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Dear Roger

Westpac Branch Detailed Seismic Assessment Report - 2 Cobham Court, Porirua

We have now completed the more detailed seismic assessment of the Westpac branch located at 2 Cobham Court, Porirua and have summarised our methodology and the results within this report.

1 Executive Summary

Our seismic assessment of the Westpac branch at Porirua has indicated an overall score of 70*%NBS,* limited by the first floor columns flexural capacity and strong room shear capacity. This corresponds to a Grade B Building according to the guidelines set out by NZSEE and indicates that the building may not be considered to be *'earthquake prone'* (less than 34*%NBS*) or a potential *'earthquake risk'* (less than 67*%NBS*). This score is based on the structural drawings of the 1979 and 1988 additions and an intrusive investigation of key elements in the building.

2 Background

The building at 2 Cobham Court, Porirua was originally constructed circa 1960. Three separate additions were carried out on the building; the first of unknown date and the remaining two circa 1979 and 1988. The extent of each of these additions is shown in Figure 1.

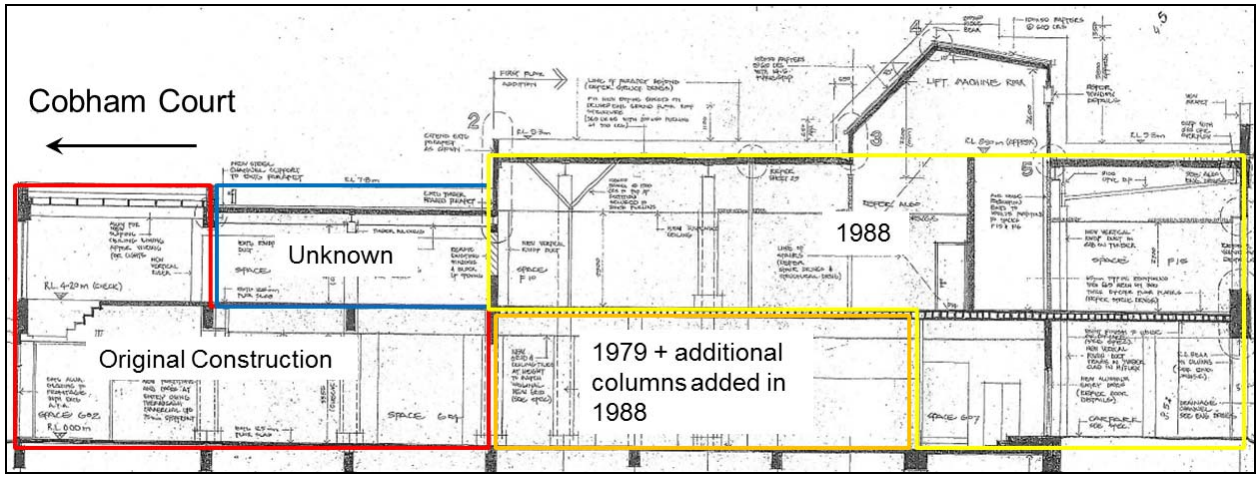


Figure 1 – Longitudinal section - dates of construction

The building is a two-storey reinforced concrete and reinforced concrete block building founded on strip and pad footings. The first floor consists of an insitu reinforced concrete slab in the front and precast hollow core units with a reinforced concrete topping at the back. The strong room has been confirmed as being connected to the diaphragm at first floor level. The roof is lightweight and consists of steel rafters and timber purlins and is not braced based on our visual inspection.

Lateral resistance to earthquake motion is resisted by a number of mechanisms throughout the structure. In the longitudinal direction, seismic shaking is resisted by the reinforced concrete block shear walls that run the length of the building on both sides. In the transverse direction, the original part of the structures resists lateral load via the strong room shear walls at ground floor level, and by cantilever action of the reinforced concrete columns at first floor level. The rear portion of the structure resists load in the transverse direction with the reinforced concrete frames added in 1988. The first floor diaphragm is assumed to distribute the load to the various ground floor force resisting mechanisms, and the steel rafters in the roof are required to act about their weak axis to distribute that load due to the lack of roof bracing.

Figure 2 – Porirua Branch, 2 Cobham Court

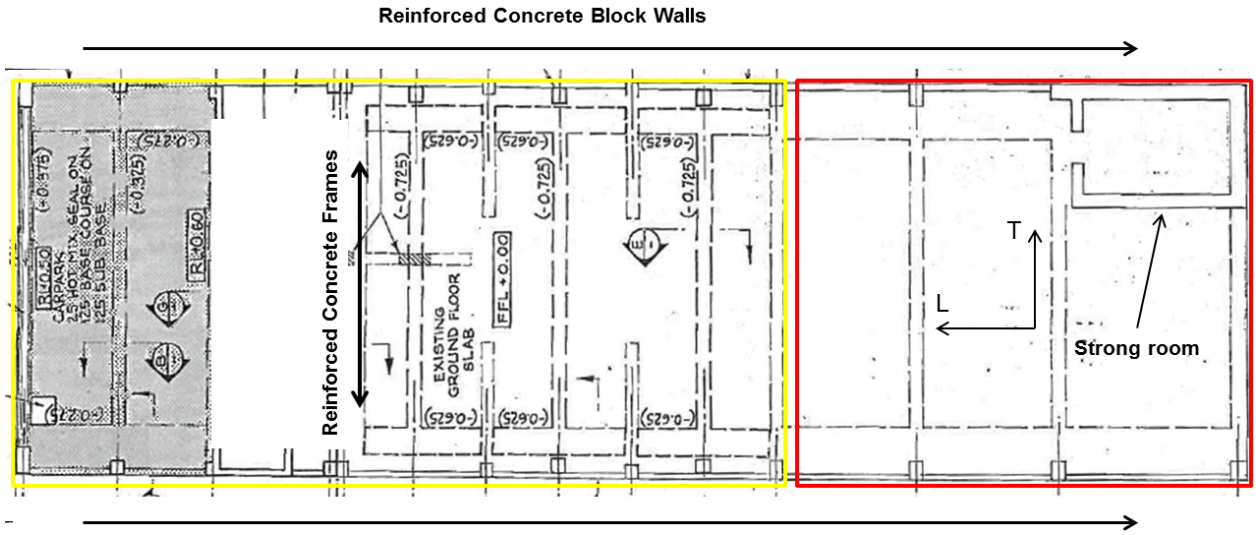


Figure 3 - Floor Plan

Overall the building appears to be in good condition with no signs of structural degradation. There are no signs of any structural modifications within the building since the 1988 addition; however, the building has undergone at least one re-fitout since. It is assumed no structural modifications were made during this time.

3 Preliminary IEP

Beca undertook an Initial Evaluation Procedure (IEP) seismic assessment of the building issued in February 2012. The building scored 35%*NBS* in the longitudinal direction and 35%*NBS* in the transverse direction. The IEP assessment of this building therefore indicated an overall score of 35%*NBS*, corresponding to a Grade C building as defined by the New Zealand Society for Earthquake Engineering (NZSEE) building grading scheme. The building was therefore not considered to be '*Earthquake Prone'*, but was considered a potential *'Earthquake Risk'.*

The building initially scored a low baseline *%NBS* due to its age of construction. At the time the IEP was carried out only structural information of the 1988 addition was available, and it could not be confirmed whether the original part of the building had been strengthened. This meant the baseline score could not be raised to account for the 1988 addition. The building was awarded a high "F factor" however, due to the presence of walls in the longitudinal direction and moment resisting frames in the transverse direction.

The IEP is however a very coarse qualitative assessment of a buildings structural integrity and capacity, when compared to the current building code requirements. A large emphasis when scoring the building is given to the date when the building was designed and constructed. The IEP assessment then makes assumptions based on this date and observations of any critical structural weaknesses present to determine the likely performance of the building when compared with a similar new building. Further quantitative assessment is necessary to give a more representative score for the building.

4 More Detailed Assessment

The further seismic assessment carried for this building out has consisted of an independent capacity check on the building, utilising the current load requirements of NZS 1170:5 for a “design level earthquake”. For normal use buildings (e.g. offices, apartments), the “design” earthquake load is set at the 1 in 500 year return period earthquake event. This event has a probability of occurrence of 10% over the 50 year life of the building**.**

4.1 Assessment Methodology

We adopted a stepped analysis approach in undertaking the seismic assessment in order to determine the seismic vulnerability of the building, starting with simpler analysis methods and adding incremental levels of sophistication of analysis and calculation where required.

Our methodology is briefly summarized below:

- Review of the structural drawings and any other relevant information available.
- A site visit to ensure the drawings accurately represent the building and investigate elements crucial to the structures performance that could not be determined from the drawings.
- Identification of the potential critical failure modes for the building and the corresponding critical elements which will govern these.
- Calculation of the seismic coefficients, expected gravity and seismic loads on the building following current New Zealand loading standards (*NZS1170*).
- Determine from hand analysis the expected forces on the structure for a design seismic event.
- Analysis of the critical structural elements using section analysis software and hand calculations to determine their capacities. Not all critical structural elements could be analysed due to the unavailability of drawings.
- Once identified, carry out intrusive investigation of the critical structural elements and determine their capacities.
- Determine the likely seismic performance of the building compared with an equivalent new building at the site based on our inspections, the structural weaknesses identified, our calculations, and our engineering judgment.

4.2 Information Provided

Beca obtained the following drawings from Porirua City Council:

- Structural and Architectural drawings of the 1979 addition
- Structural and Architectural drawings of the 1988 addition

This information was insufficient to complete a full review of the building so some intrusive investigation was carried out to determine the remaining critical information.

4.3 Building Investigation

4.3.1 Initial Building Investigation

The investigation determined the following information about the building:

- The available drawings appeared to be an accurate representation of the building.

This initial visit failed to highlight the detailing of a number of critical structural elements and as such, further intrusive inspections were required.

4.3.2 Intrusive building Investigation

In order to determine an accurate seismic rating for the building some critical structural elements needed to be investigated to determine their capacities. Preliminary calculations determined that the connection between the strong room and first floor diaphragm, the connection between the first floor columns and beams and the reinforcing detailing in the first floor columns were critical to this buildings performance.

- The strong room was confirmed to be connected to the first floor diaphragm (Figure 4).
- The connection between the first floor column and beam in the first addition was confirmed (Figure 5).
- The reinforcing detailing of the first floor column in the first addition was confirmed (Figure 6).

The above information was used during the assessment to conservatively calculate the capacity of the individual members.

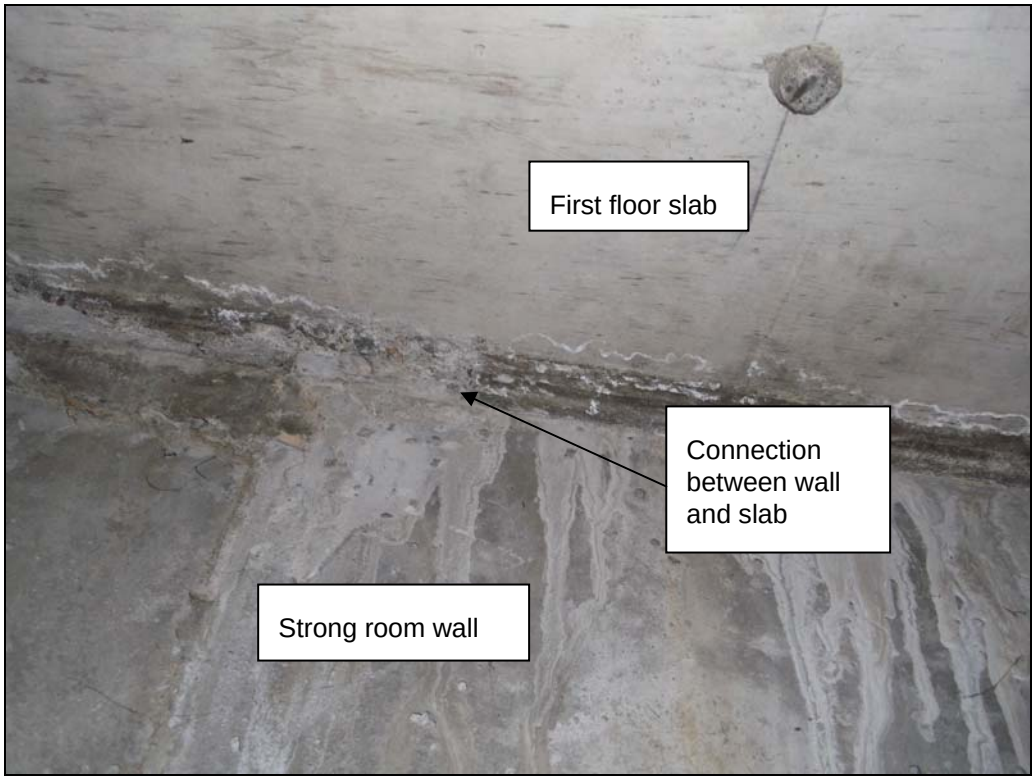


Figure 4 - Strong room to first floor slab connection

Figure 5 - Roof beam to first floor column connection

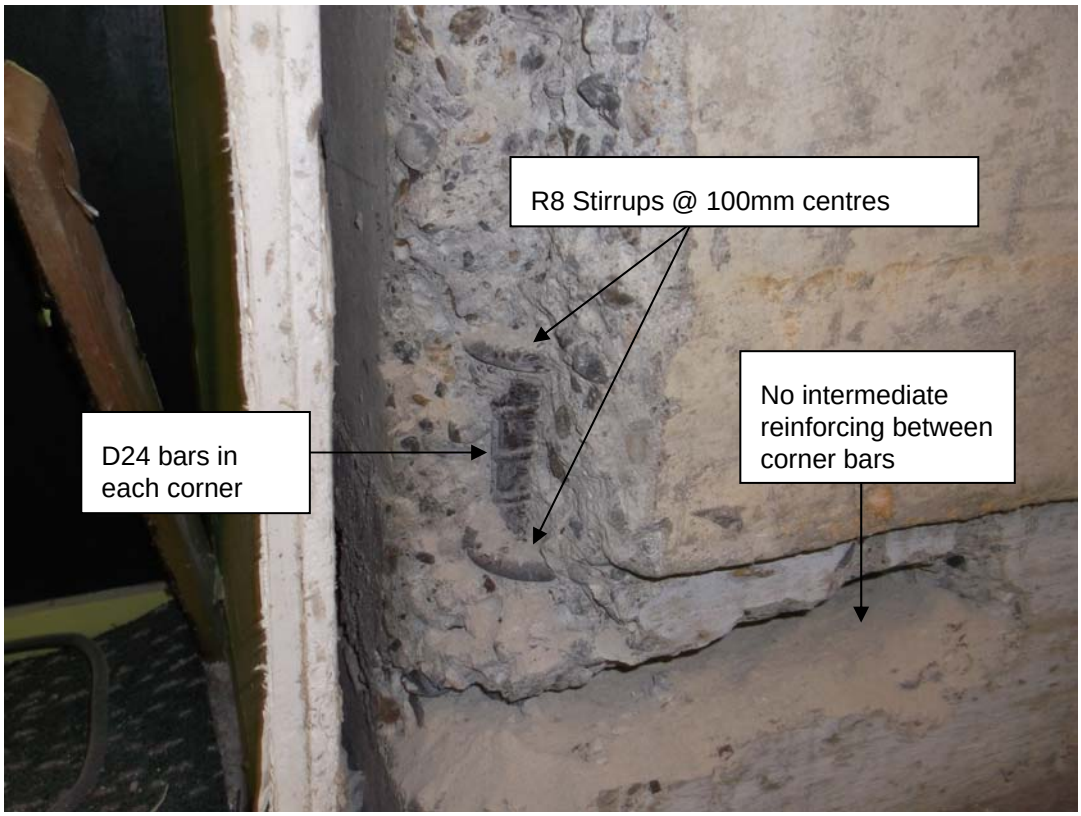


Figure 6 - Reinforcing in first floor column

4.4 Seismic Assessment Results

4.4.1 Critical Element Identification and Analysis

Calculations were carried out on various elements of the structure to determine which would be critical. The two critical elements were determined to be the capacity of the strong room walls and the first floor columns. Both of these are parts of the structure that drawings were unavailable for.

Strong Room:

Intrusive investigation confirmed that the strong room was connected to the first floor diaphragm and therefore able to transfer load as part of the structural system. When calculating the capacity of the strong room walls a conservative concrete strength was assumed and no reinforcing was accounted for. This achieved 70%*NBS* in the transverse direction. It was deemed inappropriate to investigate the wall further due to sensitive nature of the strong room and because the score achieved was above Westpac's minimum target building score of 67*%NBS*.

First Floor Columns:

Intrusive investigation confirmed the reinforcing details in the first floor columns of the first addition which enabled their capacity to be calculated. The capacity of the first floor reinforced concrete columns was determined to also achieve a score of 70*%NBS* in the transverse direction.

The capacity of the columns was calculated and a simple two-dimensional hand calculation was used to assess the seismic demand. The load corresponding to a 1 in 500 year seismic event was then applied to the system assuming a ductility of $\mu = 3$. A ductility of $\mu = 3$ is able to be used for the flexural failure of an element based on the NZSEE guidelines, and if this were not sufficient a higher ductility could be considered due to the known reinforcing. The availability of ductility means that the dissipation of earthquake energy due to the stretching and deformation of the reinforcing bars can be considered. According to the requirements of NZS1170:5, utilising this level of ductility can result in a load reduction factor of over 60%. This frame was assessed to be able to carry 70% of the load of a design level earthquake. In order to perform to this level the column may be significantly damaged following an earthquake, however its ability to carry vertical load is not expected to be undermined.

5 Assessment of Seismic Risk

5.1 Seismic Risk and Performance Levels

From our assessment, the Westpac Porirua Branch is likely to achieve more than 70*%NBS* in terms of expected seismic performance for life safety in a 1 in 500 year design level earthquake. Therefore, it is a Grade B building, following definition of the New Zealand Society for Earthquake Engineering (NZSEE) building grading scheme, which could be regarded as exposing the occupants to a low or medium seismic risk.

The New Building Standard requires a building to have a low probability of collapse in a 1 in 500-years "design level" earthquake (i.e. an earthquake with a probability of exceedance of approximately 10% in the assumed 50 year design life of a building).

Table 3 - Relative Earthquake Risk

Building Grade	Percentage of New Building Strength (*%NBS*)	Approx. Risk Relative to a New Building	Risk Description
A+	>100	<1	low risk
A	80 to 100	1 to 2 times	low risk
B	67 to 80	2 to 5 times	low or medium risk
C	33 to 67	5 to 10 times	medium risk
D	20 to 33	10 to 25 times	high risk
E	<20	more than 25 times	very high risk

Using the 2006 NZSEE Guidelines terminology, a building with less than 34*%NBS* is categorised as an Earthquake Prone Building (EPB) and a building with less than 67*%NBS* is categorised as an Earthquake Risk Building (ERB). The Porirua branch building is therefore not categorised as an Earthquake Prone Building under the 2006 NZSEE guidelines.

The capacity of the building is limited by:

- The shear capacity of the strong room.
- The flexural capacity of the first floor columns in the older (front) portion of the building.

5.2 Comparison of IEP and Detailed Assessment Findings

The IEP assessment penalised the building primarily due to its age. At the time of construction earthquake engineering was not as well understood as today and the design requirements were lower. The building was not penalised for any other specific issues, and the F factor was used to increase the score due to the more modern additions. It was unknown whether the existing structure was strengthened with any of the additions; therefore the IEP could not consider these to improve the score.

Our detailed assessment has shown that the newer additions to the building are likely to perform well in a moderate-large seismic event. It has also shown that the older portion of the building should perform better than the IEP assessment indicated. This is mainly due to the fact the strong room is connected to the first floor diaphragm and able to help the building resist seismic load. If this were not the case the building would have scored significantly less.

6 Recommendations

Beca understands it is Westpac's policy for their buildings to achieve greater >67*%NBS*, therefore Westpac may be satisfied that no further work be carried out on the Westpac Porirua Branch at this time.

7 Explanatory Notes

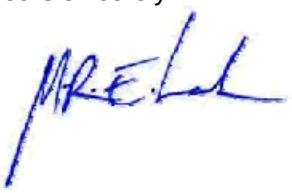
- This report has been prepared by Beca at the request of our Client and is exclusively for our Client's use for the purpose for which it is intended in accordance with the agreed scope of work. Beca accepts no responsibility or liability to any third party for any loss or damage whatsoever arising out of the use of or reliance on this report by that party or any party other than our Client.
- The inspections of the building discussed in this report have been undertaken to assist in the structural assessment of the building structure for seismic loads only. This assessment does not cover non-structural elements and the performance of partitions and ceilings has not been evaluated.
- This assessment does not include an assessment of the building condition or repairs that may be required.
- The building assessment is necessarily reliant on the accuracy, currency and completeness of the information provided to us, including the structural and architectural drawings, and we have not sought to independently verify all of the information provided.
- The basis of Beca's advice and our responsibility to our Client is set out above and in the terms of engagement with our Client.

8 Conclusions

In conclusion, the detailed assessment of the Westpac branch at 2 Cobham Court, Porirua has indicated an overall score of 70*%NBS.* The score is limited by the first floor columns flexural capacity and strong room shear capacity. This corresponds to a Grade B Building according to the guidelines set out by NZSEE and indicates that the building may not be considered to be 'earthquake prone' (less than 35%*NBS*), or a potential 'earthquake risk' (less than 67*%NBS*).

I trust that the above is clear, however if you have any queries or would like clarification of any aspect then please feel free to contact me.

Yours sincerely



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on behalf of

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