Christchurch City Council

PRK_3534_BLDG_006 EQ2
Corsair Bay Changing Sheds and Toilets
5 Park Terrace, Corsair Bay

QUALITATIVE ASSESSMENT REPORT

FINAL

- Rev B
- 17 January 2013

Christchurch City Council
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1. Executive Summary

1.1. Background

A Qualitative Assessment was carried out on the Corsair Bay Changing Sheds and Toilets PRK_3534_BLDG_006 EQ2 located at 5 Park Terrace, Corsair Bay. The building is a single storey timber framed building with weatherboard cladding. An aerial photograph illustrating these areas is shown below in Figure 1. Detailed descriptions outlining the buildings age and construction type are given in Section 5 of this report.

- **Figure 1 Aerial Photograph of 5 Park Terrace**

The qualitative assessment includes a summary of the building damage as well as an initial assessment of the current seismic capacity compared with current seismic code loads using the Initial Evaluation Procedure (IEP).

This Qualitative report for the building structure is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011, visual inspections on 6th December 2012 and architectural drawings of the structure dated March 2007.

1.2. Key Damage Observed

Key damage observed includes:-

- Grout material between the building and external drainage on the south corner of the building has separated and cracked.

- External landscaping including the small footpath stone retaining wall and the fence posts have moved away from their original position exposing cracks and damaging the horizontal steel rail on the south corner of the building.
- Vertical 1.5mm crack at the foundation on the east corner of the building.

1.3. Critical Structural Weaknesses

No potential critical structural weaknesses have been identified.

1.4. Indicative Building Strength (from IEP and CSW assessment)

Based on the information available, and using the NZSEE Initial Evaluation Procedure, the buildings original capacity has been assessed to be in the order of 100%NBS and post earthquake capacity in the order of 100%NBS.

The building has been assessed to have a seismic capacity in the order of 100% NBS and is therefore not potentially earthquake prone.

1.5. Recommendations

It is recommended that:

a) No placard was displayed on the building however we recommend that the current placard status of the building be Green 1.

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

2. Introduction

Sinclair Knight Merz was engaged by Christchurch City Council to prepare a qualitative assessment report for the Corsair Bay Changing Sheds and Toilets PRK_3534_BLDG_006 EQ2 located at 5 Park Terrace, Corsair Bay following the magnitude 6.3 earthquake which occurred in the afternoon of the 22nd of February 2011 and the subsequent aftershocks.

The Qualitative Assessment uses the methodology recommended in the Engineering Advisory Group document "Guidance on Detailed Engineering Evaluation of Earthquake affected Non-residential Buildings in Canterbury" (part 2 revision 5 dated 19/07/2011 and part 3 draft revision dated 13/12/2011). The qualitative assessment includes a summary of the building damage as well as an initial assessment of the likely current Seismic Capacity compared with current seismic code requirements.

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).

This report describes the structural damage observed during our inspection and indicates suggested remediation measures. The inspection was undertaken from floor levels and was a visual inspection only. Our report reflects the situation at the time of the inspection and does not take account of changes caused by any events following our inspection. A full description of the basis on which we have undertaken our visual inspection is set out in section 7.

The NZ Society for Earthquake Engineering (NZSEE) Initial Evaluation Procedure (IEP) was used to assess the likely performance of the building in a seismic event relative to the New Building Standard (NBS). 100% NBS is equivalent to the strength of a building that fully complies with current codes. This includes a recent increase of the Christchurch seismic hazard factor from 0.22 to 0.3[1].

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.

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[1] http://www.dbh.govt.nz/seismicity-info

3. Compliance

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

3.1. Canterbury Earthquake Recovery Authority (CERA)

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

Section 38 – Works

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

Section 51 – Requiring Structural Survey

This section enables the chief executive to require a building owner, insurer or mortgagee carry out a full structural survey before the building is re-occupied.

We understand that CERA will require a detailed engineering evaluation to be carried out for all buildings (other than those exempt from the Earthquake Prone Building definition in the Building Act). It is anticipated that CERA will adopt the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011. This document sets out a methodology for both qualitative and quantitative assessments.

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

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

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

- The extent of any earthquake damage

3.2. Building Act

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

3.2.1. Section 112 – Alterations

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

3.2.2. Section 115 – Change of Use

This section requires that the territorial authority (in this case Christchurch City Council (CCC)) be satisfied that the building with a new use complies with the relevant sections of the Building Code 'as near as is reasonably practicable'. Regarding seismic capacity 'as near as reasonably practicable' has previously been interpreted by CCC as achieving a minimum of 67%NBS however where practical achieving 100%NBS is desirable. The New Zealand Society for Earthquake Engineering (NZSEE) recommend a minimum of 67%NBS.

3.2.3. Section 121 – Dangerous Buildings

The definition of dangerous building in the Act was extended by the Canterbury Earthquake (Building Act) Order 2010, and it now defines a building as dangerous if:

- in the ordinary course of events (excluding the occurrence of an earthquake), the building is likely to cause injury or death or damage to other property; or
- in the event of fire, injury or death to any persons in the building or on other property is likely because of fire hazard or the occupancy of the building; or
- there is a risk that the building could collapse or otherwise cause injury or death as a result of earthquake shaking that is less than a 'moderate earthquake' (refer to Section 122 below); or
- there is a risk that that other property could collapse or otherwise cause injury or death; or
- a territorial authority has not been able to undertake an inspection to determine whether the building is dangerous.

3.2.4. Section 122 – Earthquake Prone Buildings

This section defines a building as earthquake prone if its ultimate capacity would be exceeded in a 'moderate earthquake' and it would be likely to collapse causing injury or death, or damage to other property. A moderate earthquake is defined by the building regulations as one that would generate ground shaking 33% of the shaking used to design an equivalent new building.

3.2.5. Section 124 – Powers of Territorial Authorities

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

3.2.6. Section 131 – Earthquake Prone Building Policy

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

3.3. Christchurch City Council Policy

Christchurch City Council adopted their Earthquake Prone, Dangerous and Insanitary Building Policy in 2006. This policy was amended immediately following the Darfield Earthquake of the 4th September 2010.

The 2010 amendment includes the following:

- A process for identifying, categorising and prioritising Earthquake Prone Buildings, commencing on 1 July 2012;
- A strengthening target level of 67% of a new building for buildings that are Earthquake Prone. Council recognises that it may not be practicable for some repairs to meet that target. The council will work closely with building owners to achieve sensible, safe outcomes;
- A timeframe of 15-30 years for Earthquake Prone Buildings to be strengthened; and,
- Repair works for buildings damaged by earthquakes will be required to comply with the above.

The council has stated their willingness to consider retrofit proposals on a case by case basis, considering the economic impact of such a retrofit.

We anticipate that any building with a capacity of less than 34%NBS (including consideration of critical structural weaknesses) will need to be strengthened to a target of 67%NBS of new building standard as recommended by the Policy.

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

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

3.4. Building Code

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

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

a) Hazard Factor increased from 0.22 to 0.3 (36% increase in the basic seismic design load)
b) Serviceability Return Period Factor increased from 0.25 to 0.33 (80% increase in the serviceability design loads when combined with the Hazard Factor increase)

The increase in the above factors has resulted in a reduction in the level of compliance of an existing building relative to a new building despite the capacity of the existing building not changing.

4. Earthquake Resistance Standards

For this assessment, the building's earthquake resistance is compared with the current New Zealand Building Code requirements for a new building constructed on the site. This is expressed as a percentage of new building standard (%NBS). The new building standard load requirements have been determined in accordance with the current earthquake loading standard (NZS 1170.5:2004 Structural design actions - Earthquake actions - New Zealand).

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

The New Zealand Society for Earthquake Engineering has proposed a way for classifying earthquake risk for existing buildings in terms of %NBS and this is shown in Figure 2 below.

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

- **Figure 2: NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE Guidelines**

Table 1 below provides an indication of the risk of failure for an existing building with a given percentage NBS, relative to the risk of failure for a new building that has been designed to meet current Building Code criteria (the annual probability of exceedance specified by current earthquake design standards for a building of 'normal' importance is 1/500, or 0.2% in the next year, which is equivalent to 10% probability of exceedance in the next 50 years).

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

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

5. Building Details

5.1. Building description

The Corsair Bay Changing Sheds and Toilets, PRK_3534_BLDG_006 EQ2 is located at 5 Park Terrace, Corsair Bay. The building is a single storey timber framed changing shed and toilet facility which services the Corsair Bay Reserve. The building is externally clad with timber weatherboards. The roof structure is a timber truss clad with corrugated metal. The foundation is a slab on grade with thickening beneath the walls. The building is constructed on a hill side with a timber retaining wall on the Northwest side of the building.

Our evaluation was based on the architectural drawings of the building dated March 2007 by City Solutions, Christchurch City Council. The architectural drawings show most of the structural members, their materials and the rigor of the detailing.

5.2. Gravity Load Resisting system

The gravity load resisting structure of the building is made up of the timber framed walls, supported on the reinforced slab on grade foundation. The slab also creates the floor area of the structure.

5.3. Seismic Load Resisting system

For the purposes of this report the longitudinal direction of the building is defined as being the east-west direction and the transverse direction is defined as being in the north-south direction.

Lateral load on the building are carried by 9.0mm Villaboard lined timber framed walls in both directions. The load is then transferred to the concrete foundation, which acts to hold down the walls by providing mass and soil bearing pressure.

5.4. Geotechnical Conditions

Geotechnical parameters were assumed for this site, these include.

- The site has been assessed as NZS1170.5 Class C (shallow soil) from site geology of the area.
- It is assumed that the ground will classify as good ground in accordance with NZS3604:2011.
- Liquefaction risk is low at this site.

Unless a change of use is intended for the site we do not believe that any further geotechnical investigations are required. Specific ground investigation should be undertaken if significant alterations or new structures are proposed. If any excavations are required on the site further investigation of the potential for contamination should be undertaken.

6. Damage Summary

SKM undertook inspections on the 6th December 2012. The following areas of damage were observed during the time of inspection:

1) Grout material between the building and external drainage on the south corner of the building has separated and cracked. (photo 5 and 6)
2) Vertical 1.5 mm crack at the foundation on the east corner of the building. (photo 11 and 12)
3) External landscaping including the small footpath stone retaining wall and the fence posts have moved away from their original position exposing cracks and damaging the horizontal steel rail on the south corner of the building. (photo 7)

Photos of the above damage can be found in Appendix 1 – Photos.

7. Initial Seismic Evaluation

7.1. The Initial Evaluation Procedure Process

This section covers the initial seismic evaluation of the building as detailed in the NZSEE 'Assessment and Improvement of the Structural Performance of Buildings in Earthquakes'. The IEP grades buildings according to their likely performance in a seismic event. The procedure is not yet recognised by the NZ Building Code but is widely used and recognised by the Christchurch City Council as the preferred method for preliminary seismic investigations of buildings[2].

The IEP is a coarse screening process designed to identify buildings that are likely to be earthquake prone. The IEP process ranks buildings according to how well they are likely to perform relative to a new building designed to current earthquake standards, as shown in Table 2. The building grade is indicated by the percent of the required New Building Standard (%NBS) strength that the building is considered to have. A building is earthquake prone for the purposes of this Act if, having regard to its condition and to the ground on which it is built, and because of its construction, the building—

a) will have its ultimate capacity exceeded in a moderate earthquake (as defined in the regulations); and
b) would be likely to collapse causing—
    i. injury or death to persons in the building or to persons on any other property; or
    ii. damage to any other property.

A moderate earthquake is defined as 'in relation to a building, an earthquake that would generate shaking at the site of the building that is of the same duration as, but that is one-third as strong as, the earthquake shaking (determined by normal measures of acceleration, velocity and displacement) that would be used to design a new building at the site.'

An earthquake prone building will have an increased risk that its strength will be exceeded due to earthquake actions of approximately 10 times (or more) than that of a building having a capacity in excess of 100% NBS (refer Table 1)[3]. Buildings in Christchurch City that are identified as being earthquake prone are required by law to be followed up with a detailed assessment and strengthening work within 30 years of the owner being notified that the building is potentially earthquake prone[4].

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[2] http://resources.ccc.govt.nz/files/EarthquakeProneDangerousAndInsanitaryBuildingsPolicy2010.pdf
[3] NZSEE June 2006, *Assessment and Improvement of the Structural Performance of Buildings in Earthquakes,* p 2-13
[4] http://resources.ccc.govt.nz/files/EarthquakeProneDangerousAndInsanitaryBuildingsPolicy2010.pdf

Table 2: IEP Risk classifications

Description	Grade	Risk	%NBS	Structural performance
Low risk building	A+	Low	> 100	Acceptable. Improvement may be desirable.
	A		100 to 80	
	B		80 to 67	
Moderate risk building	C	Moderate	67 to 33	Acceptable legally. Improvement recommended.
High risk building	D	High	33 to 20	Unacceptable. Improvement required.
	E		< 20	

The IEP is a simple desktop study that is useful for risk management. No detailed calculations are done and so it relies on an inspection of the building and its plans to identify the structural members and describe the likely performance of the building in a seismic event. A review of the plans is also likely to identify any critical structural weaknesses. The IEP assumes that the building was properly designed and built according to the relevant codes at the time of construction. The IEP method rates buildings based on the code used at the time of construction and some more subjective parameters associated with how the building is detailed and so it is possible that %NBS derived from different engineers may differ.

This assessment describes only the likely seismic Ultimate Limit State (ULS) performance of the building. The ULS is the level of earthquake that can be resisted by the building without collapse or other forms of failure. The IEP does not attempt to estimate Serviceability Limit State (SLS) performance of the building, or the level of earthquake that would start to cause damage to the building[5]. This assessment concentrates on matters relating to life safety as damage to the building is a secondary consideration.

The NZ Building Code describes that the relevant codes for determining %NBS are primarily:

- AS/NZS 1170 Structural Design Actions
- NZS 3101:2006 Concrete Structures Standard
- NZS 3404:1997 Steel Structures Standard
- NZS4230:2004 Design of Reinforced Concrete Masonry Structures
- NZS 3603:1993 Timber Structures Standard
- NZS 3604:2011 Timber Framed Buildings

[5] NZSEE 2006, *Assessment and Improvement of the Structural Performance of Buildings in Earthquakes,* p2-9

7.2. Design Criteria and Limitations

Following our inspection on the 6th December 2012, SKM carried out a preliminary structural review. The structural review was undertaken using the available information which was as follows:

- SKM site measurements and inspection findings of the building. Please note no intrusive investigations were undertaken.
- Architectural drawings were available, which showed most of the structural details

The design criteria used to undertake the assessment include:

- Standard design assumptions for typical office and factory buildings as described in AS/NZS1170.0:2002
  - 50 year design life, which is the default NZ Building Code design life.
  - Structure importance level 2. This level of importance is described as 'normal' with medium or considerable consequence of failure.
  - Ductility level of 3, based on our assessment and code requirements at the time of design. This level of ductility is appropriate given the age, timber framed construction and the lining of the building.
  - Site hazard factor, Z = 0.3, NZBC, Clause B1 Structure, Amendment 11 effective from 1 August 2011

This IEP was based on our visual inspection of the building and a review of the available structural drawings. Since it is not a full design and construction review, it has the following limitations:

- It is not likely to pick up on any original design or construction errors (if they exist)
- Other possible issues that could affect the performance of the building such as corrosion and modifications to the building will not be identified
- The IEP deals only with the structural aspects of the building. Other aspects such as building services are not covered.
- The IEP does not involve a detailed analysis or an element by element code compliance check.

7.3. Survey

There was no visible settlement of the structure, nor were there any significant ground movement issues around the building. The combination of these factors means that we do not recommend that any survey be undertaken at this point.

7.4. Critical Structural Weaknesses

No critical structural weaknesses were found during the inspection of the building or from the review of the drawings.

7.5. Qualitative Assessment Results

The building has had its capacity assessed using the Initial Evaluation Procedure based on the information available. The buildings capacity expressed as a percentage of new building standard (%NBS) is in order of that shown below in Table 3: Qualitative Assessment Summary.

Table 3: Qualitative Assessment Summary

Item	%NBS
Corsair Bay Changing Sheds and Toilets	100

Our qualitative assessment found that the building is likely to be classed as a ‘Low Risk Building’ (capacity between 67% and 100% of NBS). The full IEP assessment form is detailed in Appendix 2 – IEP Reports.

8. Further Investigation

Due to the likely seismic rating of this building being greater that 67%, and the lack of any structural damage or settlement no further investigation is recommended at this stage.

9. Conclusion

A qualitative assessment was carried out on the building PRK_3534_BLDG_006 EQ2 located at 5 Park Terrace, Corsair Bay. This building has been assessed to have a likely seismic capacity in the order of 100%NBS and is therefore a 'low risk building'.

Due to the likely seismic rating of this building and the lack of any structural damage no further investigation is recommended.

It is recommended that:

a) No placard was displayed on the building however we recommend that the current placard status of the building be Green 1.
b) We consider that barriers around the building are not necessary.

10. Limitation Statement

This report has been prepared on behalf of, and for the exclusive use of, SKM's client, and is subject to, and issued in accordance with, the provisions of the contract between SKM and the Client. It is not possible to make a proper assessment of this report without a clear understanding of the terms of engagement under which it has been prepared, including the scope of the instructions and directions given to, and the assumptions made by, SKM. The report may not address issues which would need to be considered for another party if that party's particular circumstances, requirements and experience were known and, further, may make assumptions about matters of which a third party is not aware. No responsibility or liability to any third party is accepted for any loss or damage whatsoever arising out of the use of or reliance on this report by any third party.

Without limiting any of the above, in the event of any liability, SKM's liability, whether under the law of contract, tort, statute, equity or otherwise, is limited in as set out in the terms of the engagement with the Client.

It is not within SKM's scope or responsibility to identify the presence of asbestos, nor the responsibility of SKM to identify possible sources of asbestos. Therefore for any property pre-dating 1989, the presence of asbestos materials should be considered when costing remedial measures or possible demolition.

There is a risk of further movement and increased cracking due to subsequent aftershocks or settlement.

Should there be any further significant earthquake event, of a magnitude 5 or greater, it will be necessary to conduct a follow-up investigation, as the observations, conclusions and recommendations of this report may no longer apply Earthquake of a lower magnitude may also cause damage, and SKM should be advised immediately if further damage is visible or suspected.

11. Appendix 1 – Photos

	
Photo 1: View of the Corsair Bay Changing Sheds and Toilets	Photo 2: Northeast elevation with the the bay in the background
	
Photo 3: View along the Northwest elevation showing the timber retaining post retaining wall	Photo 4: View along the Southwest elevation

	
Photo 5: View of the south corner of the building showing cracks between the drains and the building	Photo 6: Close up view of one of the roof drains

Photo 7: View of south corner in the opposite direction to photo 5, showing the damaged external landscaping

Photo 8: View of one of the mens toilet entrance

Photo 9: View of the roof structure

Photo 10: View of the concrete floor

	
Photo 11: View of the east corner of the building	Photo 12: Close up view from photo 11
	
Photo 13: interior view of the services room showing the timber framing and the Villaboard interior lining.	

12. Appendix 2 – IEP Reports

Table IEP-1 **Initial Evaluation Procedure – Step 1**

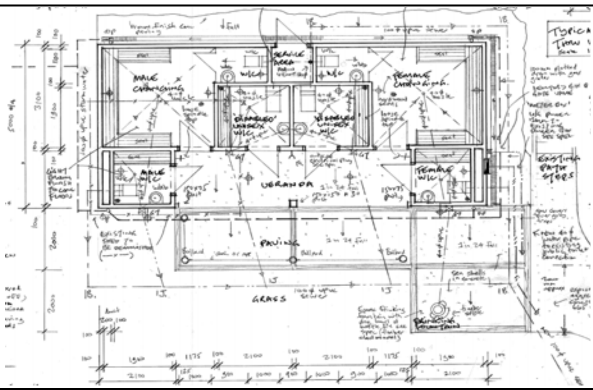
(Refer Table IEP - 2 for Step 2; Table IEP - 3 for Step 3, Table IEP - 4 for Steps 4, 5 and 6)

Building Name:	Corsair Bay Changing Sheds and Toilets (PRK_3534_BLDG_006 EQ2)	Ref.	ZB01276.206
Location:	5 Park Terrace, Corsair Bay	By	NLC
		Date	9/01/2013

Step 1 - General Information

1.1 Photos (attach sufficient to describe building)


1.2 Sketch of building plan



1.3 List relevant features

Building is a timber framed changing room and toilet facility, clad with a weatherboard exterior, and is lined with villaboard internally. The roof is timber framed clad in corrugated metail. Foundation is a concrete slab with thickening beneath the walls

1.4 Note information sources

Tick as appropriate

Visual Inspection of Exterior	✓	
Visual Inspection of Interior	✓	
Drawings (note type)	✓	Arch/Strut
Specifications	☐	
Geotechical Reports	☐	
Other (list)	☐	

Drawings indicate the building was design in 2007

An interior and exterior inspection of the building was carried out on 6-12-12

Table IEP-2 Initial Evaluation Procedure – Step 2

(Refer Table IEP - 1 for Step 1; Table IEP - 3 for Step 3, Table IEP - 4 for Steps 4, 5 and 6)

Building Name:	Corsair Bay Changing Sheds and Toilets (PRK_3534_BLDG_006	Ref.	ZB01276.206
Location:	5 Park Terrace, Corsair Bay	By	NLC
Direction Considered:	**Longitudinal & Transverse**	Date	9/01/2013

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

Step 2 - Determination of (%NBS)b

2.1 Determine nominal (%NBS) = (%NBS)nom

Pre 1935			○	See also notes 1, 3
1935-1965			○	
1965-1976	Seismic Zone;	A	○	
		B	○	
		C	○	See also note 2
1976-1992	Seismic Zone;	A	○	
		B	○	
		C	○	
1992-2004			◉	

b) Soil Type

From NZS1170.5:2004, Cl 3.1.3

A or B Rock	○
C Shallow Soil	○
D Soft Soil	◉
E Very Soft Soil	○

From NZS4203:1992, Cl 4.6.2.2
(for 1992 to 2004 only and only if known)

a) Rigid	◉	N-A
b) Intermediate	○	

c) Estimate Period, T

building Ht = 5 meters

	Longitudinal	Transverse	
Ac =			m2

Can use following:

		Longitudinal	Transverse
$T = 0.09h_n^{0.75}$	for moment-resisting concrete frames	○ MRCF	○ MRCF
$T = 0.14h_n^{0.75}$	for moment-resisting steel frames	○ MRSF	○ MRSF
$T = 0.08h_n^{0.75}$	for eccentrically braced steel frames	○ EBSF	○ EBSF
$T = 0.06h_n^{0.75}$	for all other frame structures	◉ Others	◉ Others
$T = 0.09h_n^{0.75}/A_c^{0.5}$	for concrete shear walls	○ CSW	○ CSW
$T <= 0.4sec$	for masonry shear walls	○ MSW	○ MSW

Where hn = height in m from the base of the structure to the uppermost seismic weight or mass.
Ac = ΣAi(0.2 + Lwi/hn)2
Ai = cross-sectional shear area of shear wall i in the first storey of the building, in m2
lwi = length of shear wall i in the first storey in the direction parallel to the applied forces, in m
with the restriction that lwi/hn shall not exceed 0.9

Longitudinal	Transverse	
0.2	**0.2**	Seconds

d) (%NBS)nom determined from Figure 3.3

Longitudinal	22.2	$(\%NBS)_{nom}$
Transverse	22.2	$(\%NBS)_{nom}$

			Factor
Note 1:	For buildings designed prior to 1965 and known to be designed as public buildings in accordance with the code of the time, multiply (%NBS)nom by 1.25.	No	1
	For buildings designed 1965 - 1976 and known to be designed as public buildings in accordance with the code of the time, multiply (%NBS)nom by 1.33 - Zone A or 1.2 - Zone B	No	1
Note 2:	For reinforced concrete buildings designed between 1976 -1984 (%NBS)nom by 1.2	No	1
Note 3:	For buildings designed prior to 1935 multiply (%NBS)nom by 0.8 except for Wellington where the factor may be taken as 1.	No	1

Longitudinal	22.2	$(\%NBS)_{nom}$
Transverse	22.2	$(\%NBS)_{nom}$

Continued over page

Building Name:	Corsair Bay Changing Sheds and Toilets (PRK_3534_BLDG_006 E	Ref.	ZB01276.206
Location:	5 Park Terrace, Corsair Bay	By	NLC
Direction Considered:	**Longitudinal & Transverse**	Date	9/01/2013

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

2.2 Near Fault Scaling Factor, Factor A

If T < 1.5sec, Factor A = 1

a) Near Fault Factor, N(T,D) 1

(from NZS1170.5:2004, Cl 3.1.6)

b) Near Fault Scaling Factor = 1/N(T,D) — **Factor A** 1.00

2.3 Hazard Scaling Factor, Factor B

Select Location: Christchurch

a) Hazard Factor, Z, for site

(from NZS1170.5:2004, Table 3.3)

Z = 0.3

Z 1992 = 0.8

Auckland	0.6	Palm Nth	1.2
Wellington	1.2	Dunedin	0.6
Christchurch	0.8	Hamilton	0.67

b) Hazard Scaling Factor — Type Z 1992 above

For pre 1992 = 1/Z

\# For 1992 onwards = Z 1992/Z

(Where Z 1992 is the NZS4203:1992 Zone Factor from accompanying Figure 3.5(b))

Factor B 2.67

2.4 Return Period Scaling Factor, Factor C

a) Building Importance Level 2

(from NZS1170.0:2004, Table 3.1 and 3.2)

b) Return Period Scaling Factor from accompanying Table 3.1 — **Factor C** 1.00

2.5 Ductility Scaling Factor, D

a) Assessed Ductility of Existing Structure, μ

(shall be less than maximum given in accompanying Table 3.2)

Longitudinal	3	μ Maximum = 6
Transverse	3	μ Maximum = 6

b) Ductility Scaling Factor

For pre 1976 = k_{μ}

For 1976 onwards = 1

(where k_{μ} is NZS1170.5:2005 Ductility Factor, from accompanying Table 3.3)

Longitudinal	**Factor D**	1.00
Transverse	**Factor D**	1.00

2.6 Structural Performance Scaling Factor, Factor E

Select Material of Lateral Load Resisting System

Longitudinal Concrete

Transverse Concrete

a) Structural Performance Factor, S_p

from accompanying Figure 3.4

Longitudinal	Sp	0.70
Transverse	Sp	0.70

b) Structural Performance Scaling Factor

Longitudinal	$1/S_p$	**Factor E**	1.43
Transverse	$1/S_p$	**Factor E**	1.43

2.7 Baseline %NBS for Building, $(\%NBS)_b$

(equals $(\%NSB)_{nom}$ x A x B x C x D x E)

Longitudinal	84.6	(%NBS)b
Transverse	84.6	(%NBS)b

Table IEP-3 Initial Evaluation Procedure – Step 3

(Refer Table IEP - 1 for Step 1; Table IEP - 2 for Step 2, Table IEP - 4 for Steps 4, 5 and 6)

Building Name:	Corsair Bay Changing Sheds and Toilets (PRK_3534_BLDG_006 EQ2)	Ref.	ZB01276.206
Location:	5 Park Terrace, Corsair Bay	By	NLC
Direction Considered:	**a) Longitudinal**	Date	9/01/2013

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

Step 3 - Assessment of Performance Achievement Ratio (PAR)

(Refer Appendix B - Section B3.2)

Critical Structural Weakness	Effect on Structural Performance (Choose a value - Do not interpolate)	Building Score

3.1 Plan Irregularity

	Severe	Significant	Insignificant		
Effect on Structural Performance	○	○	◉	**Factor A**	1
Comment					

3.2 Vertical Irregularity

	Severe	Significant	Insignificant		
Effect on Structural Performance	○	○	◉	**Factor B**	1
Comment					

3.3 Short Columns

	Severe	Significant	Insignificant		
Effect on Structural Performance	○	○	◉	**Factor C**	1
Comment					

3.4 Pounding Potential

(Estimate D1 and D2 and set D = the lower of the two, or =1.0 if no potential for pounding)

a) Factor D1: - Pounding Effect
Select appropriate value from Table

Note:
Values given assume the building has a frame structure. For stiff buildings (eg with shear walls), the effect of pounding may be reduced by taking the co-efficient to the right of the value applicable to frame buildings.

Factor D1 1

Table for Selection of Factor D1	Severe	Significant	Insignificant
Separation	0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Alignment of Floors within 20% of Storey Height	○ 0.7	○ 0.8	◉ 1
Alignment of Floors not within 20% of Storey Height	○ 0.4	○ 0.7	○ 0.8

b) Factor D2: - Height Difference Effect
Select appropriate value from Table

Factor D2 1

Table for Selection of Factor D2	Severe	Significant	Insignificant
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

Factor D 1

(Set D = lesser of D1 and D2 or..
set D = 1.0 if no prospect of pounding)

3.5 Site Characteristics - (Stability, landslide threat, liquefaction etc)

	Severe	Significant	Insignificant		
Effect on Structural Performance	○ 0.5	○ 0.7	◉ 1	**Factor E**	1

3.6 Other Factors

For < 3 storeys - Maximum value 2.5,

otherwise - Maximum value 1.5. No minimum. **Factor F** 1.19

Record rationale for choice of Factor F:

Bracing calculations show the building has in excess of 100% NBS

3.7 Performance Achievement Ratio (PAR)
(equals A x B x C x D x E x F) **PAR** 1.19

(Refer Table IEP - 1 for Step 1; Table IEP - 2 for Step 2, Table IEP - 4 for Steps 4, 5 and 6)

Building Name:	Corsair Bay Changing Sheds and Toilets (PRK_3534_BLDG_00	Ref.	ZB01276.206
Location:	5 Park Terrace, Corsair Bay	By	NLC
Direction Considered:	**b) Transverse**	Date	9/01/2013

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

Step 3 - Assessment of Performance Achievement Ratio (PAR)

(Refer Appendix B - Section B3.2)

Critical Structural Weakness	Effect on Structural Performance (Choose a value - Do not interpolate)	Building Score

3.1 Plan Irregularity

	Severe	Significant	Insignificant	
Effect on Structural Performance	○	○	◉	**Factor A** 1
Comment				

3.2 Vertical Irregularity

	Severe	Significant	Insignificant	
Effect on Structural Performance	○	○	◉	**Factor B** 1
Comment				

3.3 Short Columns

	Severe	Significant	Insignificant	
Effect on Structural Performance	○	○	◉	**Factor C** 1
Comment				

3.4 Pounding Potential

(Estimate D1 and D2 and set D = the lower of the two, or =1.0 if no potential for pounding)

a) Factor D1: - Pounding Effect

Select appropriate value from Table

Note:
Values given assume the building has a frame structure. For stiff buildings (eg with shear walls), the effect of pounding may be reduced by taking the co-efficient to the right of the value applicable to frame buildings.

Factor D1 1

Table for Selection of Factor D1	Severe	Significant	Insignificant
Separation	0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Alignment of Floors within 20% of Storey Height	○ 0.7	○ 0.8	◉ 1
Alignment of Floors not within 20% of Storey Height	○ 0.4	○ 0.7	○ 0.8

b) Factor D2: - Height Difference Effect

Select appropriate value from Table

Factor D2 1

Table for Selection of Factor D2	Severe	Significant	Insignificant
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

Factor D 1

(Set D = lesser of D1 and D2 or..
set D = 1.0 if no prospect of pounding)

3.5 Site Characteristics - (Stability, landslide threat, liquefaction etc)

	Severe	Significant	Insignificant	
Effect on Structural Performance	○ 0.5	○ 0.7	◉ 1	**Factor E** 1

3.6 Other Factors

For < 3 storeys - Maximum value 2.5,

otherwise - Maximum value 1.5. No minimum. **Factor F** 1.19

Record rationale for choice of Factor F:

Bracing calculations show the building has in excess of 100% NBS

3.7 Performance Achievement Ratio (PAR)
(equals A x B x C x D x E x F) **PAR** 1.19

Table IEP-4

Initial Evaluation Procedure – Steps 4, 5 and 6

(Refer Table IEP - 1 for Step 1; Table IEP - 2 for Step 2, Table IEP - 3 for Step 3)

Building Name:	Corsair Bay Changing Sheds and Toilets (PRK_3534_BLDG_006 EQ2)	Ref.	ZB01276.206
Location:	5 Park Terrace, Corsair Bay	By	NLC
Direction Considered:	**Longitudinal & Transverse**	Date	9/01/2013

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

Step 4 - Percentage of New Building Standard (%NBS)

	Longitudinal	Transverse
4.1 Assessed Baseline (%NBS)$_b$ (from Table IEP - 1)	84	84
4.2 Performance Achievement Ratio (PAR) (from Table IEP - 2)	1.19	1.19
4.3 PAR x Baseline (%NBS)$_b$	100	100

4.4 Percentage New Building Standard (%NBS)
(Use lower of two values from Step 4.3) **100**

Step 5 - Potentially Earthquake Prone?
(Mark as appropriate)

%NBS ≤ 33 NO

Step 6 - Potentially Earthquake Risk?

%NBS < 67 NO

Step 7 - Provisional Grading for Seismic Risk based on IEP

Seismic Grade **A**

Evaluation Confirmed by

[signature] Signature

Nick Calvert Name

242062 CPEng. No

Relationship between Seismic Grade and % NBS :

Grade:	A+	A	B	C	D	E
%NBS:	> 100	100 to 80	80 to 67	67 to 33	33 to 20	< 20

13. Appendix 3 – CERA Standardised Report Form

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Corsair Bay Changing Sheds and Toilets		Reviewer:	Nick Calvert
	Unit / No: / Street		CPEng No:	242062
Building Address:	Corsair Bay Reserve / 5 / Park Terrace, Corsair Bay		Company:	Sinclair Knight Merz
Legal Description:			Company project number:	ZB01276.206
			Company phone number:	03 940 4900
	Degrees / Min / Sec			
GPS south:			Date of submission:	
GPS east:			Inspection Date:	6/12/2012
			Revision:	A
Building Unique Identifier (CCC):			Is there a full report with this summary?	yes

Site

Site slope:	slope >1 in 5	Max retaining height (m):	1.2
Soil type:	mixed	Soil Profile (if available):	
Site Class (to NZS1170.5):	C		
Proximity to waterway (m, if <100m):	55	If Ground improvement on site, describe:	
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	0.00

Building

No. of storeys above ground:	1 (single storey = 1)	Ground floor elevation (Absolute) (m):	8.00
Ground floor split?	no	Ground floor elevation above ground (m):	0.00
Storeys below ground	0		
Foundation type:	mat slab	if Foundation type is other, describe:	
Building height (m):	4.40	height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	56		
Age of Building (years):	5	Date of design:	2004-
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):	Toilet and changing room		
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber truss	truss depth, purlin type and cladding	100 x 50 rafters, roof sarking
Floors:	concrete flat slab	slab thickness (mm)	100mm, with thickening beneath walls
Beams:			
Columns:	load bearing walls	typical dimensions (mm x mm)	100mm thick walls
Walls:			

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	lightweight timber framed walls		note typical wall length (m)	1.6
Ductility assumed, μ:	3.00			
Period along:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):	5		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	lightweight timber framed walls		note typical wall length (m)	1.6
Ductility assumed, μ:	3.00			
Period across:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):	5		estimate or calculation?	estimated
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:	other light	describe	timber weather boards
Roof Cladding:	Metal	describe	0.4mm corrugated metal
Glazing:			
Ceilings:			
Services(list):			

Available documentation

Architectural	full	original designer name/date	One set of architectural drawings with structural details. David Greenslade, City Solutions, Christchurch City Council. March 2007
Structural		original designer name/date	
Mechanical		original designer name/date	
Electrical		original designer name/date	
Geotech report		original designer name/date	

Damage

Site: (refer DEE Table 4-2)

Site performance:		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:	Damage will not affect the %NBS
	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:	minor non-structural	Describe:	re grouting around areas of the damage around drain
Building Consent required:	no	Describe:	
Interim occupancy recommendations:	full occupancy	Describe:	

Along	Assessed %NBS before:	100%	%NBS from IEP below	If IEP not used, please detail assessment methodology:	Qualitative Assessment carried out, this includes the NZSEE IEP - refer to SKM report
	Assessed %NBS after:	100%			
Across	Assessed %NBS before:	100%	%NBS from IEP below		
	Assessed %NBS after:	100%			

14. Appendix 4 - IEP Backup Calculations

SKM

Job No. ZB01276.206

Calc. Series

Client Christchurch City Council

Page 1

Job Name Corsair Bay Changing Sheds and Toilets

By Nigel Chan

Calcs Title Bracing Schedule

Date 6-12-12

Bracing Demand

Using NZS3604:2011, table 5.8

roof cladding	=	light
single storey cladding	=	light
roof pitch	=	45°
EQ zone	=	2
Soil Class	=	C

Bracing Demand = 13 BUs/m² × 0.6
= 7.8 BUs/m²

Bracing Demand of Building = 7.8 BUs/m² × 5m × 11.1m
= 433 BUs

SKM

Job No. ZBØ1276.206

Calc. Series

Client: Christchurch City Council

Page: 2

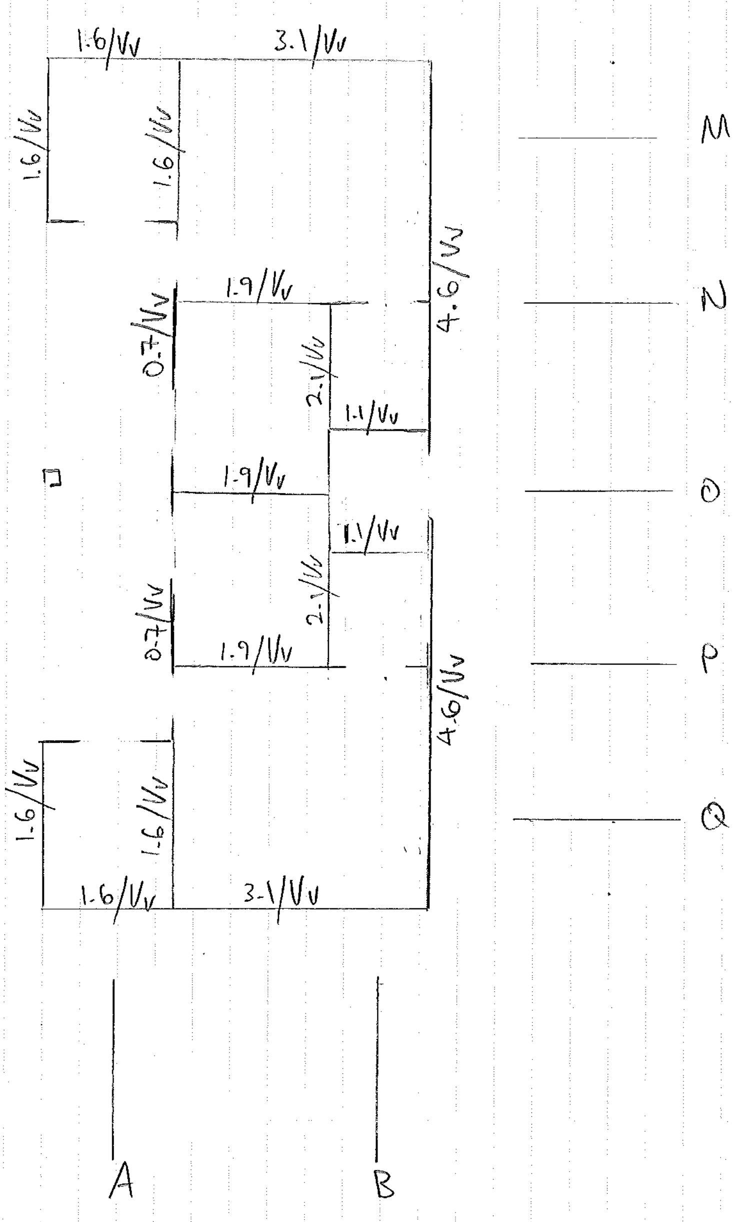
Job Name: Corsair Bay Changing Sheds and Toilets

By: Nigel Chan

Calcs Title: Bracing Schedule

Date: 6-12-12

Bracing Plan



SKM

Job No. ZBØ1276.206
Calc. Series
Client: Christchurch City Council
Page: 3
Job Name: Corsair Bay Changing Sheds and Toilets
By: Nigel Chan
Calcs Title: Bracing Schedule
Date: 6-12-12

Bracing Capacity

Along Direction

			Bus/m	Bus
Line A	1.6m	Villaboard	101	162
	1.6m	"	101	162
	1.6m	"	101	162
	1.6m	"	101	162
Line B	2.1m	"	101	212
	2.1m	"	101	212
	4.6m	"	98	451
	4.6m	"	98	451
			Total	1974

Across Direction

			Bus/m	
Line M	1.6m	Villaboard	101	162
	3.1m	"	98	304
Line N	1.9m	"	101	192
Line O	1.1m	"	85	94
	1.1m	"	85	94
Line P	1.9m	"	101	192
Line Q	1.6m	"	101	162
	3.1m	"	98	304
			Total	1504

Check

% NBS = capacity / demand

= 1504 / 433

≥ 100% in both directions

James Hardie
a smarter way™

BRACING SYSTEM
VILLABOARD® LINING

November 2012

System Number	Bracing Wall Length	System Description	Bracing Units (BU's)/m Wind	Bracing Units (BU's)/m EQ
Vv	0.4m	Villaboard® Lining one side of the wall	81	105
	0.6m		88	85
	1.2m to 2.4m		130*	101
	2.4m or more		125*	98

**A limit of 120BU's/m maximum applies to timber floors and 150BU's/m maximum to concrete floors built as per NZS 3604: 2011 unless a specific engineering design is carried out to ensure the uplift force generated by bracing elements does not exceed the maximum limit for each floor type.*

FRAMING REQUIREMENTS:

Timber framing must comply with the requirements of NZS 3604: 2011, be minimum size 90x45mm. The stud spacing must not exceed 600mm centres maximum. The framing must be treated to minimum H1.2 timber treatment level as per the requirements of NZS 3640: 2011.

The bottom plate must be fixed to slab or timber frame at both ends of the bracing element with a Ramset bracing anchor PBA or GIB Handibrac®. In addition to this, the bottom plate must also be fixed as per the requirements of NZS 3604: 2011.

LINING:

The bracing values achieved are based on using Villaboard® Lining installed vertically fixed to the internal face of a wall. When more than one sheet is used, allow a gap of 2mm at the vertical sheet joints between two sheets.

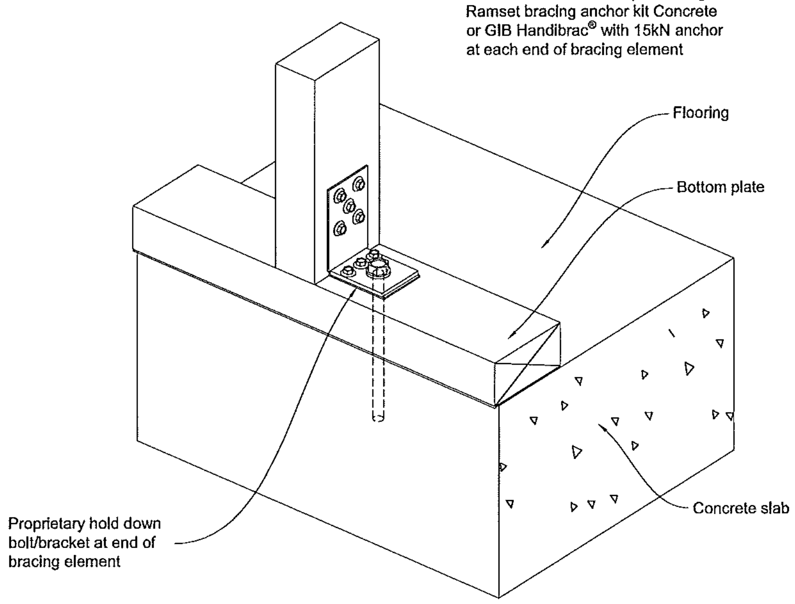
FASTENERS:

The sheets must be fixed to the entire framing using a 40x2.8mm hot dip galvanised nails at 150mm centres in dry areas.

When in wet areas or fixing in a H3.2 CCA treated timber, 40x2.8mm stainless steel ring shank nails must be used.

Notes for Figure 10:

- **Concrete floor** bottom plate fixing:- Ramset bracing anchor kit Concrete or GIB Handibrac® with 15kN anchor at each end of bracing element



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