Christchurch City Council

Old Akaroa Plunket Room (Café Truby's) PRK 3643 BLDG 001

Detailed Engineering Evaluation

Quantitative Assessment Report

Christchurch City Council

Old Akaroa Plunket Room (Café Truby's)

Quantitative Assessment Report

Prepared By	Soon Ong Structural Engineer	Opus International Consultants Ltd Christchurch Office 20 Moorhouse Avenue PO Box 1482, Christchurch Mail Centre, Christchurch 8140 New Zealand	
Reviewed By	Bob Stimson Senior Structural Engineer SE 2888 (California)	Telephone: Facsimile:	+64 3 363 5400 +64 3 365 7858
		Date: Reference: Status:	September 2013 6-QUCCC.32 Final
Approved By	Will Parker Principal Structural Engineer		

Summary

Old Akaroa Plunket Room (Café Truby's)
PRK 3643 BLDG 001

Detailed Engineering Evaluation
Quantitative Report - Summary
Final

This is a summary of the quantitative report for the building structure, and is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011. The Old Akaroa Plunket Room is located at 83 Rue Jolie, Akaroa and is currently operated as Café Truby's.

Structural drawings were unavailable, so a Profoscope rebar detector was used to measure the reinforcement within the structural concrete members. The updated seismic capacity of the building is based on the results obtained from this investigation. Based on calculations performed during this Quantitative Assessment, the seismic capacity of the building is as follows:

- North - South direction: 50% NBS
- East - West direction: 75% NBS

The building is estimated to have a seismic capacity of 50% NBS and is therefore not classified as an earthquake prone building.

Contents

1 Background

Opus International Consultants Limited has been engaged by Christchurch City Council (CCC) to undertake a detailed engineering evaluation of the Old Akaroa Plunket Room, located at 83 Rue Jolie, Akaroa. The building is currently operated as Café Truby's. Our services have been performed in conjunction with City Care and Joseph & Associates.

The scope of the quantitative assessment is as follows:

1. An analysis of the lateral load resisting systems for seismic loads in the N-S and E-W directions to determine the %NBS.

2. Provide recommendations for the building if the %NBS is found to be less than 33% or 67%.

This report is a Stage Two quantitative assessment of the building structure, and is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Engineering Society (SESOC) on 19 July 2011[4].

2 Seismic Load Resisting System

A detailed description of the structure is provided in the qualitative report [1]. As there are no structural or architectural drawings provided, the loading estimates and existing structural layout have been assessed based on site inspections during the Stage 1 report and a follow-up site investigation by Soon Ong and Wayne Parsons of Opus International Consultants on 14 Feb 2012. In the latter inspection, a Profoscope rebar detector and covermeter was used to provide the closest approximation of the reinforcement within the reinforced concrete structural members, without the need for physical invasive investigation.

Seismic force in both the N-S and E-W directions is generated by the response of the roof mass and the perimeter reinforced concrete ring beam. The lateral load is transferred to the foundation via the moment resisting reinforced concrete frame around the perimeter of the building.

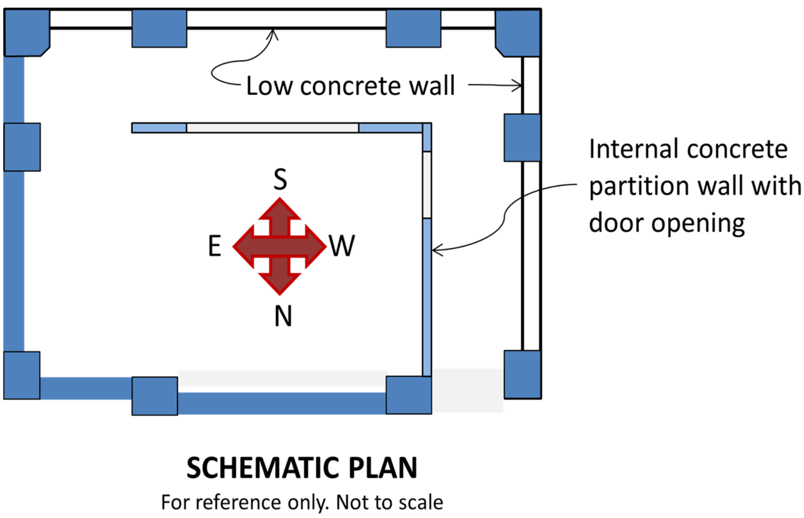

Figure 1 - Schematic Plan

The wall infill along the north and east elevation appears to be constructed of lightly reinforced concrete. Similarly the internal wall partitions are also constructed of lightly reinforced concrete with door openings. These internal walls are not considered to be part of the lateral load resisting system because the capacity of the fixings, if any, to the roof structure is not likely to be sufficient to transfer the required forces parallel to the wall.

3 Seismic Loading – Equivalent Static Method of Analysis

3.1 Seismic coefficient parameters

The seismic design parameters based on current design requirements from NZS1170:2002 [5] and the NZBC clause B1 for this building are:

- Site soil class C, clause 3.1.3 NZS 1170:2002
- Site hazard factor, Z=0.3, B1/VM1 clause 2.2.14B
- Return period factor Ru = 1.0 from table 3.5, NZS 1170.5:2004 [2], for an Importance Level 2 structure with a 50 year design life.

3.2 Expected ductility factor

Based on our assessment of the building structural layout and using guidance from the concrete structures standard NZS3101:2006 [3], our estimates for the expected maximum structural ductility factors for the main seismic resisting systems are:

Table 1: Summary of Seismic Resisting Systems

Direction / Element		μ_{max}
N-S	Moment resisting reinforced concrete frame	1.25
E-W	Moment resisting reinforced concrete frame	1.25

The ductility for both directions is limited to 1.25 because the perimeter reinforced concrete columns are found to be lightly reinforced with no indication of any transverse reinforcements.

4 Analysis Methodology

The seismic force arising from the roof mass is predominantly distributed to the perimeter moment resisting frame by the timber roof framing that is supported directly on the perimeter ring beam. There is no evidence of any cross bracing within the roof framing, but there is a timber match lining ceiling. Because of this, and the small size of the building we assumed that the roof framing has sufficient rigidity to distribute seismic forces to the concrete frame.

The N-S (transverse) seismic force is distributed to the concrete frame along east and west elevations. Due to the presence of infill wall along the east elevation, the west elevation concrete frame is considered as the relatively weaker lateral load resisting system in the transverse direction.

Similarly, the east-west (longitudinal) seismic force is distributed to concrete frame along the north and south elevations. As there is also infill wall between the columns along the north elevation, the south elevation concrete frame is considered as the weaker frame in the longitudinal direction.

Key Components Analysis

Based on the observed structural weaknesses in the lateral load resisting systems, the quantitative analysis for the following key components was carried out:

North – South (transverse) direction

- Flexure capacity of the west elevation concrete frame

East – West (longitudinal) direction

- Flexure capacity of the south elevation concrete frame

5 Reinforcement Estimates and Material Properties

As no structural drawings are available, a Profoscope rebar detector was used to scan the existing reinforced concrete structural members. This provided an approximation of the steel reinforcement within the concrete. While the Profoscope was able to detect the existence of steel reinforcement and its cover within the perimeter columns, it was not able to determine the size of the reinforcing bar due to the irregularities of the pebbledash finishes.

However, the measurement of bar size could be taken for those foundation columns within the sub-structure that are without the pebbledash finishes. These foundation columns are directly below the perimeter columns above. For the purposes of our analysis, we assumed that both these columns would contain the same reinforcement. The bar size detected is 6 mm which is equivalent to ¼ inch diameter bar during that period of construction. No transverse reinforcement was detected.

The following material properties were used in the analysis:

Table 2: Summary of Material Properties

Material	Nominal Strength
Reinforcing steel, f_y	300[1] Mpa
Concrete	30[2] Mpa

[1] Clause 7.1.1 (e) NZSEE (June 2006) [4]
[2] Clause 7.1.1 (f) NZSEE (June 2006) [4]

6 Analysis of Results

The equivalent static method was used to analyse the forces in the components of the lateral resisting system. The results of the analysis are reported in the following table as %NBS, where for the component:

Table 3: Summary of Seismic Performance

$$\% \, NBS = \frac{\text{Reliable Strength}}{\text{New Building Standard force}}$$

Component	Seismic Rating %NBS
North – South direction • Flexure capacity of the west elevation concrete frame	50% NBS
East – West direction • Flexure capacity of the south elevation concrete frame	75% NBS
Overall Building	**50% NBS**

In determining the reliable strength of the west elevation frame, we assumed that only two out of the three columns are effective in providing lateral resistance. This is primarily due to the presence of a low infill wall between the columns. The low wall provides restraint to the column base and hence reduces the effective clear height, which in turn increases the column stiffness and attracts greater lateral load. The lateral resistance from the far end column is ignored because there is no evidence of reinforcement tying the column into the infill wall to provide an active restraint.

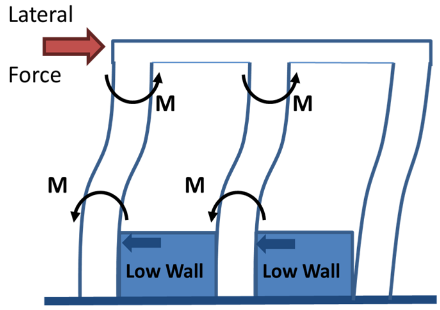

Figure 2 - Lateral Restraint Diagram

Similarly for the E-W direction, we assumed only three out of the four columns of the north elevation frame are effective in providing lateral restraint.

7 Evaluation of Results

The overall result is generally consistent with the minimal damage sustained by the building. The detailed assessment has also essentially confirmed that the weakest component of the lateral load resisting system is the flexure capacity of the frame along the west elevation.

The building is estimated to have 50% NBS and is therefore not classed as an earthquake prone building as it has a seismic capacity of greater than 33% NBS.

8 Conclusions

(a) The seismic rating of the building is approximately 50% of the current building code new building standard, and is therefore not classed as an earthquake prone building.

(b) If it is required to improve the rating to more than 67% NBS, the west elevation concrete frame will need to be strengthened.

(c) Further feasibility studies to be undertaken to determine the most cost effective strengthening option in order to increase the rating to 100%.

9 Limitations

(a) This report is based on an inspection of the structure of the building with a focus on the damage sustained from the 22 February Canterbury Earthquake and aftershocks only. Some non-structure damage is mentioned but is not intended to be a comprehensive list to non-structural items.

(b) Apart from the invasive investigation on 18 November 2011, our inspections have been visual and non-intrusive, no linings or finishes were removed to expose structural elements. Our professional services are performed using a degree of care and skill normally exercised, under similar circumstances, by reputable consultants practicing in this field at the time.

(c) The report is prepared for the CCC to assist with assessing remedial works required for council buildings and facilities. It is not intended for any other party or purpose.

10 References

[1] Old Akaroa Plunket Room (Café Truby's), Detailed Engineering Evaluation, Stage One Qualitative Report, prepared by Opus International Consultants for Christchurch City Council, 31 January 2012

[2] AS/NZS 1170.5: 2004, Structural design actions, Part 5: Earthquake actions - New Zealand.

[3] NZS 3101:2006, Concrete Structures Standard, Standards New Zealand

[4] NZSEE: 2006, Assessment and improvement of the structural performance of buildings in earthquakes, New Zealand Society for Earthquake Engineering.

[5] NZS1170:2002, Structural Design Actions, Part 0: General Principals.

Appendix 1 – CERA DEE Spreadsheet

Detailed Engineering Evaluation Summary Data V1.14

Location

Building Name:	Old Akaroa Plunket Room (Café Truby's)	Reviewer:	Will Parker
	Unit / No: / Street	CPEng No:	144116
Building Address:	83 Rue Lavaud, Akaroa	Company:	Opus International Consultants
Legal Description:		Company project number:	6-QUCCC.32
		Company phone number:	03-3635400
	Degrees / Min / Sec		
GPS south:	43 / 48 / 20.13	Date of submission:	Sep-13
GPS east:	172 / 57 / 57.93	Inspection Date:	6-Sep-11
		Revision:	Final
Building Unique Identifier (CCC):	PRK 3643 BLDG 001	Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	gravel	Soil Profile (if available):	
Site Class (to NZS1170.5):	C		
Proximity to waterway (m, if <100m):	0	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):	1.00
Ground floor split?	no		Ground floor elevation above ground (m):	0.00
Storeys below ground				
Foundation type:	other (describe)		if Foundation type is other, describe:	RC pillars on RC pad
Building height (m):	3.00		height from ground to level of uppermost seismic mass (for IEP only) (m):	3.5
Floor footprint area (approx):	50			
Age of Building (years):	78		Date of design:	Pre 1935
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	retail		Brief strengthening description:	
Use (upper floors):				
Use notes (if required):	café			
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	frame system		
Roof:	timber framed	rafter type, purlin type and cladding	clay tiles on timber frame
Floors:	concrete flat slab	slab thickness (mm)	approx 100
Beams:	cast-insitu concrete	overall depth x width (mm x mm)	200x300
Columns:	cast-insitu concrete	typical dimensions (mm x mm)	400x254
Walls:	non-load bearing	0	

Lateral load resisting structure

Lateral system along:	non-ductile concrete moment frame	**Note: Define along and across in detailed report!**	note typical bay length (m)	
Ductility assumed, μ:	1.25			
Period along:	0.23	0.23 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:	non-ductile concrete moment frame		note typical bay length (m)	
Ductility assumed, μ:	1.25			
Period across:	0.23	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:			none
Wall cladding:	plaster system	describe	pebbledash finish
Roof Cladding:	Heavy tiles	describe	
Glazing:	other (specify)		both timber & aluminium framing
Ceilings:			timber t&g
Services(list):			

Available documentation

Architectural	none	original designer name/date	
Structural	none	original designer name/date	
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	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:	Observation of minimal structural damage
	Describe (summary):	No structural damage observed		
Across	Damage ratio:	0%		
	Describe (summary):	No structural damage observed		
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 structural	Describe:	Column strengthening to above 67%NBS
	Building Consent required:	yes	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before e'quakes:	75%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology:
	Assessed %NBS after e'quakes:	75%		
Across	Assessed %NBS before e'quakes:	50%	##### %NBS from IEP below	
	Assessed %NBS after e'quakes:	50%		

Opus International Consultants Ltd
20 Moorhouse Avenue
PO Box 1482, Christchurch Mail Centre,
Christchurch 8140
New Zealand

t: +64 3 363 5400
f: +64 3 365 7858
w: www.opus.co.nz