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Halswell Domain - Toilets
Qualitative Engineering Evaluation

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Prepared for:
Christchurch City Council

Functional Location ID: PRK_1691_BLDG_008

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1	**8 January 2013**	Draft	S. Broglio	S. Broglio	L. Castillo	L. Castillo
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Approval

Author Signature		Approver Signature	
Name	Sara Broglio	Name	Luis Castillo
Title	Structural Engineer	Title	Senior Structural Engineer

Contents

Appendices

Executive Summary

This is a summary of the Qualitative Engineering Evaluation for the Halswell Domain - Toilets building and is based on the Detailed Engineering Evaluation Procedure document issued by the Engineering Advisory Group on 19 July 2011, visual inspections, available structural documentation and summary calculations as appropriate.

Building Details	**Name**	Halswell Domain - Toilets			
Building Location ID	PRK_1691_BLDG_008			**Multiple Building Site**	N
Building Address	Halswell Domain, Halswell Road			**No. of residential units**	0
Soil Technical Category	NA	**Importance Level**	1	**Approximate Year Built**	1981
Foot Print (m²)	16.0	**Storeys above ground**	1	**Storeys below ground**	0
Type of Construction	Light weight roof, timber purlins and rafters, lightly reinforced concrete masonry walls, strip footings beneath the concrete masonry walls and slab on grade foundations.				

Qualitative L4 Report Results Summary		
Building Occupied	Y	The Halswell Domain - Toilets is currently in service.
Suitable for Continued Occupancy	N	The Halswell Domain - Toilets is not suitable for continued use.
Key Damage Summary	Y	Refer to summary of building damage Section 3.1 report body.
Critical Structural Weaknesses (CSW)	N	No critical structural weaknesses were identified.
Levels Survey Results	Y	Level survey performed.
Building %NBS From Analysis	<33%	Based on an analysis of bracing capacity and demand.

Qualitative L4 Report Recommendations		
Geotechnical Survey Required	N	Geotechnical survey not required due to lack of observed ground damage on site.
Proceed to L5 Quantitative DEE	N	A quantitative DEE is not required for this structure.

Approval			
Author Signature		Approver Signature	
Name	Sara Broglio	Name	Luis Castillo
Title	Structural Engineer	Title	Senior Structural Engineer

1 Introduction

1.1 General

On 25 October 2012 and 1 November 2012 Aurecon engineers visited the Halswell Domain - Toilets to undertake a qualitative building damage assessment on behalf of Christchurch City Council. Detailed visual inspections were carried out to assess the damage caused by the earthquakes on 4 September 2010, 22 February 2011, 13 June 2011, 23 December 2011 and related aftershocks.

The scope of work included:

- Assessment of the nature and extent of the building damage.
- Visual assessment of the building strength particularly with respect to safety of occupants if the building is currently occupied.
- Assessment of requirements for detailed engineering evaluation including geotechnical investigation, level survey and any areas where linings and floor coverings need removal to expose structural damage.

This report outlines the results of our Qualitative Assessment of damage to the Halswell Domain - Toilets and is based on the Detailed Engineering Evaluation Procedure document issued by the Engineering Advisory Group on 19 July 2011, visual inspections, available structural documentation and summary calculations as appropriate.

2 Description of the Building

2.1 Building Age and Configuration

Halswell Domain toilet block represents a portion of a larger building jointly owned by the CCC and a community group. As the CCC is not responsible for the main part of the building, only the toilet block has been investigated. All the conclusions provided in this report have been inferred from the inspection conducted only in this part of the building representing about the 10% of the entire structure.

The Halswell Domain - Toilets is a single storey toilet block constructed in 1981(with possible alteration in 1996 and again in 2007). The building is of lightly reinforced concrete blocks, with longitudinal reinforcement at the corners. For sake of conservatism and considering the small amount of reinforcement detected during the inspection, the toilet block has been assessed as having unreinforced masonry walls.

The building has a timber roof (assumed), clad in corrugated iron, a concrete floor and concrete strip footings (assumed) below the concrete masonry walls.

The portion investigated has an approximate floor area of about 16 square metres. In accordance with AS/NZS 1170 Part 0:2002, it is considered as an importance level 1 structure.

2.2 Building Structural Systems Vertical and Horizontal

The Halswell Domain - Toilets vertical elements are of lightly reinforced concrete masonry. The gravity loads from the timber framed roof are transferred into the ground via the concrete masonry walls and strip footings. The loads from the ground floor are resisted by the concrete floor slab.

The lateral load resisting system is identical to the gravity one in which the lateral loads in both principal directions are resisted by the concrete masonry walls.

2.3 Reference Building Type

The Halswell Domain - Toilets vertical structural elements are of lightly reinforced concrete masonry construction typical of the 1980s and 1990s. Although, being the drawings not available it is assumed that the walls are partially filled.

A general overview of the reference building type, construction era and likely earthquake risk is presented in the figure below. The Halswell Domain - Toilets is a lightly reinforced partially filled concrete masonry building constructed in 1981 and according to the figure below may be earthquake prone.

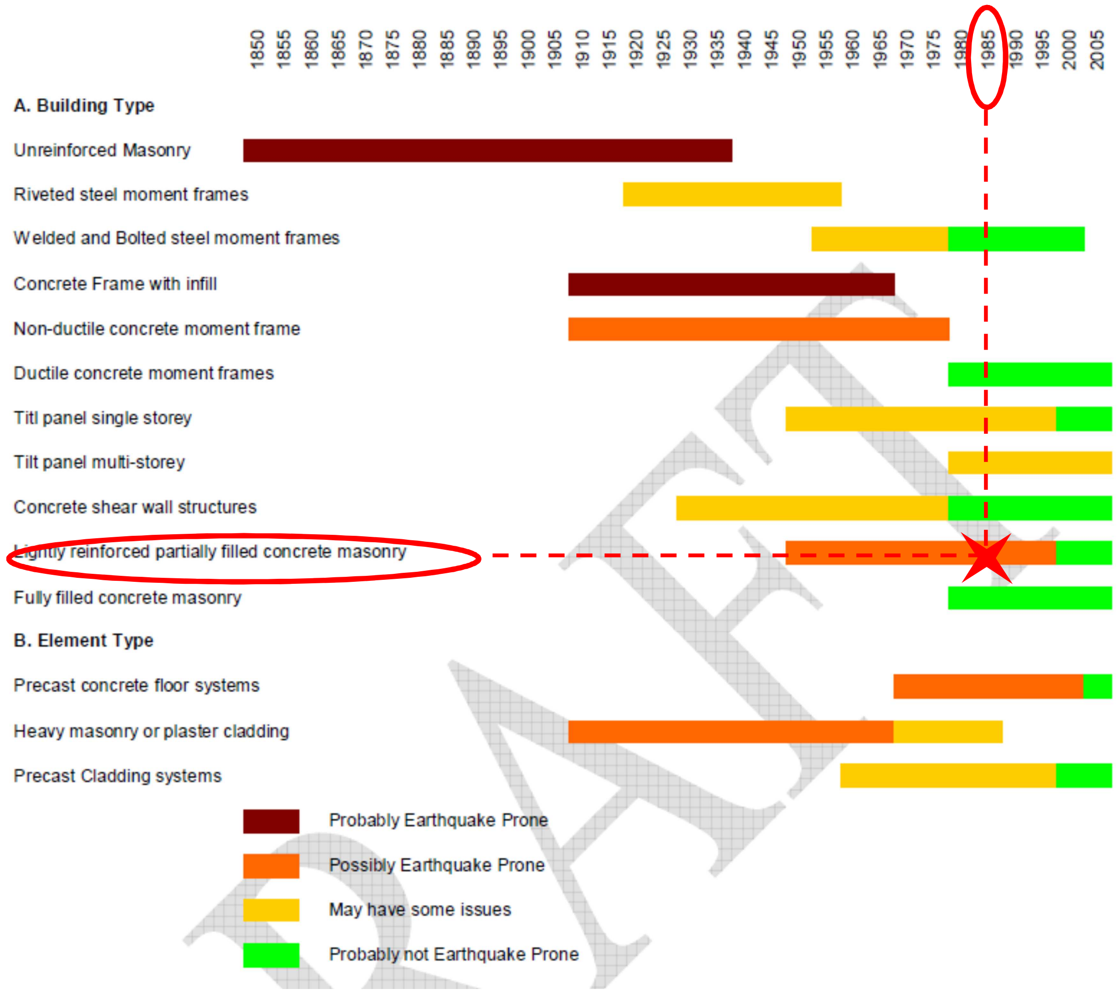


Figure 1: Timeline showing the building types, approximate time of construction and likely earthquake risk.

(From the Draft Guidance on DEEs of non-residential buildings by the Engineering Advisory Group)

2.4 Building Foundation System and Soil Conditions

The Halswell Domain is used for non-residential recreational purposes; the Department of Housing and Building (DBH) has classified the residential area next to Halswell Domain as Technical Category 2 (TC 2) land. According to CERA, TC2 land is considered to be likely to incur in moderate land damage from liquefaction in future significant earthquakes. See Appendix A for details.

2.5 Available Structural Documentation and Inspection Priorities

No drawings were available at the time of the inspection.

The inspection priorities for the building are the review of damage to the mortar joints which are inherently weaker than the concrete masonry blocks. Additionally, the damage assessment focused on the building geometry and other forms of potential damage such as cracking in the concrete masonry block and concrete floor.

2.6 Available Survey Information

A floor level survey was undertaken to establish the level of unevenness across the floors. The results of the survey are presented on the attached drawing in Appendix A. All of the levels were taken on top of the existing floor concrete slab which may have introduced some margin of error.

The Department of Building and Housing (DBH) published the "Revised Guidance on Repairing and Rebuilding Houses Affected by the Canterbury Earthquake Sequence" in November 2011, which recommends some form of re-levelling or rebuilding of the floor

1. If the slope is greater than 0.5% for any two points more than 2m apart, or
2. If the variation in level over the floor plan is greater than 50mm, or
3. If there is significant cracking of the floor.

It is important to note that these figures are recommendations and are only intended to be applied to residential buildings. However, they provide useful guidance in determining acceptable floor level variations.

The floor levels for the Halswell Domain - Toilets are considered to be acceptable despite not being within the recommended tolerances: the limit of 0.5% has been exceeded once considering the results of level survey.

A scan of the walls using a rebar scanner has been performed along the entire building detecting a small amount of reinforcement only located in the corners of the structure. A reinforcement pattern was not identified during this survey. The lack of reinforcement can affect the strength of the structure and for this reason this aspect has been taken into account for the assessment of the structure assuming the walls as unreinforced.

3 Structural Investigation

3.1 Summary of Building Damage

As mentioned before, Halswell Domain toilet block represents only a portion of a larger building. As the CCC is not responsible for the main part of the building, only the toilet block has been assessed. All the conclusions and considerations provided in this report have been inferred from the inspection conducted only on this section. However, it has to be taken into account that in case of a future earthquake, the behaviour of the toilet block will be influenced by the behaviour of the rest of the building.

Some damage was noted during the investigation:

- Cracking of the mortar joints has been observed on the eastern side of the building, starting below the toilet window and running through the other property (pictures shown in Appendix A). These mortar cracks penetrate the entire width of the wall.
- Vertical cracking has been detected at the connection between orthogonal walls as can be observed in the photos in Appendix A. This results in disconnected elements in the two principal directions.
- Other damage has been observed in non-structural components (e.g. between lintel and vertical wall as shown in Appendix A).

3.2 Record of Intrusive Investigation

An intrusive investigation was neither warranted nor undertaken for Halswell Domain - Toilets. Because of the generic nature of the building a significant amount of information can be inferred from an external and internal inspection.

In order to assess the presence of reinforcement, a rebar scanning was performed during the inspection indicating a negligible amount of steel in the walls. (Appendix B)

3.3 Damage Discussion

As mentioned in section 3.1, cracking of the mortar has been observed on the eastern side of the building affecting both the toilet block and the other property. Considering that the construction is of lightly reinforced concrete blocks with reinforcement only in the corner, the out of plane failure mechanism is likely to happen.

The vertical cracks observed at the edge of few walls do not compromise the stability of the block under the static loads. However, in case of a future earthquake, it is possible that this lack of connection between structural members leads to pounding between orthogonal walls causing damage to the elements and favouring the out-of-plane mechanism of the perimeter walls.

Because of the aforementioned lack of connection between orthogonal walls, “box”-behaviour is not guaranteed for this structure.

4 Building Review Summary

4.1 Building Review Statement

As noted above no intrusive investigations were carried out for the Halswell Domain - Toilets. Because of the generic nature of the building a significant amount of information can be inferred from an external and internal inspection.

4.2 Critical Structural Weaknesses

The cracking along the intersection of orthogonal walls represents a structural weakness for this structure. During a significant seismic event the movement of these walls can cause pounding between the members and it can trigger the out-of-plane mechanism of the perimeter walls.

The presence non-bearing walls lower than the bearing one, can lead to pounding between elements and concentration of localized shear stresses in the upper part of the orthogonal walls (perimeter walls).

Building Strength (Refer to Appendix C for background information)

4.3 General

The Halswell Domain - Toilets is a lightly reinforced concrete masonry construction. The building has showed moderate damage during the Canterbury earthquake sequence. However the presence of structural vulnerabilities, such as the lack of reinforcement, the lower non-bearing walls in proximity of other vertical elements and the lack of connection between orthogonal walls is accounted for the evaluation of this structure.

4.4 Initial %NBS Assessment

The Halswell Domain - Toilets has not been subject to specific engineering design and the initial evaluation procedure or IEP is not an appropriate method of assessment for this building.

Nevertheless an estimate of lateral load capacity can be made by adopting assumed values for strengths of existing materials and calculating the capacity of existing walls.

Selected assessment seismic parameters are tabulated in the table on the next page.

Table 1: Parameters used in the Seismic Assessment

Seismic Parameter	Quantity	Comment/Reference
Site Soil Class	D	NZS 1170.5:2004, Clause 3.1.3, Deep or Soft Soil
Site Hazard Factor, Z	0.30	DBH Info Sheet on Seismicity Changes (Effective 19 May 2011)
Return period Factor, R_u	1.00	NZS 1170.5:2004, Table 3.5, Importance Level 2 Structure with a Design Life of 50 years
Ductility Factor in the Along Direction, μ	1.25	Lightly reinforced, partially filled concrete masonry walls
Ductility Factor in the Across Direction, μ	1.25	Lightly reinforced, partially filled concrete masonry walls

The seismic demand for the Halswell Domain - Toilets has been calculated based on the current code requirements of NZS 1170.5:2004 (Structural Design Actions) and the “Assessment and Improvement of Unreinforced Masonry Buildings for Earthquake resistance” (2011 supplement to “Assessment and Improvement of the structural Performance of Building in Earthquakes”, NZSEE 2012).

The assessment of the members has been performed assuming unreinforced masonry ignoring reinforcement as minimal.

The capacity of the existing walls was calculated from assumed strengths of existing materials and the number and length of walls present for both the along and across directions. The seismic demand was then compared with the building capacity in these directions. The building was found to do not have a sufficient number and length of walls in both the along and across directions to achieve a capacity of 67% NBS.

The calculations performed to assess the Halswell Domain toilet block showed issues in terms of out-of-plane mechanism, showing a 21% NBS for one of the assessed walls. Being this percentage the lowest values detected during the assessment, it represents the initial %NBS for the entire block.

4.5 Results Discussion

The presence of both moderate damage and structural vulnerabilities leads to a low value of %NBS.

Only a partial inspection of the construction was possible and all the conclusions and consideration have been based on conservative assumptions suitable for the toilet block.

5 Conclusions and Recommendations

Being that the Halswell Domain - Toilets is only a small portion of a larger building, all the conclusions provided in this report have been inferred from the investigation conducted only on this section of the building. The damage state of the remaining part of the building has not been assessed.

However, it is important to observe that in case of a significant future earthquake, the behaviour of the toilet block will be influenced by the seismic behaviour of the remaining part of the construction.

Considering the low %NBS (less than 33%NBS) value obtained for the toilet block, strengthening is necessary. The box behaviour should be restored **ensuring the connection between the vertical elements**.

However the partial strengthening of the construction without considering its effect on the other portion of the building is not suggested. The seismic performance improvement of a portion of a large construction can lead to undesired seismic behaviour of the structure.

In general, results of a partial investigation should be considered carefully. The results can be influenced by assumptions based on a non-representative portion of the entire building. For this reason a more complete investigation including the entire structure is suggested.

6 Explanatory Statement

The inspections of the building discussed in this report have been undertaken to assess structural earthquake damage. No analysis has been undertaken to assess the strength of the building or to determine whether or not it complies with the relevant building codes, except to the extent that Aurecon expressly indicates otherwise in the report. Aurecon has not made any assessment of structural stability or building safety in connection with future aftershocks or earthquakes – which have the potential to damage the building and to jeopardise the safety of those either inside or adjacent to the building, except to the extent that Aurecon expressly indicates otherwise in the report.

This report is necessarily limited by the restricted ability to carry out inspections due to potential structural instabilities/safety considerations, and the time available to carry out such inspections. The report does not address defects that are not reasonably discoverable on visual inspection, including defects in inaccessible places and latent defects. Where site inspections were made, they were restricted to external inspections and, where practicable, limited internal visual inspections.

To carry out the structural review, existing building drawings were obtained (where available) from the Christchurch City Council records. We have assumed that the building has been constructed in accordance with the drawings.

While this report may assist the client in assessing whether the building should be repaired, strengthened, or replaced that decision is the sole responsibility of the client.

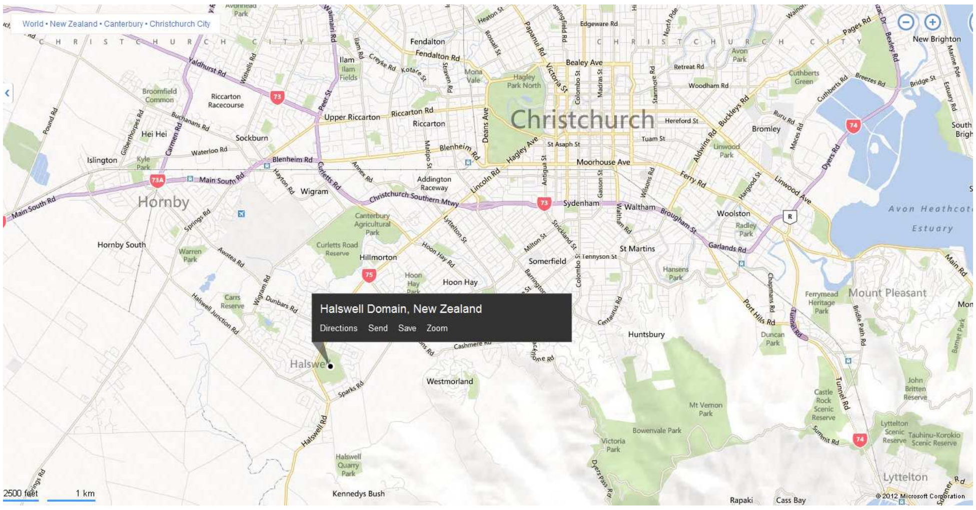
This review has been prepared by Aurecon at the request of its client and is exclusively for the client's use. It is not possible to make a proper assessment of this review without a clear understanding of the terms of engagement under which it has been prepared, including the scope of the instructions and directions given to and the assumptions made by Aurecon. The report will 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, Aurecon's liability, whether under the law of contract, tort, statute, equity or otherwise, is limited as set out in the terms of the engagement with the client.

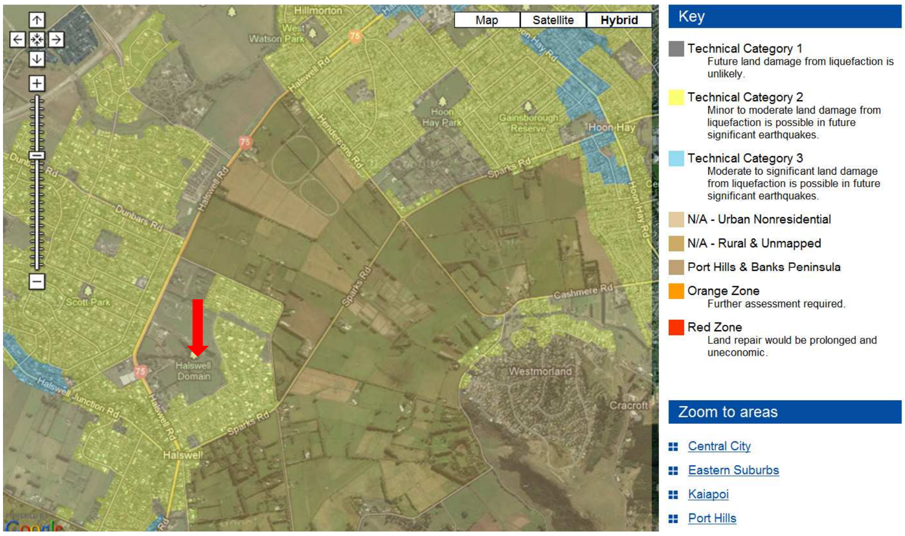
Appendices

Appendix A
Site Location, Photos and Levels Survey

25 October 2012 – Halswell Domain - Toilets Site Photographs

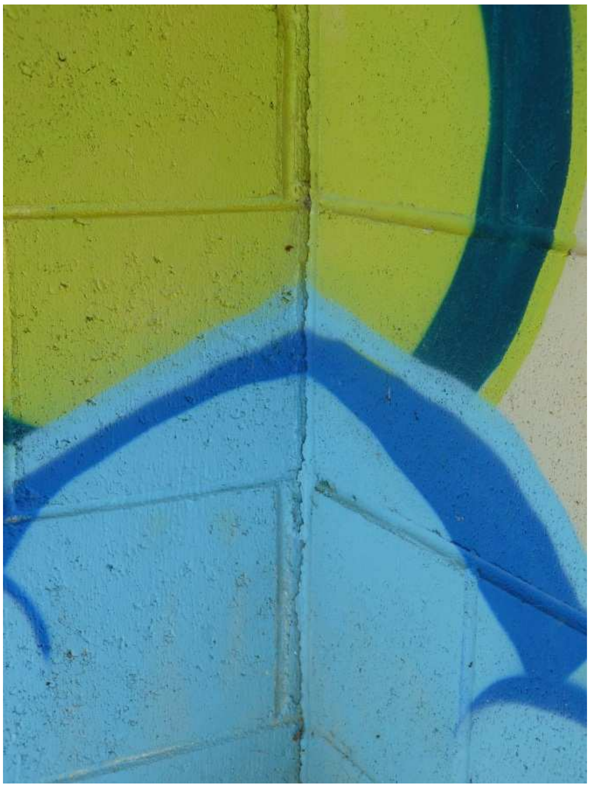


Technical land categories next to Halswell Domain (http://cera.govt.nz/maps/technical-categories)

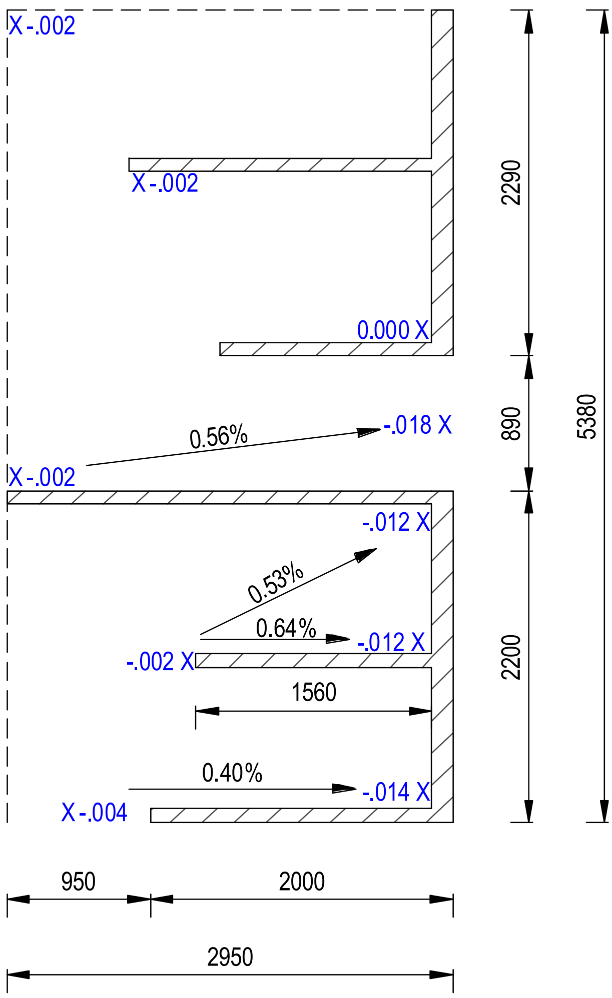


Halswell Domain - Toilets as part of a main building.

Oblique view of the Halswell Domain - Toilets	
Halswell Domain - Toilets southern side.	
Halswell Domain - Toilets eastern side.	
Cracking along the mortar on the eastern side of the building.	

Detail of the cracking along the mortar on the eastern side of the building.	
Cracks at the connection of two orthogonal walls.	

Cracking between lintel and the wall Halswell Domain - Toilets.	
Minor damage to Halswell Domain - Toilets ceiling (non-structural)	



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CLIENT
Christchurch City Council

REV	DATE	REVISION DETAILS	APPROVAL

DRAWN	SURVEYED
D.HUNIA	S.BROGLIO
CHECKED	
L.CASTILLO	
APPROVED	
DATE	
L.CASTILLO	

PROJECT
HALSWELL DOMAIN
TOILET BLOCK

TITLE
LEVEL SURVEY

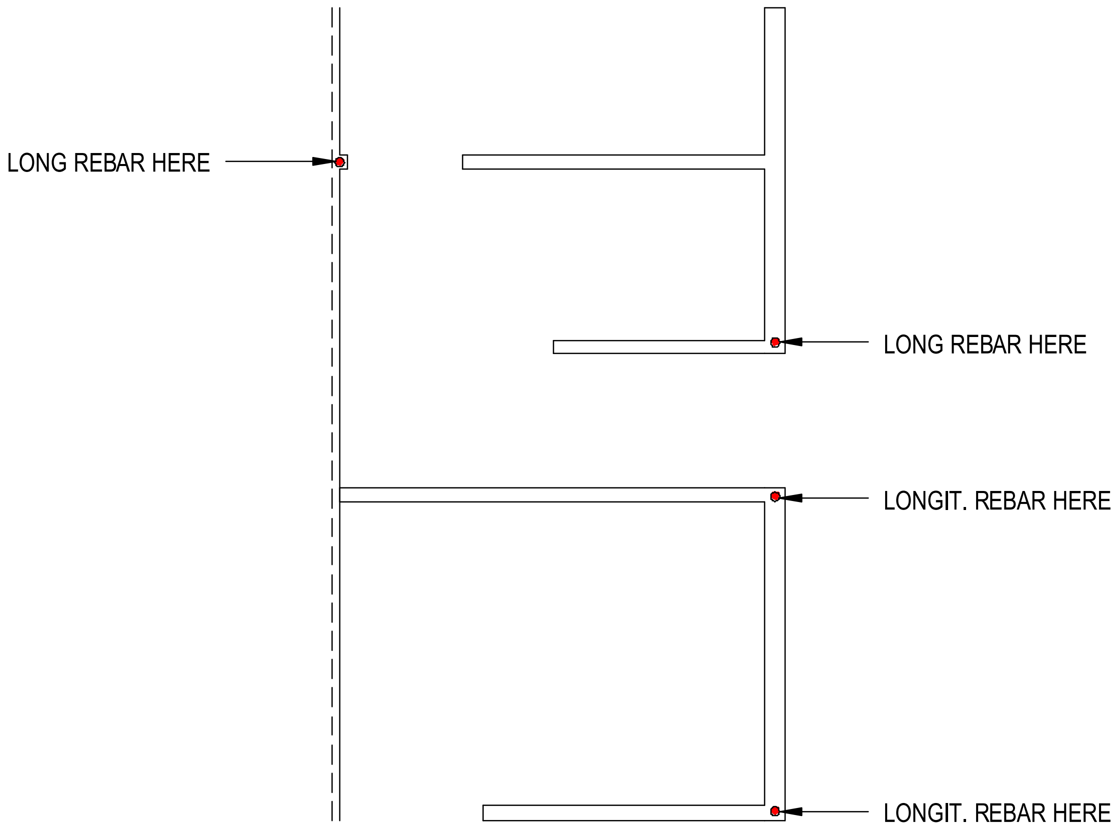
PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT No.
232879

SCALE	SIZE
1 : 50	A4

DRAWING No.	REV
S-01-01	

Appendix B
Rebar Scanning Results



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aurecon	DRAWN: D.HUNIA	SURVEYED: S.BROGLIO
CLIENT: Christchurch City Council	CHECKED: L.CASTILLO	
	APPROVED: L.CASTILLO	DATE

REV	DATE	REVISION DETAILS	APPROVAL

PROJECT	HALSWELL DOMAIN TOILET BLOCK
TITLE	REBAR SCANNING RESULTS
PRELIMINARY	NOT FOR CONSTRUCTION
PROJECT No.	232879
SCALE	1 : 50
SIZE	A4
DRAWING No.	S-01-02
REV	

Appendix C
References

1. Department of Building and Housing (DBH), “Revised Guidance on Repairing and Rebuilding Houses Affected by the Canterbury Earthquake Sequence”, November 2011

2. New Zealand Society for Earthquake Engineering (NZSEE), “Assessment and Improvement of the Structural Performance of Buildings in Earthquakes”, April 2012

3. Standards New Zealand, “AS/NZS 1170 Part 0, Structural Design Actions: General Principles”, 2002

4. Standards New Zealand, “AS/NZS 1170 Part 1, Structural Design Actions: Permanent, imposed and other actions”, 2002

5. Standards New Zealand, “NZS 1170 Part 5, Structural Design Actions: Earthquake Actions – New Zealand”, 2004

6. Standards New Zealand, “NZS 3101 Part 1, The Design of Concrete Structures”, 2006

7. Standards New Zealand, “NZS 3404 Part 1, Steel Structures Standard”, 1997

8. Standards New Zealand, “NZS 3603, Timber Structures Standard”, 1993

9. Standards New Zealand, “NZS 3604, Timber Framed Structures”, 2011

10. Standards New Zealand, “NZS 4229, Concrete Masonry Buildings Not Requiring Specific Engineering Design”, 1999

11. Standards New Zealand, “NZS 4230, Design of Reinforced Concrete Masonry Structures”, 2004

Appendix D
Strength Assessment Explanation

New Building Standard (NBS)

New building standard (NBS) is the term used with reference to the earthquake standard that would apply to a new building of similar type and use if the building was designed to meet the latest design Codes of Practice. If the strength of a building is less than this level, then its strength is expressed as a percentage of NBS.

Earthquake Prone Buildings

A building can be considered to be earthquake prone if its strength is less than one third of the strength to which an equivalent new building would be designed, that is, less than 33%NBS (as defined by the New Zealand Building Act). If the building strength exceeds 33%NBS but is less than 67%NBS the building is considered at risk.

Christchurch City Council Earthquake Prone Building Policy 2010

The Christchurch City Council (CCC) already had in place an Earthquake Prone Building Policy (EPB Policy) requiring all earthquake-prone buildings to be strengthened within a timeframe varying from 15 to 30 years. The level to which the buildings were required to be strengthened was 33%NBS.

As a result of the 4 September 2010 Canterbury earthquake the CCC raised the level that a building was required to be strengthened to from 33% to 67% NBS but qualified this as a target level and noted that the actual strengthening level for each building will be determined in conjunction with the owners on a building-by-building basis. Factors that will be taken into account by the Council in determining the strengthening level include the cost of strengthening, the use to which the building is put, the level of danger posed by the building, and the extent of damage and repair involved.

Irrespective of strengthening level, the threshold level that triggers a requirement to strengthen is 33%NBS.

As part of any building consent application fire and disabled access provisions will need to be assessed.

Christchurch Seismicity

The level of seismicity within the current New Zealand loading code (AS/NZS 1170) is related to the seismic zone factor. The zone factor varies depending on the location of the building within NZ. Prior to the 22nd February 2011 earthquake the zone factor for Christchurch was 0.22. Following the earthquake the seismic zone factor (level of seismicity) in the Christchurch and surrounding areas has been increased to 0.3. This is a 36% increase.

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 C1 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 C1: NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE Guidelines

Table C1 below compares the percentage NBS to the relative risk of the building failing in a seismic event with a 10% probability 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% probability of exceedance in the next year.

Table C1: Relative Risk of Building Failure In A

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

Appendix E
Background and Legal Framework

Background

Aurecon has been engaged by the Christchurch City Council (CCC) to undertake a detailed engineering evaluation of the building

This report is a Qualitative Assessment of the building structure, and is based 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).

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.

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

Building Act

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

Section 112 – Alterations

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

Section 115 – Change of Use

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

Section 121 – Dangerous Buildings

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

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

Section 122 – Earthquake Prone Buildings

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

Section 124 – Powers of Territorial Authorities

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

Section 131 – Earthquake Prone Building Policy

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

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.

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.

Appendix F
Standard Reporting Spread Sheet

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Halswell Domain -Toilets	Reviewer:	Lee Howard
	Unit / No: / Street	CPEng No:	1008889
Building Address:	Halswell Domain / Halswell Road	Company:	Aurecon
Legal Description:		Company project number:	232879
		Company phone number:	03 366 0821
	Degrees / Min / Sec		
GPS south:	43 / 34 / 40.96	Date of submission:	11/10/2013
GPS east:	170 / 34 / 9.29	Inspection Date:	25/10/2012
		Revision:	3
Building Unique Identifier (CCC):	PRK_161_BLDG_008	Is there a full report with this summary?	yes

Site

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

Building

No. of storeys above ground:	1 (single storey = 1)	Ground floor elevation (Absolute) (m):	
Ground floor split?	no	Ground floor elevation above ground (m):	0.15
Storeys below ground	0		
Foundation type:	pads with tie beams	if Foundation type is other, describe:	assumed
Building height (m):	2.75	height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):			
Age of Building (years):	31	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):	Toilet		
Importance level (to NZS1170.5):	IL1		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber framed	rafter type, purlin type and cladding	Timber structure assumed. Clad in corrugated Steel.
Floors:	concrete flat slab	slab thickness (mm)	
Beams:			
Columns:			
Walls:	partially filled concrete masonry	thickness (mm)	140

Lateral load resisting structure

Lateral system along:	unreinforced masonry bearing wall - brick	**Note: Define along and across in detailed report!**	concrete blockwork construction
Ductility assumed, μ:	1.25	note wall thickness and cavity	
Period along:	0.20	0.40 from parameters in sheet / estimate or calculation?	estimated
Total deflection (ULS) (mm):		estimate or calculation?	
maximum interstorey deflection (ULS) (mm):		estimate or calculation?	
Lateral system across:	unreinforced masonry bearing wall - brick		concrete blockwork construction
Ductility assumed, μ:	1.25	note wall thickness and cavity	
Period across:	0.20	0.00 / estimate or calculation?	estimated
Total deflection (ULS) (mm):		estimate or calculation?	
maximum interstorey deflection (ULS) (mm):		estimate or calculation?	

Separations:

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

Non-structural elements

Stairs:			N/A
Wall cladding:	exposed structure	describe	Paint
Roof Cladding:	Metal	describe	Corrugated Steel
Glazing:			N/A
Ceilings:	light tiles		Particle boards
Services(list):			

Available documentation

Architectural	none	original designer name/date	N/A
Structural	none	original designer name/date	N/A
Mechanical	none	original designer name/date	N/A
Electrical	none	original designer name/date	N/A
Geotech report	none	original designer name/date	N/A

Damage

Site: (refer DEE Table 4-2)

Site performance:		Describe damage:	No relevant damage on the site
Settlement:	none observed	notes (if applicable):	N/A
Differential settlement:	0-1:350	notes (if applicable):	assumed observing the crack on the eastern side
Liquefaction:	none apparent	notes (if applicable):	N/A
Lateral Spread:	none apparent	notes (if applicable):	N/A
Differential lateral spread:	none apparent	notes (if applicable):	N/A
Ground cracks:	none apparent	notes (if applicable):	N/A
Damage to area:	none apparent	notes (if applicable):	N/A

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?:	yes	Describe:	cracking between lintel and wall

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

Recommendations

	Level of repair/strengthening required:	significant structural and strengthening	Describe:	
	Building Consent required:	yes	Describe:	
	Interim occupancy recommendations:	do not occupy	Describe:	
Along	Assessed %NBS before e'quakes:	37% ##### %NBS from IEP below	If IEP not used, please detail assessment methodology:	Calculation
	Assessed %NBS after e'quakes:	37%		
Across	Assessed %NBS before e'quakes:	21% ##### %NBS from IEP below		
	Assessed %NBS after e'quakes:	21%		

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: m

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

	along	across
Period (from above):	0.2	0.2
(%NBS)nom from Fig 3.3:		

Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0

Note 2: for RC buildings designed between 1976-1984, use 1.2

Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0)

along across

Final (%NBS)nom:	**0%**	**0%**

2.2 Near Fault Scaling Factor

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

	along	across
Near Fault scaling factor (1/N(T,D), **Factor A**:	#DIV/0!	#DIV/0!

2.3 Hazard Scaling Factor

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

Z_{1992}, from NZS4203:1992

Hazard scaling factor, **Factor B:** #DIV/0!

2.4 Return Period Scaling Factor

Building Importance level (from above): 1

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

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)		
Ductility scaling factor: =1 from 1976 onwards; or =kμ, if pre-1976, fromTable 3.3:		
Ductiity Scaling Factor, **Factor D**:	1.00	1.00

2.6 Structural Performance Scaling Factor:

Sp:		
Structural Performance Scaling Factor **Factor E**:	#DIV/0!	#DIV/0!

2.7 Baseline %NBS, (NBS%)b = (%NBS)nom x A x B x C x D x E

%NBSb:	**#DIV/0!**	**#DIV/0!**

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

3.1. Plan Irregularity, factor A: 1

3.2. Vertical irregularity, Factor B: 1

3.3. Short columns, Factor C: 1

3.4. Pounding potential

Pounding effect D1, from Table to right

Height Difference effect D2, from Table to right

Therefore, Factor D: 0

3.5. Site Characteristics 1

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

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

3.6. Other factors, Factor F

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

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

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

3.7. Overall Performance Achievement ratio (PAR)	**0.00**	**0.00**
4.3 PAR x (%NBS)b: PAR x Baselline %NBS:	**#DIV/0!**	**#DIV/0!**
4.4 Percentage New Building Standard (%NBS), (before)		**#DIV/0!**

Official Use only:

Accepted By

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