %NBS compared to relative risk of failure

4. Building Description

4.1 General

The building is located at South New Brighton Park, 74 Beatty Street, New Brighton. The building was constructed in 1972 and is used solely as a public toilet.

The roof of the structure is formed by two 150mm thick cast-in-situ reinforced concrete slabs. The reinforced concrete slabs span in the longitudinal direction of the building. Each slab is supported along the two short ends by reinforced concrete downstands which are tied into the supporting concrete masonry walls. The connection consists of 12mm reinforcing starter bars lapped onto the vertical reinforcement in the walls at 600mm centres. Photograph 2 shows the concrete masonry walls supporting two sides only of each roof slab.

In the centre of each roof slab is a large diameter precast concrete pipe which is bolted to the reinforced concrete roof slab to provide an opening in the slab.

The 190 mm thick concrete masonry walls consist of partially filled masonry units with 12mm vertical reinforcing and a bond beam reinforced with 2 no. 10mm longitudinal bars in the top course of each concrete masonry wall. The vertical reinforcement in the walls consists of 12mm diameter bars spaced at 1200mm centres in the longitudinal direction and 600mm centres in the transverse direction.

The foundations of the structure consist of linked reinforced concrete ground beams beneath the concrete masonry walls and a reinforced concrete slab-on-grade. The ground beams are generally 550x250mm and are reinforced with 4 no. 12mm longitudinal bars with 6mm stirrups at 300mm centres. The concrete floor slab is 100mm thick and is reinforced with 668 Mesh.

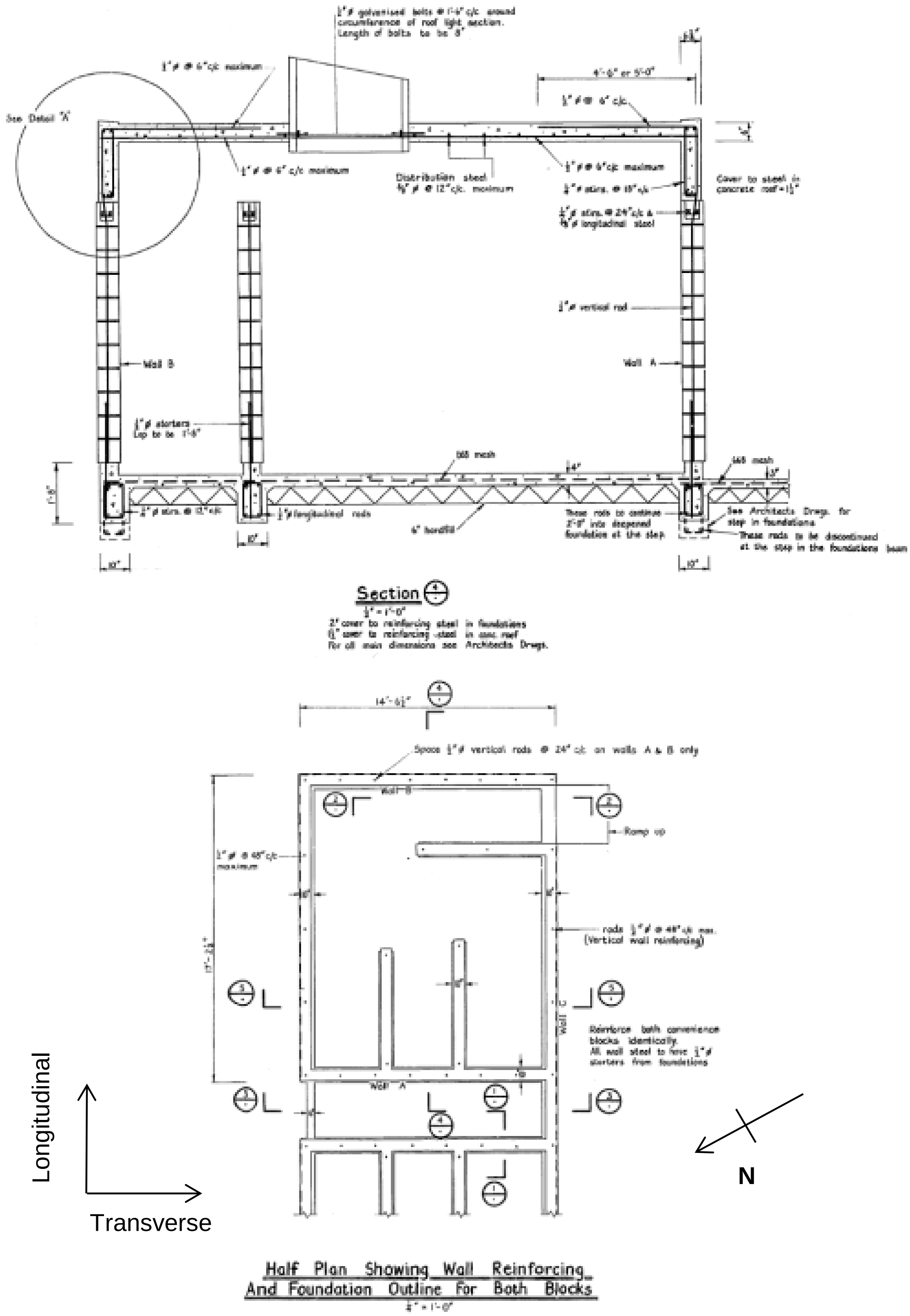


Figure 2 Excerpt from Drawings Showing Key Structural Elements

The building is approximately 11.5 m in length by 4.5 m in width with a height of 3.0 m. The building occupies a footprint of approximately $52m^2$. The relatively flat site is approximately 200m east of the Avon-Heathcote Estuary.

Structural drawings of the building, dated 1972, were made available.

4.2 Gravity Load Resisting System

Gravity loads acting on the building are resisted by load bearing concrete masonry walls. The reinforced concrete roof slabs span between concrete masonry walls supporting each short end of the of the roof slab. Gravity loads are transferred from the reinforced concrete roof slab to the concrete masonry walls. The gravity loads are transferred through the concrete masonry walls to the reinforced concrete ground beams where they are distributed into the ground. Floor gravity loads are transferred through the reinforced concrete slab to the underlying ground.

4.3 Lateral Load Resisting System

In the transverse direction of the building, the reinforced concrete roof slab acts as a diaphragm to transfer seismic forces in the roof structure to the lateral load resisting concrete masonry walls. Lateral loads are resisted primarily by the panel action of concrete masonry walls. Loads are then transferred to the foundations through shear and bending of the concrete masonry walls.

In the longitudinal direction of the building, there is minimal connection between the reinforced concrete roof slab and the concrete masonry walls in the plane of loading. There is no reliable load path in the structure to transfer seismic loads from the reinforced concrete roof slab to the lateral load resisting concrete masonry walls. The seismic loads are likely to be resisted by out-of-plane action of the transverse concrete masonry walls supporting the roof slabs.

The 190mm thick concrete masonry partition walls and the longitudinal external concrete walls are unrestrained along the top edge. Out-of-plane loading on these walls is likely to be resisted by a combination of the walls spanning horizontally between return walls and cantilever action.

5. Assessment

An inspection of the building was undertaken on the 14 September 2012. Both the interior and exterior of the building were inspected.

The inspection consisted of scrutinising the building to determine the structural systems and likely behaviour of the building during an earthquake. The site was assessed for damage, including examination of the ground conditions, checking for damage in areas where damage would be expected for the type of structure and noting general damage observed throughout the building in both structural and non-structural elements.

The %NBS score determined for this building has been based on the IEP procedure described by the NZSEE and based on the information obtained from visual observation of the building and a review of the available drawings.

5.1 Damage Assessment

5.1.1 Surrounding Buildings

No damage to surrounding buildings or structures was observed.

5.1.2 Residual Displacements and General Observations

No residual displacements of the structure were observed during inspection of the building. Some cracking in the concrete floor slab was observed at the eastern entrance to the building as can be seen in Photograph 4. It is unclear if this damage was caused by seismic activity.

5.1.3 Ground Damage

No ground damage was observed in the immediate vicinity of the building or in the area surrounding the building.

5.1.4 Floor Level Survey

No level or verticality surveys have been undertaken for this building at this stage as indicated by Christchurch City Council guidelines

6. Critical Structural Weakness

6.1 Short Columns

No short columns are present in the structure.

6.2 Lift Shaft

The building does not contain a lift shaft.

6.3 Roof

For an earthquake occurring in the longitudinal direction of the building, there is no obvious load path in the structure to transfer seismic loads from the reinforced concrete roof slab to the lateral load resisting concrete masonry walls in the plane of loading.

The absence of a reliable load path in the longitudinal direction of the building has been assessed as a 'significant' vertical irregularity Critical Structural Weakness in accordance with the NZSEE guidelines.

6.4 Concrete Masonry Walls

The 190mm thick concrete masonry partition walls are unrestrained along the top edge (see Photograph 5). These unrestrained masonry walls may be susceptible to collapse from out-of-plane seismic actions. The unrestrained concrete masonry panels are not expected to have an adverse effect on overall structural performance; however, they do have implications for possible threat to life if they collapse. Accordingly, a compensating provision for a 'significant' potential threat to life has been incorporated in Factor F, in accordance with the NZSEE guidelines.

6.5 Staircases

The building does not contain a staircase.

6.6 Site Characteristics

Following the geotechnical appraisal it was found that the site has a minor potential for liquefaction. For the purposes of the IEP assessment of the building and the determination of the %NBS score, the effects of soil liquefaction on the performance of a building of this type and size has been assessed as an 'insignificant' site characteristic in accordance with the NZSEE guidelines.

7. Geotechnical Consideration

7.1 Site Description

The site is situated on the New Brighton Spit, in eastern Christchurch. It is relatively flat at approximately 1.8m above mean sea level. It is approximately 200m east of the Avon-Heathcote Estuary and 550m west of the coast (Pegasus Bay).

7.2 Published Information on Ground Conditions

7.2.1 Published Geology

The geological map of the area[1] indicates that the site is underlain by:

- Dominantly sand of fixed and semi-fixed dunes and beaches, being marine soils of the Christchurch Formation, Holocene in age.

Brown & Weeber (1992) indicates that groundwater is likely within 1m of the ground surface.

7.2.2 Environment Canterbury Logs

Information from Environment Canterbury (ECan) indicates that 5 boreholes with lithographic logs are located within 100m of the site (see Table 2).

These indicate the area is underlain by sand with varying amounts of silt to 30m bgl.

Groundwater was recorded between 1.0 and 4.0m bgl.

Table 2 ECan Borehole Summary

Bore Name	Log Depth	Groundwater	Distance & Direction from Site
M35/10997	10.5m	1.0m bgl	70m W
M35/11828	13.0m	1.0m bgl	95m E
M35/11827	13.0m	1.0m bgl	40m E
M35/11826	13.0m	1.0m bgl	60m W
M35/11708	95.63m	4.0m bgl	80m SE

It should be noted the logs have been written by the well driller and not a geotechnical professional or to a standard. In addition strength data is not recorded.

7.2.3 EQC Geotechnical Investigations

The Earthquake Commission has not undertaken geotechnical testing in the area of the subject site.

[1] Brown, L. J. & Weeber, J.H. (1992): *Geology of the Christchurch Urban Area*. Institute of Geological and Nuclear Sciences 1:25,000 Geological Map 1. IGNS Limited: Lower Hutt.

7.2.4 Land Zoning

Canterbury Earthquake Recovery Authority (CERA) has indicated the site is situated within the Green Zone, indicating that repair and rebuild may take place.

Land in the CERA green zone has been divided into three technical categories. These categories describe how the land is expected to perform in future earthquakes.

The site has been categorised as "N/A – Urban Non-residential". However, neighbouring residential properties within 80m of the site are classified as being within the TC2 (yellow) zone[2]. This means that minor to moderate land damage from liquefaction is possible in future significant earthquakes.

7.2.5 Post February Aerial Photography

Aerial photography taken following the 22 February 2011 earthquake shows signs of minor liquefaction outside the building footprint, as shown in Figure 3.

Figure 3 Post February 2011 Earthquake Aerial Photography[3]

[2] CERA Landcheck website, http://cera.govt.nz/my-property

[3] Aerial Photography Supplied by Koordinates sourced from http://koordinates.com/layer/3185-christchurch-post-earthquake-aerial-photos-24-feb-2011/

7.2.6 Summary of Ground Conditions

From the information presented above, the ground conditions underlying the site are anticipated to comprise sands with varying amounts of silt to 30m bgl. Groundwater is anticipated to be 1.0 to 4.0m bgl, it is expected to vary seasonally and is unlikely to be influenced by the tide.

7.3 Seismicity

7.3.1 Nearby Faults

There are many faults in the Canterbury region, however only those considered most likely to have an adverse effect on the site are detailed below.

Table 3 Summary of Known Active Faults[4][5]

Known Active Fault	Distance from Site	Direction from Site	Max Likely Magnitude	Avg Recurrence Interval
Alpine Fault	130 km	NW	~8.3	~300 years
Greendale (2010) Fault	30 km	W	7.1	~15,000 years
Hope Fault	110 km	N	7.2~7.5	120~200 years
Kelly Fault	110 km	NW	7.2	~150 years
Porters Pass Fault	70 km	NW	7.0	~1100 years

The recent earthquakes since 4 September 2010 have identified the presence of a previously unmapped active fault system underneath the Canterbury Plains, including Christchurch City, and the Port Hills. Research and published information on this system is in development and not generally available. Average recurrence intervals are yet to be estimated.

7.3.2 Ground Shaking Hazard

New Zealand Standard NZS 1170.5:2004 quantifies the Seismic Hazard factor for Christchurch as 0.30, being in a moderate to high earthquake zone. This value has been provisionally upgraded recently (from 0.22) to reflect the seismicity hazard observed in the earthquakes since 4 September 2010.

The recent seismic activity has produced earthquakes of Magnitude-6.3 with peak ground accelerations (PGA) up to twice the acceleration due to gravity (2g) in some parts of the city. This has resulted in widespread liquefaction throughout Christchurch.

7.4 Slope Failure and/or Rockfall Potential

The topography surrounding the site suggests that rockfall is not a potential hazard. However, given its proximity to the Avon-Heathcote Estuary, and evidence from the recent earthquakes, the site may be

[4] Stirling, M.W, McVerry, G.H, and Berryman K.R. (2002) A New Seismic Hazard Model for New Zealand, Bulletin of the Seismological Society of America, Vol. 92 No. 5, pp 1878-1903, June 2002.

[5] GNS Active Faults Database

susceptible to lateral spreading. In addition, any retaining structures or embankments nearby should be further investigated to determine the site-specific local slope instability potential.

7.5 Liquefaction Potential

The site is considered to have a minor susceptibility to liquefaction, due to the following reasons:

- Evidence of minor liquefaction in post-earthquake aerial photography;
- Classification of neighbouring properties as TC2; and,
- Anticipated presence of predominantly saturated sands beneath the site.

7.6 Conclusions & Recommendations

This assessment is based on a review desktop of the geology and existing ground investigation information, and observations from the Christchurch earthquakes since 4 September 2010, no site visit was undertaken.

The site appears to be situated on sand with varying amounts of silt. Associated with this the site also has a minor liquefaction potential, in particular where saturated sands are present.

A soil class of **D** (in accordance with NZS 1170.5:2004) should be adopted for the site.

Should a more comprehensive liquefaction and/or ground condition assessment be required, it is recommended that intrusive investigation be conducted.

8. Initial Capacity Assessment

8.1 % NBS Assessment

The building has had its capacity assessed using the Initial Evaluation Procedure based on the information available. The buildings capacity excluding critical structural weaknesses is in the order of 14% NBS. The assessed capacity including Critical Structural Weaknesses is in the order of 10% NBS. These capacities are subject to confirmation by a more detailed quantitative analysis.

Item	%NBS
Building excluding CSW's	14
Vertical Irregularity (30% Reduction)	10

Table 4 Indicative Building and Critical Structural Weaknesses Capacities based on the NZSEE Initial Evaluation Procedure

Following an IEP assessment, the building has been assessed as achieving 10% New Building Standard (NBS). Under the New Zealand Society for Earthquake Engineering (NZSEE) guidelines the building is considered potentially Earthquake Prone as it achieves less than 34% NBS.

8.2 Seismic Parameters

The seismic design parameters based on current design requirements from NZS 1170:2002 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 1 August 2011
- Return period factor R_u = 1.0 NZS 1170.5:2004, Table 3.5, Importance level 2 structure with a 50 year design life.

An increased Z factor of 0.3 for Christchurch has been used in line with requirements from the Department of Building and Housing resulting in a reduced % NBS score.

8.3 Expected Structural Ductility Factor

A structural ductility factor of 1.25 has been assumed based on the concrete masonry wall system observed. The walls are expected to be nominally ductile as the units are partially filled and lightly reinforced.

8.4 Discussion of Results

The results obtained from the initial IEP assessment are consistent with those expected for a building of this age and construction type, founded on soft soil. The building was constructed in 1972 and was likely designed to the loading standard current at the time, specifically NZS 1900:1965. The design loads used in accordance with this standard are likely to have been less than those required by the current loading standard. Combined with the increase in the seismic hazard factor for Christchurch to 0.3 and the presence of a critical structural weakness, it is reasonable to expect the building would achieve less than 34% NBS.

9. Initial Conclusions & Recommendations

The building has been assessed to have a seismic capacity in the order of 10% NBS and is therefore potentially Earthquake Prone.

A quantitative assessment of the building should be undertaken to determine the seismic capacity and to develop potential strengthening options.

10. Limitations

10.1 General

This report has been prepared subject to the following limitations:

- No intrusive structural investigations have been undertaken.
- No intrusive geotechnical investigations have been undertaken.
- No level or verticality surveys have been undertaken.
- No material testing has been undertaken.
- No calculations, other than those included as part of the IEP in the CERA Building Evaluation Report, have been undertaken. No modelling of the building for structural analysis purposes has been performed.

It is noted that this report has been prepared at the request of Christchurch City Council and is intended to be used for their purposes only. GHD accepts no responsibility for any other party or person who relies on the information contained in this reportrite a specific limitations section.

10.2 Geotechnical Limitations

This report presents the results of a geotechnical appraisal prepared for the purpose of this commission, and solely for the use of Christchurch City Council and their advisors. The data and advice provided herein relate only to the project and structures described herein and must be reviewed by a competent geotechnical engineer before being used for any other purpose. GHD Limited (GHD) accepts no responsibility for other use of the data.

The advice tendered in this report is based on a visual geotechnical appraisal. No subsurface investigations have been conducted. An assessment of the topographical land features have been made based on this information. It is emphasised that Geotechnical conditions may vary substantially across the site from where observations have been made. Subsurface conditions, including groundwater levels can change in a limited distance or time. In evaluation of this report cognisance should be taken of the limitations of this type of investigation.

An understanding of the geotechnical site conditions depends on the integration of many pieces of information, some regional, some site specific, some structure specific and some experienced based. Hence this report should not be altered, amended or abbreviated, issued in part and issued incomplete in any way without prior checking and approval by GHD. GHD accepts no responsibility for any circumstances, which arise from the issue of the report, which have been modified in any way as outlined above.

Appendix A

Photographs

Photograph 1 View of the building from the south-west

Photograph 2 View of concrete masonry wall and reinforced concrete roof slab

Photograph 3 View of the building from the north-east

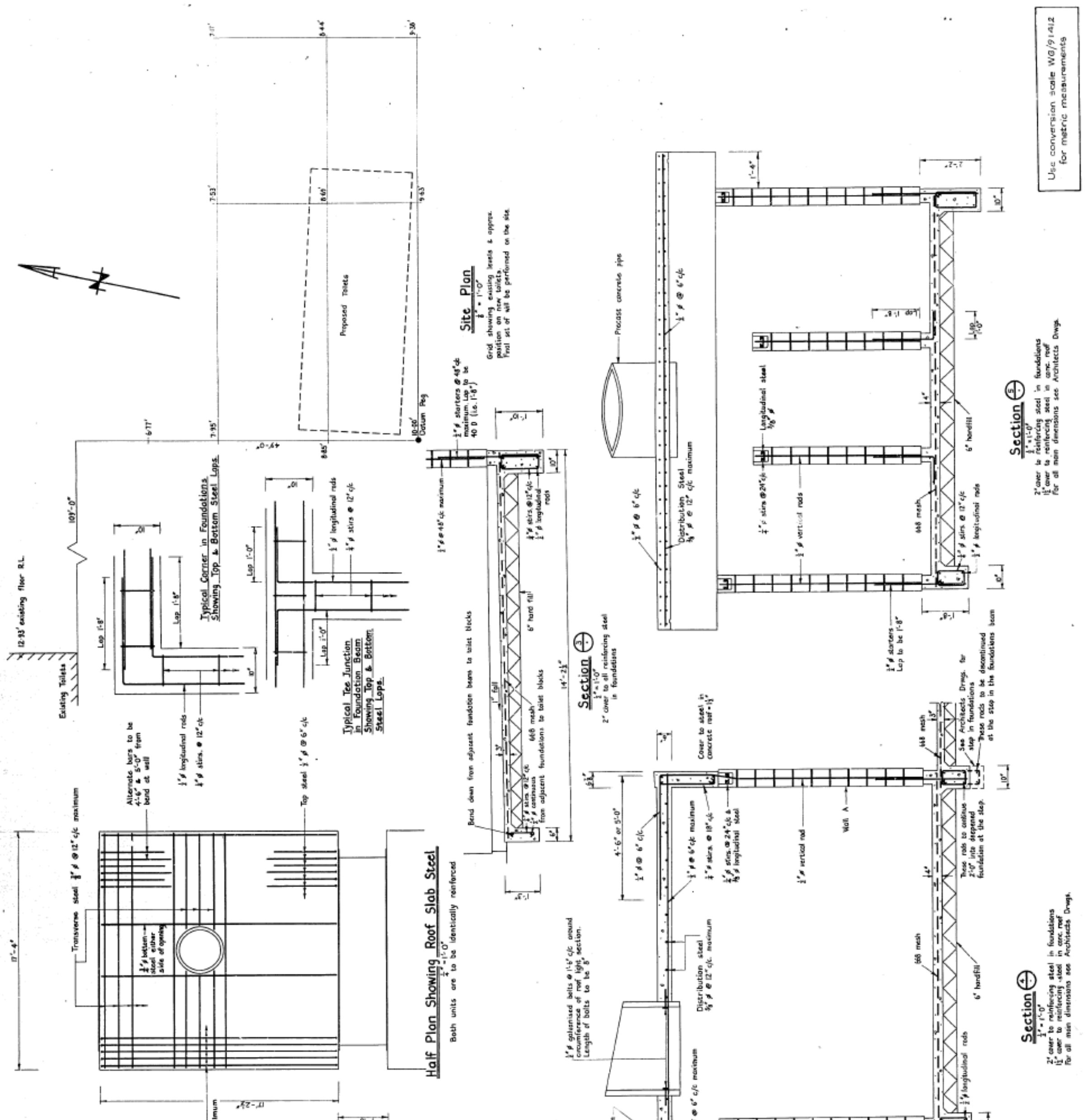
Photograph 4 Cracking in concrete floor slab at the eastern corner of the building

Photograph 5 Internal concrete masonry partition walls clad with ceramic tiles

Photograph 6 Reinforced concrete legs supporting the reinforced concrete roof slab

Appendix B

Drawings


Site Plan
Half Plan Showing Roof Slab Steel
Half Plan Showing Wall Reinforcing And Foundation Outline For Both Blocks
Detail 'A'
Typical Corner in Foundations Showing Top & Bottom Steel Laps
Typical Tee Junction in Foundation Beam Showing Top & Bottom Steel Laps
Proposed Toilets
Existing Toilets

Appendix C

CERA Building Evaluation Form

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	South New Brighton Park - North Toilets	Reviewer:	Stephen Lee
	Unit / No: 74 / Street: Beatty Street	CPEng No:	1006840
Building Address:	74 Beatty Street	Company:	GHD
Legal Description:		Company project number:	513090272
		Company phone number:	04 472 0799
GPS south: (Degrees / Min / Sec)		Date of submission:	
GPS east:		Inspection Date:	9/14/2012
		Revision:	
Building Unique Identifier (CCC):	PRK_1944_BLDG_008	Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:		Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
Proximity to waterway (m, if <100m):		If Ground improvement on site, describe:	
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	1.80

Building

No. of storeys above ground:	1 (single storey = 1)	Ground floor elevation (Absolute) (m):	1.90
Ground floor split?	no	Ground floor elevation above ground (m):	0.10
Storeys below ground	0		
Foundation type:	strip footings	if Foundation type is other, describe:	
Building height (m):	2.95	height from ground to level of uppermost seismic mass (for IEP only) (m):	2.95
Floor footprint area (approx):	52		
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):	Public Toilet		
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	concrete	slab thickness (mm)	150
Floors:	other (note)	describe sytem	Slab on grade
Beams:			
Columns:			
Walls:	partially filled concrete masonry	thickness (mm)	190

Lateral load resisting structure

Lateral system along:	partially filled CMU	**Note: Define along and across in detailed report!**		
Ductility assumed, μ:	1.25		note total length of wall at ground (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			
Ductility assumed, μ:	1.25		note total length of wall at ground (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:	
Wall cladding:	
Roof Cladding:	
Glazing:	
Ceilings:	
Services(list):	

Available documentation

Architectural	none	original designer name/date	
Structural	full	original designer name/date	CCC - City Engineers Dept. (1972)
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:	Good	Describe damage:	
Settlement:	none observed	notes (if applicable):	
Differential settlement:	none observed	notes (if applicable):	
Liquefaction:	none apparent	notes (if applicable):	
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	none apparent	notes (if applicable):	

Building:

	Current Placard Status:	green	
Along	Damage ratio:	0%	Describe how damage ratio arrived at:
	Describe (summary):	No visible damage to structure.	
Across	Damage ratio:	0%	
	Describe (summary):	No visible damage to structure.	
Diaphragms	Damage?:	no	Describe:
CSWs:	Damage?:	no	Describe:
Pounding:	Damage?:	no	Describe:
Non-structural:	Damage?:	no	Describe:

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

Recommendations

	Level of repair/strengthening required:			Describe:
	Building Consent required:			Describe:
	Interim occupancy recommendations:			Describe:
Along	Assessed %NBS before e'quakes:	10%	10% %NBS from IEP below	If IEP not used, please detail assessment methodology:
	Assessed %NBS after e'quakes:	10%		
Across	Assessed %NBS before e'quakes:	10%	10% %NBS from IEP below	
	Assessed %NBS after e'quakes:	10%		

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: 2.95m

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:	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: 0.8

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 =kμ, if pre-1976, fromTable 3.3:	1.14	1.14
Ductiity Scaling Factor, **Factor D**:	1.14	1.14

2.6 Structural Performance Scaling Factor:

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

	along	across
2.7 Baseline %NBS, $(NBS\%)_b = (\%NBS)_{nom}$ x A x B x C x D x E **$\%NBS_b$:**	**21%**	**21%**

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:	significant	0.7
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 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	0.7	0.7
Rationale for choice of F factor, if not 1	Unrestrained Masonry Walls	Unrestrained Masonry 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)	**0.49**	**0.49**
4.3 PAR x $(\%NBS)_b$: PAR x Baselline %NBS:	**10%**	**10%**

4.4 Percentage New Building Standard (%NBS), (before) **10%**

GHD

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