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Hillsborough Park Pavilion
PRK_0962_BLDG_001
Detailed Engineering Evaluation
Qualitative Report
Version Final

22 Bishopworth Street, Hillsborough

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

Hillsborough Park Pavilion
PRK_0962_BLDG_001

Detailed Engineering Evaluation
Qualitative Report
Version Final

22 Bishopworth Street, Hillsborough

Christchurch City Council

Prepared By
Dale Donovan

Reviewed By
David Lee

Date
23 May 2013

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Qualitative Report Summary

Hillsborough Park Pavilion

PRK_0962_BLDG_001

Detailed Engineering Evaluation

Qualitative Report - SUMMARY

Version Final

22 Bishopworth Road, Hillsborough

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 17 July 2012.

Key Damage Observed

Key damage observed includes:-

- Possible settlement has occurred nearby
- Minor cracks in the edge of the concrete slab-on-grade foundation

Critical Structural Weaknesses

No potential critical structural weaknesses have been identified in the structure.

Due to the ground conditions on site it is possible that liquefaction will occur. However the effect liquefaction will have on the structure will not be a severe threat, therefore in terms of the IEP the site characteristics have been deemed to not be significant.

Indicative Building Strength (from IEP and CSW assessment)

Based on the information available, and using the NZSEE Initial Evaluation Procedure, the building's original capacity has been assessed to be in the order of 61% NBS and post-earthquake capacity also in the order of 61% NBS. The building's post-earthquake capacity excluding critical structural weaknesses is in the order of 61% NBS.

The building has been assessed to have a seismic capacity in the order of 61% NBS and is therefore considered to be potentially an Earthquake Risk.

Recommendations

The recent seismic activity in Christchurch has caused very minor visible damage to the building. As the building has achieved between 34% NBS and 67% NBS following a qualitative Detailed Engineering Evaluation of the building, further assessment is not required. However, GHD recommended that a quantitative assessment be carried out and if necessary strengthening options explored.

The building can remain occupied as the building has not been found to be earthquake prone.

1. Background

GHD has been engaged by the Christchurch City Council (CCC) to undertake a detailed engineering evaluation of the Hillsborough Park pavilion.

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 were made available, and these have been considered in our evaluation of the building. The building description below is based on a review of the drawings and our visual inspections.

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 pavilion is located at 22 Bishopworth Street, Hillsborough Domain in Hillsborough. The original construction date of the structure is unknown but based on site observation is estimated to be in late 1970's or early 1980's. The pavilion and seating area is integrated with a toilet block also located in the domain. The park site is bordered by residential properties in the northern and southern directions.

The site slopes towards a small creek at the southern edge of the reserve.

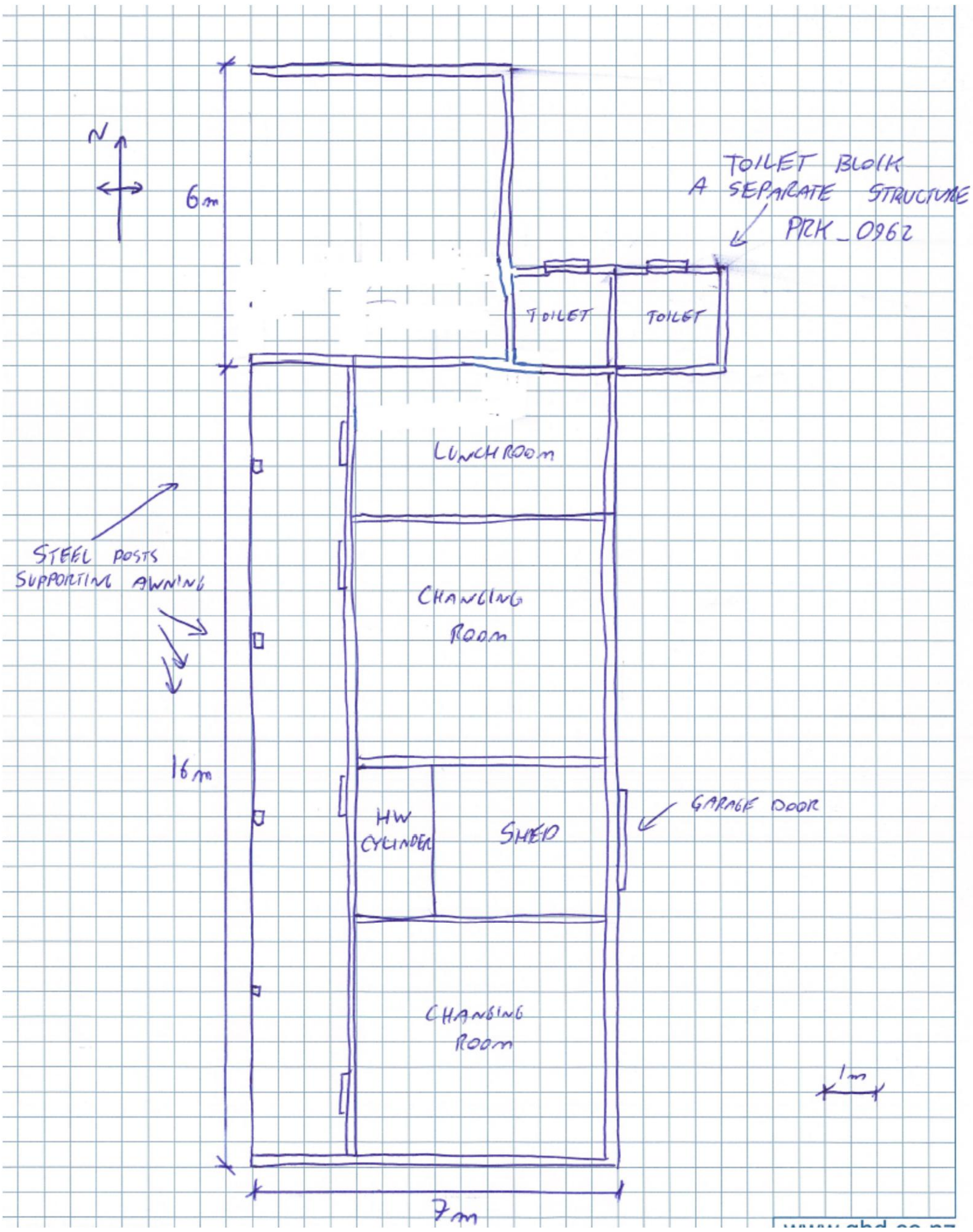

Figure 2 Plan Sketch Showing Key Structural Elements

The building is a single row of filled or partially filled concrete blockwork masonry. The single storey construction has a concrete slab on grade floor. The timber beam roof consists of lightweight metal cladding with a single plastic skylight panel supported by timber purlins and beams.

The dimensions of the pavilion building are 16m long by 7m wide and 3.6m high at the apex. This area includes a 2m wide veranda covered by a canopy on the western side of the building. The canopy is supported by end walls and 4 steel support posts.

The internal layout of the pavilion consists of a 3m wide lunchroom at the northern end of the structure. In centre area and southern end of the building are two 5m wide changing rooms containing seating and showers. Between the changing rooms is a 3m wide area split into a storage shed and a hot water cylinder area.

Adjacent the northern side wall of the pavilion is a freestanding wall consisting of single row of filled or partially filled concrete blockwork masonry wall 11m long and 2m high surrounding a seating area.

Adjacent to the north eastern side of the pavilion is a toilet block. The toilet block shares 2m of the northern wall of the pavilion and 2m of the freestanding masonry wall. This structure is integrated and in effect part of the same structure.

4.2 Gravity Load Resisting System

The gravity loads in the structure are resisted by timber beams across the structure. The roof cladding is supported by timber purlins spanning between the timber beams. These beams allow the transfer of the gravity load into a lintel/eaves beam that is continuously supported by the reinforced, filled concrete blockwork external walls. The load is then transferred from the lintel/eaves beam into the external walls, through to the slab on grade, and into the ground.

4.3 Lateral Load Resisting System

Lateral loads acting on the structure are resisted by concrete masonry walls both along and across the dimensions of the building. The internal blockwork walls offer additional lateral resistance across the structure. These masonry walls transfer the lateral load from the roof down to the slab on grade foundation.

5. Assessment

An inspection of the building was undertaken on 17 July 2012. Both the interior and exterior of the building were inspected. The main structural components of the building were all able to be viewed due to the exposed straightforward construction of the building.

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 solely from visual observation of the building due to the lack of available drawings.

6. Damage Assessment

6.1 Surrounding Buildings

The nearest residential building is located approximately 20m to the south. Based on visual inspections from property boundaries there was no damage evident to these buildings. The connected toilet block had similar levels of minor cracking at the edges of the slab on grade as shown in Photograph 4. There was no visible damage to the roof or walls of the attached structure. Within 3m of the freestanding wall there is a drinking fountain with significant cracking damage to the concrete foundation.

6.2 Residual Displacements and General Observations

No residual displacements of the structure were noticed during the inspection of the building.

The only visible external damage was minor cracking at the edges of the concrete slab on grade around the door areas.

No damage was evident to the timber beam roof structure.

With regards to the adjacent drinking foundation concrete foundation significant damage was observed. Shear failure has occurred both along and across the foundations with the largest crack width 30 mm. The cracks are evident in Photographs 5 and 6 in Appendix A. In addition pieces of concrete have been displaced and are now missing.

6.3 Ground Damage

There was no visible evidence of ground damage on the property or surrounding neighbours land.

7. Critical Structural Weakness

7.1 Short Columns

No short columns are present in the structure.

7.2 Lift Shaft

The building does not contain a lift shaft.

7.3 Roof

No roof bracing was visible due to the presence of ceiling panels. Roof elements such as the purlins and roof material were not clearly visible but are expected to provide sufficient bracing to the roof structure. See photographs 7 and 8. The edges of the canopy are securely bolted to steel support posts. See photographs 9 and 10.

7.4 Staircases

The building does not contain a staircase.

7.5 Pounding effect

At the toilet block and pavilion are connected and in effect part of the same building there does not appear to be any pounding potential.

7.6 Liquefaction

No Liquefaction was observed on site or in the surrounding neighbourhood. However as noted in Section 8.5 of this report it is possible that liquefaction will occur on site. The effect liquefaction will have on the structure will not be a severe threat, therefore in terms of the IEP the site characteristics have been deemed to not be significant.

8. Geotechnical Consideration

8.1 Site Description

The site is situated in the suburb of Hillsborough, southeast of Christchurch City centre. It is relatively flat at approximately 20m above mean sea level. It is approximately 550m west of Heathcote River, 400m southwest of the Main South Line Railway, and 2.5km west of the coast (Pegasus Bay).

8.2 Published Information on Ground Conditions

8.2.1 Published Geology

The geological map of the area1 indicates that the site is underlain by:

- Dominantly alluvial sand and silt overbank deposits, being alluvial soils of the Yaldhurst Member, sub-group of the Springston Formation, Holocene in age.

Figure 72 from Brown & Weeber indicates that groundwater is approximately 1m below ground level and and liquefaction susceptibility is low.

8.2.2 Environment Canterbury Logs

Information from Environment Canterbury (ECan) indicates that thirteen boreholes with lithographic logs are located within 200m of the site. Four borehole logs with significant information are summarised in the table (see Table 2).

These indicate the area is underlain by sand, silt and clay mixtures with ground water table found 1.4m below ground level.

Table 2 ECan Borehole Summary

Bore Name	Log Depth	Groundwater	Distance & Direction from Site
M36-1181-WC	18.2 m	1.4m bgl	140m NE
M36-1182-WC	18.2 m	1.4m bgl	140m NE
M36-1183-WC	18.2 m	1.4m bgl	140m NE
M36-1184-WC	18.2 m	1.4m bgl	140m NE

It should be noted the quality of soil logging descriptions included on the boreholes is unknown and were likely written by the well driller and not a geotechnical professional or to a recognised geotechnical standard. In addition strength data is not recorded.

[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.

8.2.3 EQC Geotechnical Investigations

The Earthquake Commission has undertaken geotechnical testing in the area of the site. Information pertaining to this investigation is included in the Tonkin & Taylor Report for Hillsborough[2]. Two investigation points were undertaken within 200m of the site, as summarised below in Table 3.

Table 3 EQC Geotechnical Investigation Summary Table

Bore Name	Orientation from Site	Depth (m bgl)	Log Summary
CPT-HLB-11	80m NE	0 – 3	Firm to stiff silty sand to sandy silt
		3 - 6.5	Medium dense to dense sand to silty sand (GWT at 2.0m bgl)
CPT-HLB-12	127m S	0 – 0.5	Loose silty sand to very soft sandy silt
		0.5 – 2.2	Loose to medium dense silty sand to stiff sandy silt
		2.2 – 2.75	Firm Sandy silt to silty clay
		2.75 – 8	Medium dense to dense sand to silty sand (GWT at 2m bgl)

Initial observations of the CPT results indicate the soils are sand and sand mixtures with lenses of silt mixtures with ground water table 2m below ground level.

8.2.4 CERA Land Zoning

Canterbury Earthquake Recovery Authority (CERA) has classified 22 Bishopworth Street, Hillsborough as "Green Zone, N/A – Urban Nonresidential" category. Land in this zone is generally considered suitable for residential construction, though some areas may require stronger foundations or design where rebuilding or repairs are required. The "Not Applicable (N/A)" technical category is the classification given for those properties within Port Hills and Bank Peninsula and non-residential properties in a rural area or beyond the extent of land damage mapping.

The surrounding properties are classified as "Green Zone, TC 2 – yellow" category. Technical Category 2 (TC2, yellow) means that minor to moderate land damage from liquefaction is possible in future significant earthquakes.

8.2.5 Post February Aerial Photography

Aerial photography taken following the 22 February 2011 earthquake shows negligible signs of liquefaction outside the building footprint or adjacent to the site, as shown in Figure 2.

[2] Tonkin & Taylor Ltd., 2011: Christchurch Earthquake Recovery, *Geotechnical Factual Report, Hillsborough.*

Figure 2 Post February 2011 Earthquake Aerial Photography [3]

8.2.6 Summary of Ground Conditions

From the information presented above, the ground conditions underlying the site are anticipated to comprise multiple strata of sand and silt with varying amount of sand and silt mixtures with ground water table approximately 1.5m below ground level.

8.3 Seismicity

8.3.1 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 4 Summary of Known Active Faults[4,5]

Known Active Fault	Distance from Site	Direction from Site	Max Likely Magnitude	Avg Recurrence Interval
Alpine Fault	129 km	NW	~8.3	~300 years
Greendale (2010) Fault	24 km	W	7.1	~15,000 years
Hope Fault	108 km	NW	7.2~7.5	120~200 years
Kelly Fault	108 km	NW	7.2	~150 years

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

[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

Porters Pass Fault	65 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.

8.3.2 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.

8.4 Slope Failure and/or Rockfall Potential

Given the site's location, global slope instability is considered negligible. However, any localised retaining structures or embankments should be further investigated to determine the site-specific slope instability potential.

8.5 Liquefaction Potential

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

- Negligible signs of liquefaction (evidence from the post-earthquake aerial photography);
- Adjacent properties are classified by CERA as "Green Zone, Technical Category 2, yellow".
- Anticipated presence of alluvial sand and silts deposits beneath the site; and,
- Shallow ground water level at approximately 1.5m below ground level.

8.6 Conclusions & Recommendations

This assessment is based on a review of the geology and existing ground investigation information, and observations from the Christchurch earthquakes since 4 September 2010.

The site appears to be situated on stratified alluvial deposits, comprising sand and silt. Associated with this the site also has a minor to moderate liquefaction potential, in particular where sands and/or silts 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.

9. Survey

No level or verticality surveys have been undertaken for this building at this stage.

10. Initial Capacity Assessment

10.1 % 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 and the capacity of any identified weaknesses are expressed as a percentage of new building standard (%NBS) and are in the order of that shown below in Table 5. These capacities are subject to confirmation by a more detailed quantitative analysis.

Item	%NBS
Building excluding CSW's	61

Table 5 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 61% New Building Standard (NBS). Under the New Zealand Society for Earthquake Engineering (NZSEE) guidelines the building is considered an Earthquake Risk but not Earthquake Prone as it achieves greater than 33% NBS but less than 67% NBS. This score has not been adjusted when considering damage to the structure as all damage observed was relatively minor and considered unlikely to adversely affect the load carrying capacity of the structural systems.

10.2 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, Silty Sand
- 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.

10.3 Expected Structural Ductility Factor

A structural ductility factor of 1.25 has been assumed based on the structural system observed and the date of construction.

10.4 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. Although the original building construction date is unknown it was likely designed to the loading standard current at the time. The design loads used in this standard are likely to have been less than those required by the current loading standard. When combined with the increase in the hazard factor for Christchurch to 0.3, it would be expected that the building would not achieve

100% NBS. Due to the age of the building it is reasonable to expect the building to be classified as an Earthquake Risk.

10.5 Occupancy

As the structures achieve only 61% NBS, they are potentially an Earthquake Risk in accordance with the NZSEE guidelines. No critical structural weakness have been identified. However the building does not pose an immediate risk to users and occupants. The building has not been assessed as Earthquake Prone, therefore the building can remain occupied.

11. Initial Conclusions

The building has been assessed to have a seismic capacity in the order of 61% NBS and is therefore potentially Earthquake Risk in accordance with the NZSEE guidelines. The site where the toilet block is located is close to a watercourse which increases the risk of liquefaction. However the effects of liquefaction on the toilets are considered minor so the IEP risk has been deemed insignificant. The lack of any cracking in the building suggests that the toilet block is well constructed. In addition the lack displacement of the block wall indicates that the walls are most likely fully grouted and reinforced. As the building has not been assessed to be Earthquake Prone, the building may remain occupied.

12. Recommendations

The recent seismic activity in Christchurch has caused no visible damage to the building. The building can remain occupied as the building had not been assessed as Earthquake Prone. However, as the building has not achieved 67% NBS or higher, GHD recommend that a quantitative assessment and geotechnical investigation be carried out and if necessary strengthening options explored. The building also requires further investigation to confirm that the walls and floor slab on grade are adequately grouted and reinforced.

13. Limitations

13.1 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.

13.2 Geotechnical Limitations

This report presents the results of a geotechnical appraisal prepared for the purpose of this commission, and for prepared 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 South elevation.

Photograph 2 West elevation.

Photograph 3 View of the seating area and pavilion from the north west.

Photograph 4 Minor cracking at edges of slab on grade

Photograph 5 Cracking in base of adjacent drinking fountain.

Photograph 6 Cracking and loss of concrete in base of drinking fountain.

Photograph 7 Timber end beams and purlin edges.

Photograph 8 Timber beam on the side and back walls connecting the roof to the masonry walls.

Photograph 9 Canopy over veranda area on the western side of pavilion.

Photograph 10 Connection of steel canopy supports with timber beams.

Photograph 11 Wall surrounding pavilion area connected to toilet block.

Photograph 12 Side wall of pavilion shares wall with toilet block.

Appendix B
Existing Drawings

No existing drawings were available for the building.

Appendix C

CERA Building Evaluation Form

Detailed Engineering Evaluation Summary Data

V1.11

Location

Building Name:	Hillsborough Domain Pavilion		Reviewer:	David Lee
	Unit / No: / Street		CPEng No:	112052
Building Address:	Bishopsworth Road, Hillsborough	22	Company:	GHD
Legal Description:	RES 3803		Company project number:	513090253
			Company phone number:	
	Degrees / Min / Sec			
GPS south:	43	33 / 38.94	Date of submission:	23/05/2013
GPS east:	172	40 / 23.43	Inspection Date:	17/07/2012
			Revision:	Final
Building Unique Identifier (CCC):	PRK_0962_BLDG_001		Is there a full report with this summary?	yes

Site

Site slope:	slope < 1in 10	Max retaining height (m):	
Soil type:	silty sand	Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
Proximity to waterway (m, if <100m):	5	If Ground improvement on site, describe:	
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m):	20.00
Ground floor split?	no		Ground floor elevation above ground (m):	0.10
Storeys below ground	0			
Foundation type:	mat slab		if Foundation type is other, describe:	Slab on grade
Building height (m):	3.60		height from ground to level of uppermost seismic mass (for IEP only) (m):	1.8
Floor footprint area (approx):	136			
Age of Building (years):	40		Date of design:	1976-1992
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	public		Brief strengthening description:	
Use (upper floors):				
Use notes (if required):				
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber framed	rafter type, purlin type and cladding	
Floors:	concrete flat slab	slab thickness (mm)	
Beams:			
Columns:			
Walls:	partially filled concrete masonry	thickness (mm)	200

Lateral load resisting structure

Lateral system along:	partially filled CMU	**Note: Define along and across in detailed report!**	note total length of wall at ground (m):	7
Ductility assumed, μ:	1.25		wall thickness (m):	0.2
Period along:	0.40	0.40 from parameters in sheet	estimate or calculation?	
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):	16

Ductility assumed, μ:	1.25		wall thickness (m):	0.2
Period across:	0.40	0.40 from parameters in sheet	estimate or calculation?	
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	

Separations:

north (mm):	0	leave blank if not relevant
east (mm):		
south (mm):		
west (mm):		

Non-structural elements

Stairs:			
Wall cladding:	exposed structure	describe	Painted Block Walls
Roof Cladding:	Metal	describe	Light corrugated steel
Glazing:	timber frames		
Ceilings:	fibrous plaster, fixed		
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	partial	original designer name/date	

Damage

Site:

(refer DEE Table 4-2)

Site performance:		Describe damage:	
Settlement:	0-25mm	notes (if applicable):	
Differential settlement:	none observed	notes (if applicable):	
Liquefaction:	none apparent	notes (if applicable):	
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	slight	notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):			
Across	Damage ratio:	0%		
	Describe (summary):			
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:	none		Describe:	
	Building Consent required:	no		Describe:	
	Interim occupancy recommendations:	full occupancy		Describe:	
Along	Assessed %NBS before:	61%	61% %NBS from IEP below	If IEP not used, please detail assessment methodology:	
	Assessed %NBS after:	61%			
Across	Assessed %NBS before:	61%	61% %NBS from IEP below		
	Assessed %NBS after:	61%			

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): 1976-1992

h_n from above: 1.8m

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:	17.0%	17.0%

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:	17%	17%

2.2 Near Fault Scaling Factor

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

2.6 Structural Performance Scaling Factor:

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

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

	along	across
%NBSb:	61%	61%

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	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

		Along	Across
3.6. Other factors, Factor F	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

		Along	Across
3.7. Overall Performance Achievement ratio (PAR)		1.00	1.00
4.3 PAR x (%NBS)b:	PAR x Baselline %NBS:	61%	61%
4.4 Percentage New Building Standard (%NBS), (before)			61%

GHD

Level 11, Guardian Trust House
15 Willeston street, Wellington 6011
T: 64 4 472 0799   F: 64 4 472 0833   E: wgtnmail@ghd.com

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