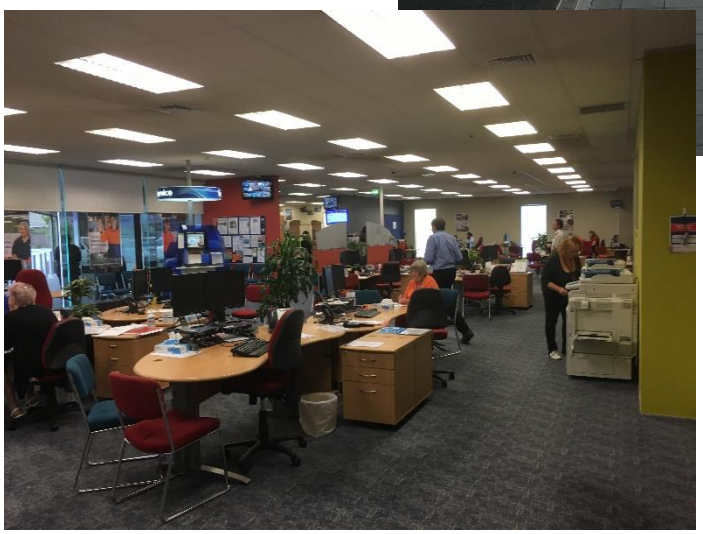
CENTRAUS STRUCTURAL CONSULTING
AEQ HOUSE, 61 CAMBRIDGE TERRACE, 2ND FLOOR, CHRISTCHURCH | 03 374 9878

DETAILED ENGINEERING EVALUATION

27 SHANDS ROAD
HORNBY, CHRISTCHURCH 8042

Mkb Properties Limited c/of Mark Brown
Bayleys Canterbury - c/o - Nick O'Styke

22nd February 2017
JN 170015A



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1.0 EXECUTIVE SUMMARY

In response to a request by our client, Mkb Properties Limited c/of Mark Brown (with agent Bayleys Canterbury c/o Nick O'Styke) as owners representative of the building, Centraus Limited is pleased to present this report of our Detailed Engineering Evaluation of the commercial building located at 27 Shands Road, Hornby, Christchurch 8042. The Assessment was performed in order to evaluate the building for earthquake damage and determine if any seismic vulnerabilities (critical structural weaknesses) in the seismic load resisting system exist and provide recommendations for repair and further action.

The subject site consists of a single storey commercial building constructed in 1977s with an addition and strengthening in 2004 and a further addition in 2006. The original building is concrete pre-cast walls with steel gravity and lateral frames.

A Detailed Engineering Evaluation Procedure (DEE) – Qualitative Method (ISA) for this building was completed which concluded that the building is as noted below and providing a classification of risk to the structure as outlined in the New Zealand Society of Earthquake Engineering's "Assessment and Improvement of the Structural Performances of Buildings in Earthquakes".

Our Detailed Engineering Evaluation confirms the rating of 70-75%NBS resulting in a Non-Earthquake Prone, Low Risk assessment, Grade B for the building. The building is currently in a sound condition and should provide full functionality of the building systems. Our review of the building has identified no critical issues but there are a few items which could affect the future performance of the building.

Michael King
BSc, MIPENZ, CPEng, IntPE (NZ), SE (CA USA)
Senior Structural Engineer, Director

2.0 SCOPE OF ENGAGEMENT

Centraus Limited has been engaged to undertake a Detailed Engineering Evaluation of the building located at 27 Shands Road, Hornby, Christchurch 8042. The site is one building with a combination of light industrial business with several tenants, currently occupied.

This evaluation has been carried out in accordance with the "Guidance on Detailed Engineering Evaluation of Earthquake Affected Buildings in Canterbury" Draft prepared by the Engineering Advisory Group; Revision 5 dated 19 July 2011.

The assessment is made with regard to Clause B1 – Structure of the New Zealand Building Code. No other building code clauses have been assessed by this report. This structural assessment is based upon review of noted materials and visual evidence and indications present at the time of inspection. The findings of this report may be subject to revision pending deterioration of elements from subsequent aftershocks or ground settlement.

The report is provided solely for use by the owners and shall not be relied on by any other parties without written approval from Centraus Limited.

3.0 BACKGROUND INFORMATION

The building at 27 Shands Road, Hornby, Christchurch is a single storey concrete tilt-slab industrial structure. The roof is a lightweight steel framed roof supported on steel frames and concrete masonry walls. The main building (Building 2) was reportedly built in 1970's with an extensive addition and upgrade in 2004. Google Earth satellite image from 14 April 2004 show the building under construction with reframing of the roof and addition to the original building elements in Unit 31. Further Google earth image from 16 Jan 2006 indicate the further addition of units 21-25 (Building 1) on the north side of the building. This report covers the combined building only and does not cover the adjacent structures.

The subject building is positioned in a high seismic zone of the western part of Christchurch on New Zealand's South Island. We inspected the property on 22nd February 2017.

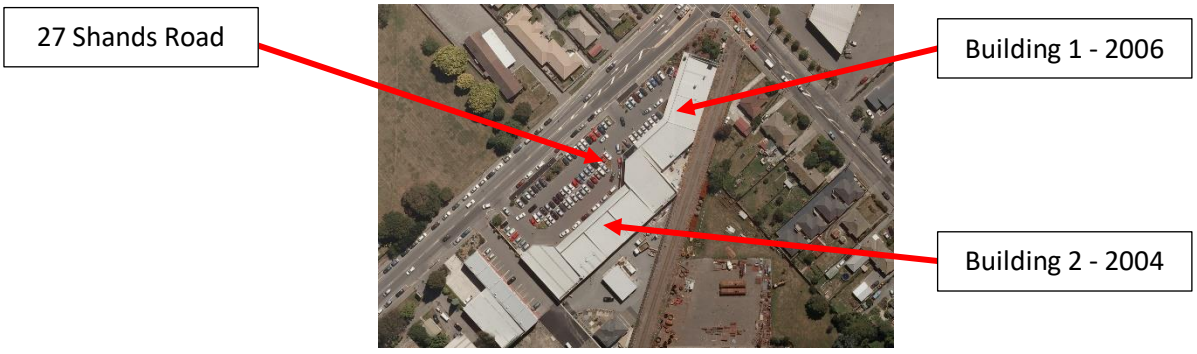

FIGURE 1 – BUILDING SITE LOCATION

For purposes of this report, the property outlook onto Shands Road is considered to be oriented North.

As part of our evaluation we have reviewed the following documents provided by the owner:

- Report to Canterbury Earthquake Recovery Authority by Harrison Grierson dated January 2013 (*26 pages*)

3.1 BUILDING DESCRIPTION

The original construction documents were available for our review as part of the report provided by Harrison Grierson. The building was reportedly designed in two phases with the original built about 1977 as building two in the HG Report (Units 27-33) and 2004 (Units 21-25). These building is concrete pre-cast walls with cold formed steel roof framing and steel girders fixed directly to the panels. The floors are concrete slab on grade with perimeter foundations. There are timber framed walls dividing the spaces into offices and separations within each of the tenanted spaces. There is a car park extends along the front of the structure. Refer to figure 1 and Appendix A for photos taken at specific areas throughout the subject building.

Our report is based upon discussions with owners and information as gathered at the site, no independent analysis has been performed. The inspection was limited to readily accessible areas of the property only. No intrusive investigations were completed.

3.2 GRAVITY LOAD RESISTING SYSTEM

Table 1 below outlines the gravity load resisting system for the subject building.

Building Portion	Description
Building 1 and 2	The gravity load resisting system for the steel framed roof supported on steel beams and portal frames and concrete walls. The concrete walls and steel portal frames are supported on assumed foundations

TABLE 1 – GRAVITY LOAD RESISTING SYSTEM

3.3 LATERAL LOAD RESISTING SYSTEM

A building's lateral load resisting system (LLRS) helps brace the structure against earthquake and wind loading. The building is generally concrete shear walls on the sides and long direction. The longitudinal direction has some spandrel frame action in the steel framing to support the lateral loads. The short direction the concrete walls support the lateral loads. Seismic lateral loads are typically supported by the roof braced diaphragm and distributed to the lateral system described below through direct fixings of the roof framing. The seismic loads are supported by in plane shear action through the wall panels and portal action to the foundations and ground below.

3.4 GEOTECHNICAL CONDITIONS AND FOUNDATION SYSTEM

The land in this area is not included in the Landcheck information as it is commercially zoned. We do not have any other geotechnical notation on the site.

A review of the site did not note any observable settlement in the area of the buildings, parking lots or adjacent streets.

Site-specific geotechnical investigation will identify the best foundation design for your property to reduce the risk of injury to people and damage to your property in future earthquakes.

3.5 EARTHQUAKE DAMAGE DESCRIPTION

We reviewed the site visually in order to determine the nature and scope of the current building condition. From our site observations we did not note any discernible earthquake damage to the buildings which would materially affect the overall structural capacity. It is our understanding that the earthquake damages have been previously repaired. Observations indicated epoxy injection of cracks to the tilt-slab walls.

4.0 QUALITATIVE ASSESSMENT

Our evaluation of the existing structure includes an assessment of specific building characteristics as gathered at the site. We have provided a Qualitative Assessment in accordance with the New Zealand Society of Earthquake Engineers Assessment and Improvement of the Structural Performance of Buildings in Earthquakes, See Appendix B. We have reviewed the building as a single structure built in combination of Building 2 in 1977 and upgraded in 2004 with Building 1 in 2006.

In order to identify potential seismic deficiencies associated with the existing building, an analysis of key elements of the seismic force resisting system has been reviewed based on earthquake actions in accordance with the New Zealand Standard (NZS) 1170.5. Seismic vulnerabilities and Critical Structural Weaknesses (CSW's) associated with site and building characteristics have been taken into account in accordance with NZSEE's "Assessment and Improvement of the Structural Performance of Buildings in Earthquakes".

Portion	Loading direction and loaded element	%NBS By HG Report	%NBS Centraus
21-25 Shands Building 1 (2006)	Longitudinal direction - Concrete walls and Frame action Transverse direction – Concrete panels	65% NBS Grade C	75% NBS Grade B
27-33 Shands Building 2 (1977 – Upgraded 2004)	Longitudinal direction - Concrete walls and Frame action Transverse direction – Concrete Panels	58% NBS Grade C	70% NBS Grade B

TABLE 3 – %NBS CHARACTERIZATIONS

The review concluded that the building is currently at 75%NBS of New Building Standard (%NBS) for Building 1 (Units 21-25) and 70%NBS for Building 2 (Units 27-33), thus classifying the most of the structures as *Low Risk*, Grade B.

Using engineering judgement and acknowledging that the building is regular with redundancies of differing capacities and performance characteristics we would estimate a combined building rating to be estimated as a central risk estimate. This results in an overall rating of 63%NBS resulting in C grade is as outlined in the New Zealand Society of Earthquake Engineering's "Assessment and Improvement of the Structural Performances of Buildings in Earthquakes".

Table 2.1: Grading system for earthquake risk

Percentage of New Building Standard (%NBS)	Letter grade	Relative risk (approx)	NZS 4203: 1976 or better	1965–76 No CSWs	1935–65 No CSWs	2/3 Chapter 8	Buildings with CSWs
>100	A+	< 1 time					
80–100	A	1–2 times					
67–80	B	2–5 times					
33–67	C	5–10 times					
20–33	D	10–25 times					
<20	E	> 25 times					

Note changes to the relative risk values have been made to line up with the values in Table C4.4.

Notes:

1) *%NBS* is the percentage new building standard score for a particular building
2) Values shown for *%NBS* for building groups are indicative only and will vary with location, assessed ductility, features. Many buildings may have been designed for more than the minimum requriements of the Standards of the day.
3) Letter grade is an indicator of likely performance in earthquake.
4) Relative risk (RR) is the ratio of probabilities that the ultimate strength will be exceeded in any given period of time, i.e. RR = (probability for existing building with *%NBS* value shown) ÷ (probability for building with 100%*NBS*).
5) CSW stands for critical structural weaknesses.

Table 2.2 NZSEE Risk Classifications and Improvement Recommendations

Description	Grade	Risk	%NBS	Existing Building Structural Performance
Low Risk Building	A or B	Low	Above 67	Acceptable (improvement may be desirable)
Moderate Risk Building	B or C	Moderate	34 to 66	Acceptable legally. Improvement recommended
High Risk Building	D or E	High	33 or lower	Unacceptable (Improvement required under Act)

Improvement of Structural Performance	
Legal Requirement	NZSEE Recommendation
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
	Not recommended. Acceptable only in exceptional circumstances
Unacceptable	Unacceptable

** Reprint from NZSEE, Assessment and Improvement of the Structural Performance of Buildings in Earthquakes*

4.1 CRITICAL STRUCTURAL WEAKNESS AND MITIGATION

The structural system, in our opinion, has performed well and appears to be well built. At this point, we have inspected this building and do not note any likely CSW areas of concern.

As the original building provides a Low Risk assessment there are several ways to enhance the performance of the building, if this is required. The main structural issues are considered to be deflection driven which can cause subsequent damage to non-structural elements such as

window walls and roof cladding. The following are some potential schematic mitigate methodologies which could limit the deflections of the building:

- Addition of fly bracing to the existing steel portal beams which will enhance the moment capacity and limit lateral torsional buckling of the beam.

These identified items, although we do not consider them CSW items for the building envelope they could limit other damages and maintain operational requirements of the building should a large event occur.

5.0 CONCLUSIONS, OCCUPANCY AND RECOMMENDATIONS

The building has been designed to resist the seismic loading provided in 2004 and 2006. The lateral systems provided in the buildings are considered to be specific engineered design. The Z factor has recently been modified in the Canterbury region from 0.22 to 0.3 indicating a 27% increase in design loading. The building contains most items which have a moderate to high ductility rating and can perform satisfactorily in future seismic events.

In our estimation, the combination of concrete tilt panel walls and steel frames provide seismic path which provides a relatively high ductility performance. In our opinion the building has a rating of at least 70%NBS (New Building Standard) and therefore is not considered earthquake prone (<34%NBS) and greater than 67%NBS. The building is noted to be very regular resulting in a building which should behave in a satisfactory manner.

In our opinion, although the building did perform well in the recent seismic loading it is expected to behave similar to more modern buildings with more ductile systems.

As the building is of *Low Risk*, the anticipated performance will behave slightly less than newly constructed buildings.

At this point we propose that no limitations be placed upon occupation of the building.

APPENDIX A: PHOTOS

Photo 1 – Front units towards street – Building 2 looking to Unit 33

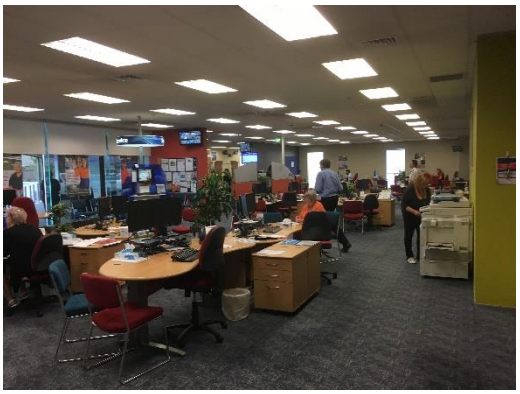

Photo 2 – Interior of Unit 27

Photo 3 – Steel roof framing for interior of Unit 33 – Tool Shed

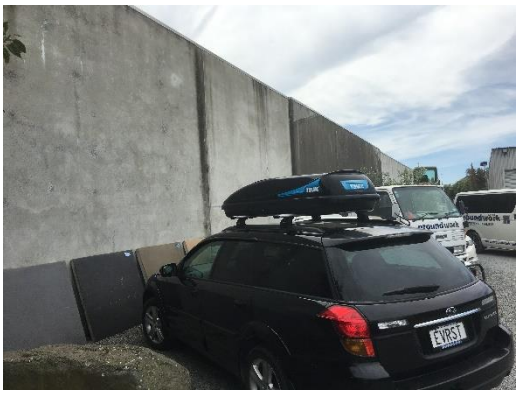

Photo 4 – Rear of building 2 showing concrete wall from original building in Unit 31

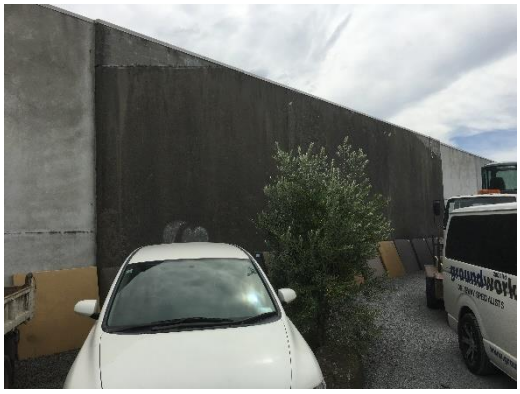

Photo 5 – Original wall for Building 2 in Unit 31

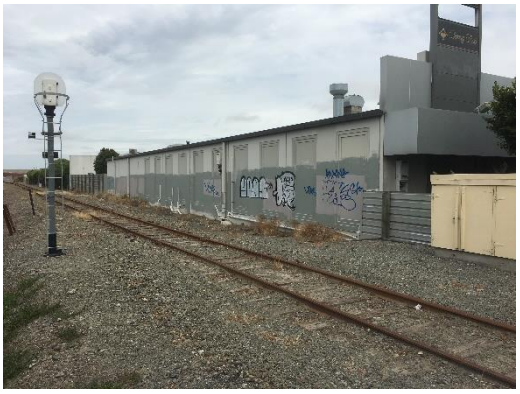

Photo 6 – Rear concrete walls at Building 1

APPENDIX B1: IEP FORM – 1977 ORIGINAL CONSTRUCTION – UPGRADED 2004 – BUILDING 2 - UNITS 27-33

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Initial Evaluation Procedure (IEP) Assessment **Page 1**

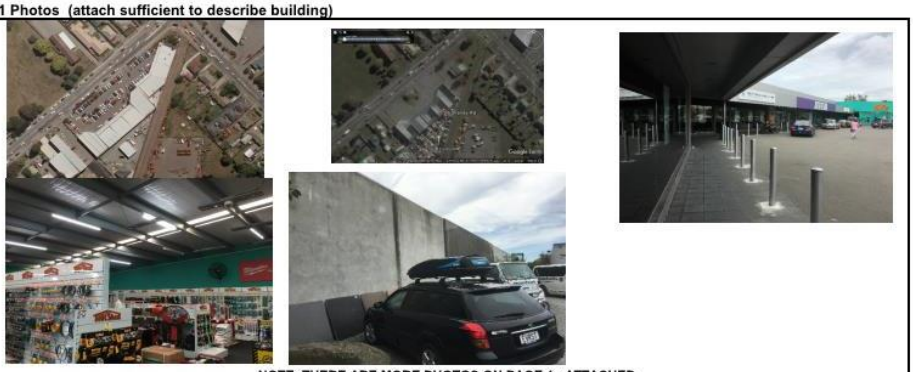
WARNING!! *This initial evaluation has been carried out solely as an initial seismic assessment of the building following the procedure set out in the New Zealand Society for Earthquake Engineering document "Assessment and Improvement of the Structural Performance of Buildings in Earthquakes, June 2006". This spreadsheet must be read in conjunction with the limitations set out in the accompanying report, and should not be relied on by any party for any other purpose. Detailed inspections and engineering calculations, or engineering judgements based on them, have not been undertaken, and these may lead to a different result or seismic grade.*

Street Number & Name:	27 Shands Road	Job No.:	170015A
AKA:	1977 Original Construction Upgraded 04 2004	By:	MJK
Name of building:	Unit 27-33	Date:	22/02/2017
City:	Hornby, Christchurch 8042	Revision No.:	A

Table IEP-1 Initial Evaluation Procedure Step 1

Step 1 - General Information

1.1 Photos (attach sufficient to describe building)



NOTE: THERE ARE MORE PHOTOS ON PAGE 1a ATTACHED

1.2 Sketches (plans etc, show items of interest)

(Refer to main report)

NOTE: THERE ARE MORE SKETCHES ON PAGE 1a ATTACHED

1.3 List relevant features (Note: only 10 lines of text will print in this box. If further text required use Page 1a)

(Refer to main report)

1.4 Note information sources Tick as appropriate

Visual Inspection of Exterior	☑	Specifications	☐
Visual Inspection of Interior	☑	Geotechnical Reports	☐
Drawings (note type)	☑	Other (list)	☐

Original construction drawings with structural information from Alan Reay 7/1995

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Initial Evaluation Procedure (IEP) Assessment — Page 2

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Table IEP-2 Initial Evaluation Procedure Step 2

Step 2 - Determination of *(%NBS)*$_b$

(Baseline *(%NBS)* for particular building - refer Section B5)

2.1 Determine nominal *(%NBS)* = *(%NBS)*$_{nom}$

	Longitudinal	Transverse
a) Building Strengthening Data		
Tick if building is known to have been strengthened in this direction	☑	☑
If strengthened, enter percentage of code the building has been strengthened to	100%	100%
If strengthened, enter original design date for information	2004	
b) Year of Design/Strengthening, Building Type and Seismic Zone		
Pre 1935	☐	☐
1935-1965	☐	☐
1965-1976	☐	☐
1976-1984	☐	☐
1984-1992	☐	☐
1992-2004	◉	◉
2004-2011	☐	☐
Post Aug 2011	☐	☐
Building Type:		
Seismic Zone:		
c) Soil Type		
From NZS1170.5:2004, Cl 3.1.3 :	D Soft Soil	D Soft Soil
From NZS4203:1992, Cl 4.6.2.2 : (for 1992 to 2004 and only if known)	Flexible	Flexible
d) Estimate Period, *T*		
Comment:		
h_n =	4	4 m
A_c =	1.00	1.00 m^2
Moment Resisting Concrete Frames: $T = \max\{0.09h_n^{0.75}, 0.4\}$	☐	☐
Moment Resisting Steel Frames: $T = \max\{0.14h_n^{0.75}, 0.4\}$	☐	☐
Eccentrically Braced Steel Frames: $T = \max\{0.08h_n^{0.75}, 0.4\}$	☐	☐
All Other Frame Structures: $T = \max\{0.06h_n^{0.75}, 0.4\}$	☐	☐
Concrete Shear Walls $T = \max\{0.09h_n^{0.75}/\sqrt{A_c}^{0.5}, 0.4\}$	◉	◉
Masonry Shear Walls: $T \leq 0.4$sec	☐	☐
User Defined (input Period):	☐	☐
Where h_n = height in metres from the base of the structure to the uppermost seismic weight or mass.		
T:	0.40	0.40
e) Factor A: Strengthening factor determined using result from (a) above (set to 1.0 if not strengthened)	**Factor A:** 1.00	1.00
f) Factor B: Determined from NZSEE Guidelines Figure 3A.1 using results (a) to (e) above	**Factor B:** 0.22	0.22
g) Factor C: For reinforced concrete buildings designed between 1976-84 Factor C = 1.2, otherwise take as 1.0.	**Factor C:** 1.00	1.00
h) Factor D: For buildings designed prior to 1935 Factor D = 0.8 except for Wellington where Factor D may be taken as 1, otherwise take as 1.0.	**Factor D:** 1.00	1.00
***(%NBS)*$_{nom}$ = AxBxCxD**	***(%NBS)*$_{nom}$** 22%	22%

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Initial Evaluation Procedure (IEP) Assessment — Page 3

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Table IEP-2 Initial Evaluation Procedure Step 2 continued

2.2 Near Fault Scaling Factor, Factor E
If $T \leq 1.5$sec, Factor E = 1

		Longitudinal	Transverse
a) Near Fault Factor, *N(T,D)* (from NZS1170.5:2004, Cl 3.1.6)	N(T,D):	1	1
b) Factor E = 1/N(T,D)	Factor E:	1.00	1.00

2.3 Hazard Scaling Factor, Factor F
a) Hazard Factor, *Z*, for site
Location: Christchurch — Refer right for user-defined locations

Z =	0.3	(from NZS1170.5:2004, Table 3.3)
Z_{1992} =	0.8	(NZS4203:1992 Zone Factor from accompanying Figure 3.5(b))
Z_{2004} =	0.22	(from NZS1170.5:2004, Table 3.3)

b) Factor F
For pre 1992 = 1/Z
For 1992-2011 = Z_{1992}/Z
For post 2011 = Z_{2004}/Z

	Longitudinal	Transverse
Factor F:	2.67	2.67

2.4 Return Period Scaling Factor, Factor G
a) Design Importance Level, I
(Set to 1 if not known. For buildings designed prior to 1965 and known to be designed as a public building set to 1.25. For buildings designed 1965-1976 and known to be designed as a public building set to 1.33 for Zone A or 1.2 for Zone B. For 1976-1984 set I value.)

	Longitudinal	Transverse
I =	1	1

b) Design Risk Factor, R_o (set to 1.0 if other than 1976-2004, or not known)

	Longitudinal	Transverse
	Not Known	Not Known
R_o =	1	1

c) Return Period Factor, R (from NZS1170.0:2004 Building Importance Level)

	Longitudinal	Transverse
Choose Importance Level	☐1 ☑2 ☐3 ☐4	☐1 ☑2 ☐3 ☐4
R =	1.0	1.0

d) Factor G = IR_o/R

	Longitudinal	Transverse
Factor G:	1.00	1.00

2.5 Ductility Scaling Factor, Factor H
a) Available Displacement Ductility Within Existing Structure
Comment:

	Longitudinal	Transverse
μ =	1.25	1.25

b) Factor H

	Longitudinal	Transverse
	k_μ	k_μ
For pre 1976 (maximum of 2) =	1.14	1.14
For 1976 onwards =	1	1
Factor H:	1.00	1.00

(where k_μ is NZS1170.5:2004 Inelastic Spectrum Scaling Factor, from accompanying Table 3.3)

2.6 Structural Performance Scaling Factor, Factor I
a) Structural Performance Factor, S_p (from accompanying Figure 3.4)
Tick if light timber-framed construction in this direction

	Longitudinal	Transverse
	☐	☐
S_p =	0.93	0.93

b) Structural Performance Scaling Factor = $1/S_p$

	Longitudinal	Transverse
Factor I:	1.08	1.08

Note Factor B values for 1992 to 2004 have been multiplied by 0.67 to account for Sp in this period

2.7 Baseline *%NBS* for Building, $(\%NBS)_b$
(equals $(\%NBS)_{nom}$ x E x F x G x H x I)

Longitudinal	Transverse
64%	64%

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Table IEP-3 Initial Evaluation Procedure Step 3

Step 3 - Assessment of Performance Achievement Ratio (PAR)
(Refer Appendix B - Section B3.2)

a) Longitudinal Direction

potential CSWs	Effect on Structural Performance (Choose a value - Do not interpolate)			Factors
3.1 Plan Irregularity				
Effect on Structural Performance	☐ Severe	☐ Significant	◉ Insignificant	Factor A 1.0
Comment				
3.2 Vertical Irregularity				
Effect on Structural Performance	☐ Severe	☐ Significant	◉ Insignificant	Factor B 1.0
Comment				
3.3 Short Columns				
Effect on Structural Performance	☐ Severe	☐ Significant	◉ Insignificant	Factor C 1.0
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, or consequences are considered to be minimal)

a) Factor D1: - Pounding Effect

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

Factor D1 For Longitudinal Direction: 1.0

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	☐ 1	☐ 1	◉ 1
Alignment of Floors not within 20% of Storey Height	☐ 0.4	☐ 0.7	☐ 0.8

Comment

b) Factor D2: - Height Difference Effect

Factor D2 For Longitudinal Direction: 1.0

Table for Selection of Factor D2	Severe	Significant	Insignificant
	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

Comment

Factor D 1.0

3.5 Site Characteristics - *Stability, landslide threat, liquefaction etc as it affects the structural performance from a life-safety perspective*

Effect on Structural Performance	☐ Severe	☐ Significant	◉ Insignificant	Factor E 1.0
Comment				

3.6 Other Factors - *for allowance of all other relevant characterstics of the building*
For ≤ 3 storeys - Maximum value 2.5 otherwise - Maximum value 1.5. No minimum. — Factor F 1.2

Record rationale for choice of Factor F:
Building is very regular. It is a light roof building though with redundancy of many concrete walls and steel frames

PAR

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

Longitudinal 1.20

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Table IEP-3 Initial Evaluation Procedure Step 3

Step 3 - Assessment of Performance Achievement Ratio (PAR)
(Refer Appendix B - Section B3.2)

b) Transverse Direction

potential CSWs	Effect on Structural Performance (Choose a value - Do not interpolate)			Factors
3.1 Plan Irregularity				
Effect on Structural Performance	☐ Severe	☐ Significant	◉ Insignificant	Factor A 1.0
Comment				
3.2 Vertical Irregularity				
Effect on Structural Performance	☐ Severe	☐ Significant	◉ Insignificant	Factor B 1.0
Comment				
3.3 Short Columns				
Effect on Structural Performance	☐ Severe	☐ Significant	◉ Insignificant	Factor C 1.0
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, or consequences are considered to be minimal)

a) Factor D1: - Pounding Effect

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

Factor D1 For Transverse Direction: 1.0

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	☐ 1	☐ 1	◉ 1
Alignment of Floors not within 20% of Storey Height	☐ 0.4	☐ 0.7	☐ 0.8

Comment

b) Factor D2: - Height Difference Effect

Factor D2 For Transverse Direction: 1.0

Table for Selection of Factor D2	Severe	Significant	Insignificant
	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

Comment

Factor D 1.0

3.5 Site Characteristics - *Stability, landslide threat, liquefaction etc as it affects the structural performance from a life-safety perspective*

Effect on Structural Performance	☐ Severe	☐ Significant	◉ Insignificant	Factor E 1.0
Comment				

3.6 Other Factors - *for allowance of all other relevant characterstics of the building*

For ≤ 3 storeys - Maximum value 2.5
otherwise - Maximum value 1.5.
No minimum.

Factor F 1.20

Record rationale for choice of Factor F:
Building is very regular. It is a light roof building though with redundancy of many concrete walls and steel frames

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

PAR
Transverse 1.20

WARNING!! *This initial evaluation has been carried out solely as an initial seismic assessment of the building following the procedure set out in the New Zealand Society for Earthquake Engineering document "Assessment and Improvement of the Structural Performance of Buildings in Earthquakes, June 2006". This spreadsheet must be read in conjunction with the limitations set out in the accompanying report, and should not be relied on by any party for any other purpose. Detailed inspections and engineering calculations, or engineering judgements based on them, have not been undertaken, and these may lead to a different result or seismic grade.*

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Initial Evaluation Procedure (IEP) Assessment

Page 6

Street Number & Name:	27 Shands Road	Job No.:	170015A
AKA:	1977 Original Construction Upgraded 04 2004	By:	MJK
Name of building:	Unit 27-33	Date:	22/02/2017
City:	Hornby, Christchurch 8042	Revision No.:	A

Table IEP-4 Initial Evaluation Procedure Steps 4, 5, 6 and 7

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

		Longitudinal	Transverse
4.1	Assessed Baseline *%NBS* $(\%NBS)_b$ (from Table IEP - 1)	64%	64%
4.2	Performance Achievement Ratio (PAR) (from Table IEP - 2)	1.20	1.20
4.3	PAR x Baseline $(\%NBS)_b$	75%	75%
4.4	Percentage New Building Standard *(%NBS)* (Use lower of two values from Step 4.3)		75%

Step 5 - Potentially Earthquake Prone? (Mark as appropriate) *%NBS* ≤ 34 NO

Step 6 - Potentially Earthquake Risk? (Mark as appropriate) *%NBS* < 67 NO

Step 7 - Provisional Grading for Seismic Risk based on IEP

Seismic Grade B

Additional Comments (items of note affecting IEP score)

Relationship between Grade and *%NBS*:

Grade:	A+	A	B	C	D	E
%NBS:	> 100	100 to 80	79 to 67	66 to 34	33 to 20	< 20

WARNING!! *This initial evaluation has been carried out solely as an initial seismic assessment of the building following the procedure set out in the New Zealand Society for Earthquake Engineering document "Assessment and Improvement of the Structural Performance of Buildings in Earthquakes, June 2006". This spreadsheet must be read in conjunction with the limitations set out in the accompanying report, and should not be relied on by any party for any other purpose. Detailed inspections and engineering calculations, or engineering judgements based on them, have not been undertaken, and these may lead to a different result or seismic grade.*

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Initial Evaluation Procedure (IEP) Assessment Page 7

Street Number & Name:	27 Shands Road	Job No.:	170015A
AKA:	1977 Original Construction Upgraded 04 2004	By:	MJK
Name of building:	Unit 27-33	Date:	22/02/2017
City:	Hornby, Christchurch 8042	Revision No.:	A

Table IEP-5 Initial Evaluation Procedure Step 8

Step 8 - Identification of potential Severe Critical Structural Weaknesses that could result in significant risk to a significant number of occupants

8.1	Number of storeys above ground level	1
8.2	Presence of heavy concrete floors and/or concrete roof? (Y/N)	N

Occupancy not considered to be significant - no further consideration required

Risk not considered to be significant - no further consideration required

IEP Assessment Confirmed by Signature

Michael King Name

1022085 CPEng. No

WARNING!! *This initial evaluation has been carried out solely as an initial seismic assessment of the building following the procedure set out in the New Zealand Society for Earthquake Engineering document "Assessment and Improvement of the Structural Performance of Buildings in Earthquakes, June 2006". This spreadsheet must be read in conjunction with the limitations set out in the accompanying report, and should not be relied on by any party for any other purpose. Detailed inspections and engineering calculations, or engineering judgements based on them, have not been undertaken, and these may lead to a different result or seismic grade.*

APPENDIX B2: IEP FORM – 2006 ADDITION CONSTRUCTION BUILDING 1 - UNITS 21-25

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Initial Evaluation Procedure (IEP) Assessment **Page 1**

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Street Number & Name:	27 Shands Road	Job No.:	170015A
AKA:	2006 Addition Construction	By:	MJK
Name of building:	Units 21-25	Date:	22/02/2017
City:	Hornby, Christchurch 8042	Revision No.:	A

Table IEP-1 Initial Evaluation Procedure Step 1

Step 1 - General Information

1.1 Photos (attach sufficient to describe building)





NOTE: THERE ARE MORE PHOTOS ON PAGE 1a ATTACHED

1.2 Sketches (plans etc, show items of interest)

(Refer to main report)

NOTE: THERE ARE MORE SKETCHES ON PAGE 1a ATTACHED

1.3 List relevant features (Note: only 10 lines of text will print in this box. If further text required use Page 1a)

(Refer to main report)

1.4 Note information sources Tick as appropriate

Visual Inspection of Exterior	☑	Specifications	☐
Visual Inspection of Interior	☑	Geotechnical Reports	☐
Drawings (note type)	☑	Other (list)	☐

Original construction drawings with structural information from Alan Reay 7/1995

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Initial Evaluation Procedure (IEP) Assessment

Page 2

Street Number & Name:	27 Shands Road	Job No.:	170015A
AKA:	2006 Addition Construction	By:	MJK
Name of building:	Units 21-25	Date:	22/02/2017
City:	Hornby, Christchurch 8042	Revision No.:	A

Table IEP-2 Initial Evaluation Procedure Step 2

Step 2 - Determination of *(%NBS)*$_b$

(Baseline *(%NBS)* for particular building - refer Section B5)

2.1 Determine nominal *(%NBS)* = *(%NBS)*$_{nom}$

	Longitudinal	Transverse
a) Building Strengthening Data		
Tick if building is known to have been strengthened in this direction	☐	☐
If strengthened, enter percentage of code the building has been strengthened to	N/A	N/A
b) Year of Design/Strengthening, Building Type and Seismic Zone		
Pre 1935	○	○
1935-1965	○	○
1965-1976	○	○
1976-1984	○	○
1984-1992	○	○
1992-2004	○	○
2004-2011	◉	◉
Post Aug 2011	○	○
Building Type:		
Seismic Zone:		
c) Soil Type		
From NZS1170.5:2004, Cl 3.1.3 :	D Soft Soil	D Soft Soil
From NZS4203:1992, Cl 4.6.2.2 : (for 1992 to 2004 and only if known)	Flexible	Flexible
d) Estimate Period, *T*		
Comment:		
h_n =	4	4 m
A_c =	1.00	1.00 m^2
Moment Resisting Concrete Frames: $T = \max(0.09h_n^{0.75}, 0.4)$	○	○
Moment Resisting Steel Frames: $T = \max(0.14h_n^{0.75}, 0.4)$	○	○
Eccentrically Braced Steel Frames: $T = \max(0.08h_n^{0.75}, 0.4)$	○	○
All Other Frame Structures: $T = \max(0.06h_n^{0.75}, 0.4)$	○	○
Concrete Shear Walls $T = \max(0.09h_n^{0.75}/A_c^{0.5}, 0.4)$	◉	◉
Masonry Shear Walls: $T \leq 0.4$sec	○	○
User Defined (input Period):	○	○
Where h_n = height in metres from the base of the structure to the uppermost seismic weight or mass.	T: 0.40	0.40
e) Factor A: Strengthening factor determined using result from (a) above (set to 1.0 if not strengthened)	**Factor A:** 1.00	1.00
f) Factor B: Determined from NZSEE Guidelines Figure 3A.1 using results (a) to (e) above	**Factor B:** 1.00	1.00
g) Factor C: For reinforced concrete buildings designed between 1976-84 Factor C = 1.2, otherwise take as 1.0.	**Factor C:** 1.00	1.00
h) Factor D: For buildings designed prior to 1935 Factor D = 0.8 except for Wellington where Factor D may be taken as 1, otherwise take as 1.0.	**Factor D:** 1.00	1.00
***(%NBS)*$_{nom}$ = AxBxCxD**	***(%NBS)*$_{nom}$** 100%	100%

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Initial Evaluation Procedure (IEP) Assessment — Page 3

Street Number & Name:	27 Shands Road	Job No.:	170015A
AKA:	2006 Addition Construction	By:	MJK
Name of building:	Units 21-25	Date:	22/02/2017
City:	Hornby, Christchurch 8042	Revision No.:	A

Table IEP-2 Initial Evaluation Procedure Step 2 continued

2.2 Near Fault Scaling Factor, Factor E
If $T \leq 1.5$sec, Factor E = 1

		Longitudinal	Transverse
a) Near Fault Factor, *N(T,D)* (from NZS1170.5:2004, Cl 3.1.6)	N(T,D):	1	1
b) Factor E = 1/N(T,D)	Factor E:	1.00	1.00

2.3 Hazard Scaling Factor, Factor F
a) Hazard Factor, *Z*, for site
Location: Christchurch — Refer right for user-defined locations

Z =	0.3	(from NZS1170.5:2004, Table 3.3)
Z_{1992} =	0.8	(NZS4203:1992 Zone Factor from accompanying Figure 3.5(b))
Z_{2004} =	0.22	(from NZS1170.5:2004, Table 3.3)

b) Factor F

		Longitudinal	Transverse
For pre 1992 = 1/Z	Factor F:	0.73	0.73
For 1992-2011 = Z_{1992}/Z			
For post 2011 = Z_{2004}/Z			

2.4 Return Period Scaling Factor, Factor G

		Longitudinal	Transverse
a) Design Importance Level, I (Set to 1 if not known. For buildings designed prior to 1965 and known to be designed as a public building set to 1.25. For buildings designed 1965-1976 and known to be designed as a public building set to 1.33 for Zone A or 1.2 for Zone B. For 1976-1984 set I value.)	I =	1	1
b) Design Risk Factor, R_o (set to 1.0 if other than 1976-2004, or not known)	R_o =	1	1
c) Return Period Factor, R (from NZS1170.0:2004 Building Importance Level) — Choose Importance Level	R =	1.0	1.0
d) Factor G = IR_o/R	Factor G:	1.00	1.00

Choose Importance Level: Longitudinal ○1 ◉2 ○3 ○4; Transverse ○1 ◉2 ○3 ○4

2.5 Ductility Scaling Factor, Factor H
a) Available Displacement Ductility Within Existing Structure
Comment:

		Longitudinal	Transverse
	μ =	1.25	1.25

b) Factor H

		k_u Longitudinal	k_u Transverse
For pre 1976 (maximum of 2)	=	1.14	1.14
For 1976 onwards	=	1	1
	Factor H:	1.00	1.00

(where k_μ is NZS1170.5:2004 Inelastic Spectrum Scaling Factor, from accompanying Table 3.3)

2.6 Structural Performance Scaling Factor, Factor I
a) Structural Performance Factor, S_p (from accompanying Figure 3.4)
Tick if light timber-framed construction in this direction

		Longitudinal	Transverse
	S_p =	0.93	0.93
b) Structural Performance Scaling Factor = $1/S_p$	Factor I:	1.00	1.00

Note Factor B values for 1992 to 2004 have been multiplied by 0.67 to account for Sp in this period

	Longitudinal	Transverse
2.7 Baseline *%NBS* for Building, $(\%NBS)_b$ (equals $(\%NBS)_{nom}$ x E x F x G x H x I)	73%	73%

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Initial Evaluation Procedure (IEP) Assessment — Page 4

Street Number & Name:	27 Shands Road	Job No.:	170015A
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Name of building:	Units 21-25	Date:	22/02/2017
City:	Hornby, Christchurch 8042	Revision No.:	A

Table IEP-3 Initial Evaluation Procedure Step 3

Step 3 - Assessment of Performance Achievement Ratio (PAR)
(Refer Appendix B - Section B3.2)

a) Longitudinal Direction

potential CSWs	Effect on Structural Performance (Choose a value - Do not interpolate)			Factors
3.1 Plan Irregularity				
Effect on Structural Performance	○ *Severe*	○ *Significant*	◉ *Insignificant*	**Factor A** 1.0
Comment				
3.2 Vertical Irregularity				
Effect on Structural Performance	○ *Severe*	○ *Significant*	◉ *Insignificant*	**Factor B** 1.0
Comment				
3.3 Short Columns				
Effect on Structural Performance	○ *Severe*	○ *Significant*	◉ *Insignificant*	**Factor C** 1.0
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, or consequences are considered to be minimal)

a) Factor D1: - Pounding Effect

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

Factor D1 For Longitudinal Direction: 1.0

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	○ 1	○ 1	◉ 1
Alignment of Floors not within 20% of Storey Height	○ 0.4	○ 0.7	○ 0.8

Comment

b) Factor D2: - Height Difference Effect

Factor D2 For Longitudinal Direction: 1.0

Table for Selection of Factor D2	Severe	Significant	Insignificant
	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

Comment

Factor D 1.0

3.5 Site Characteristics - *Stability, landslide threat, liquefaction etc as it affects the structural performance from a life-safety perspective*

Effect on Structural Performance	○ *Severe*	○ *Significant*	◉ *Insignificant*	**Factor E** 1.0
Comment				

3.6 Other Factors - *for allowance of all other relevant characterstics of the building*
Record rationale for choice of Factor F:
Building is very regular. It is a light roof building though with redundancy of many concrete walls and portal frames

For ≤ 3 storeys - Maximum value 2.5
otherwise - Maximum value 1.5.
No minimum.

Factor F 1.0

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

	PAR
Longitudinal	**1.00**

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Initial Evaluation Procedure (IEP) Assessment — Page 5

Street Number & Name:	27 Shands Road	Job No.:	170015A
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Name of building:	Units 21-25	Date:	22/02/2017
City:	Hornby, Christchurch 8042	Revision No.:	A

Table IEP-3 Initial Evaluation Procedure Step 3

Step 3 - Assessment of Performance Achievement Ratio (PAR)
(Refer Appendix B - Section B3.2)

b) Transverse Direction

potential CSWs	Effect on Structural Performance (Choose a value - Do not interpolate)			Factors
3.1 Plan Irregularity				
Effect on Structural Performance	○ Severe	○ Significant	◉ Insignificant	Factor A 1.0
Comment				
3.2 Vertical Irregularity				
Effect on Structural Performance	○ Severe	○ Significant	◉ Insignificant	Factor B 1.0
Comment				
3.3 Short Columns				
Effect on Structural Performance	○ Severe	○ Significant	◉ Insignificant	Factor C 1.0
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, or consequences are considered to be minimal)

a) Factor D1: - Pounding Effect

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

Factor D1 For Transverse Direction: 1.0

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	○ 1	○ 1	◉ 1
Alignment of Floors not within 20% of Storey Height	○ 0.4	○ 0.7	○ 0.8

Comment

b) Factor D2: - Height Difference Effect

Factor D2 For Transverse Direction: 1.0

Table for Selection of Factor D2	Severe	Significant	Insignificant
	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

Comment

Factor D 1.0

3.5 Site Characteristics - *Stability, landslide threat, liquefaction etc as it affects the structural performance from a life-safety perspective*

Effect on Structural Performance	○ Severe	○ Significant	◉ Insignificant	Factor E 1.0
Comment				

3.6 Other Factors - *for allowance of all other relevant characterstics of the building*

For ≤ 3 storeys - Maximum value 2.5
otherwise - Maximum value 1.5.
No minimum.

Factor F 1.00

Record rationale for choice of Factor F:
Building is very regular. It is a light roof building though with redundancy of many concrete walls and steel portal frames

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

PAR
Transverse 1.00

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Initial Evaluation Procedure (IEP) Assessment **Page 6**

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Table IEP-4 Initial Evaluation Procedure Steps 4, 5, 6 and 7

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

		Longitudinal	Transverse
4.1	**Assessed Baseline *%NBS* $(\%NBS)_b$** (from Table IEP - 1)	73%	73%
4.2	**Performance Achievement Ratio (PAR)** (from Table IEP - 2)	1.00	1.00
4.3	**PAR x Baseline $(\%NBS)_b$**	75%	75%
4.4	**Percentage New Building Standard *(%NBS)*** (Use lower of two values from Step 4.3)		75%

Step 5 - Potentially Earthquake Prone? (Mark as appropriate) ***%NBS* ≤ 34** NO

Step 6 - Potentially Earthquake Risk? (Mark as appropriate) ***%NBS* < 67** NO

Step 7 - Provisional Grading for Seismic Risk based on IEP

Seismic Grade B

Additional Comments (items of note affecting IEP score)

Relationship between Grade and *%NBS*:

Grade:	A+	A	B	C	D	E
%NBS:	> 100	100 to 80	79 to 67	66 to 34	33 to 20	< 20

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Initial Evaluation Procedure (IEP) Assessment **Page 7**

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Table IEP-5 Initial Evaluation Procedure Step 8

Step 8 - Identification of potential Severe Critical Structural Weaknesses that could result in significant risk to a significant number of occupants

8.1	Number of storeys above ground level	1
8.2	Presence of heavy concrete floors and/or concrete roof? (Y/N)	N

Occupancy not considered to be significant - no further consideration required

Risk not considered to be significant - no further consideration required

IEP Assessment Confirmed by _____ **Signature**

Michael King **Name**

1022085 **CPEng. No**

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