Bond Frew Ltd
CIVIL ENGINEERS

Unit 6/2 McMillan Street
PO Box 61, Darfield 7541
Phone: 03 318 8900
Fax: 03 318 8930
Email: bondfrew@xtra.co.nz

Detailed Engineering Evaluation

Sanderson China and Pottery
Storage Building
1471 State Highway 1
Waikuku

(Fromerly Donaghy's Industries Factory)

Prepared for
Mr Paul Sanderson

Prepared by
Bond Frew Ltd
Unit 6/2 McMillan Street
Darfield

12th August 2019

Ref: 3412 Preliminary

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1.0 Executive Summary

Bond Frew Ltd have been engaged by Mr Paul Sanderson to carry out a Detailed Engineering Evaluation of the Storage Building at Sanderson China and Pottery, to confirm (or otherwise) the structural suitability of the building and to be part of an application for bank finance to purchase the tavern and subsequent submission to the Waimakariri District Council.

The scope of services includes;

- An assessment of the damage to the building
- An assessment of the pre-earthquake capacity of the building
- A comparison with the New Building Standard (%NBS)
- A determination whether or not the building represents an earthquake risk
- To develop a seismic strengthening solution.
- And subsequently a Building Consent Application to the Waimakariri District Council
- Construction Monitoring of the strengthening solution. And submission to the Waimakariri District Council.

Our inspection revealed that the building was without significant distress and was in a sound condition, although not in original condition with the eastern end gable wall having been replaced with a timber framed wall in 1976 and a concrete frame has been installed into the western gable wall.

The building was constructed in about 1960 as part of Donaghys Fibre Factory.

The construction of the building is of unreinforced clay brick masonry on a concrete foundation.

The % NBS of the building is assessed at < 34%NBS due to the ineffective wall to truss connection.

With the completion of the Works identified, it is considered that the building will pose a low risk of injury, in the event of a significant seismic event, with a rating > 34%NBS

2.0 Scope of services

The following activities form part of the scope of services to complete this report:
- Review of the available architectural/structural drawings;
- Site visual inspection to investigate the building which include assessment of the damage to the structure and provide comments on the significance of the observed damage;
- Identify the structural system, probable structural system ductility, potential life safety hazards, and potential critical structural weaknesses that may affect the expected structural performance;
- Carry out a global seismic analysis to assess the demand under the design ground motion and perform checks of lateral load resisting elements to assess the seismic capacity of the critical structural components;
- Determine the effects governing the overall performance of the structure and the results in terms of percentage of new building standards (%NBS);
- Prepare a report summarising the findings and recommendations.

3.0 Sources of information

- No architectural and or structural drawings provided by the Waimakariri District Council.
- Observations from visual site inspections undertaken and photographic records thereof.
- Observations were made of the wall construction.
- Plans were supplies of a 1976 alteration to this building.

4.0 Building Code Requirements

4.1 New Buildings and Assessment of Existing Buildings

The Building Code specifies the current loading code NZS 1170:2002-Structural Design Actions as a means of compliance with the Building Act in terms of the structural strength required for new buildings. Accordingly, earthquake loading component of this loading code, NZS 1170.5:2004-Earthquake Actions has been used to define the New Building Standard (NBS) in this investigation.

The Assessment of this building has generally been undertaken in accordance with the MBIE published The seismic assessment of Existing Buildings C8 Unreinforced Masonry Buildings.

4.2 Increase of Christchurch Earthquake Standard

As a result of the recent earthquakes in Canterbury, the seismic hazard factor in the New Zealand earthquake loadings code NZS 1170.5 has been increased from 0.22g to 0.3g. This change effectively increased the design ultimate seismic loads applied to buildings by 36%. It means that a building designed to meet 100% of the NZS1170.5 before this change came in force, would now meet only around 73%NBS.

But as a result of this buildings location relative to the areas of higher seismicity, the seismic hazard factor has remained unchanged at 0.35.

4.3 Earthquake-Prone Building

The Building Act 2004 and associated regulations define any building which has a seismic capacity of less than or equal to one third of that required for a similar new building (i.e. <34%NBS) and would be likely to collapse causing injury or death to persons in the building or to persons on any other property or damage to any other property as an "Earthquake Prone" building.

4.4 Earthquake-Risk Building

The New Zealand Society for Earthquake Engineering considers that any building meeting a seismic capacity of at least two thirds of that required for a new building (i e > 67%NBS) has reached an adequate standard and does not need to be considered as an earthquake risk. Buildings with seismic capacity less than 67%NBS are deemed an "Earthquake Risk" building.

4.5 Limitations

- Our inspection was restricted to structural aspects only. Inspection of building services (e.g. electrical, sanitary fittings) and architectural elements was not a scope of this evaluation;
- The investigation comprised a visual inspection of structural elements that are visually accessible and can be safely access by our engineers;
- Carrying out works documented in this report does not preclude future damage to the building, internal fixtures and fittings in future earthquakes;

- The present study is focused on life safety, rather than damage control, in earthquake shaking. Therefore, the assessment we have carried out and the strengthening options provided are for ultimate limit state (ULS) only. We have not assessed the building for serviceability limit state conditions; and,
- Assessment of the residual service life of the building is not a scope of this evaluation.
- Our assessment was restricted to an assessment of the out building shown.

5.0 Building Description and Status

A site location plan is presented as Figure 1.

Figure 1: Site Map of 125 Bridge Street – Coalgate Tavern

5.1 Site Description

The building is situated at the intersection of Waikuku Beach Road and State Highway 1, 4km from Waikuku Beach.

5.2 General Building Description

The building was constructed in the 1960's which makes it relatively young for an unreinforced brick masonry building.

The building has an area of 372m² (12.2m x 30.5m), the footprint is rectangular in shape.

The building is currently used for storage of recycled materials.

The walls of the building are constructed of twin wythes of clay bricks and supported by 9 regularly spaced buttress along the longitudinal walls.

The walls are 230mm thick.

- **Gravity Load Resisting Systems**

The gravity load resisting system relies on timber trusses supporting a timber framed and sarked roof. The trusses are land on the masonry walls adjacent to each masonry buttress.

The exterior walls are supported on concrete foundations.

- **Lateral Load Resisting System**

The lateral load resisting system across the building relies on the capacity of the buttresses on each side of the building and the in-plane bracing of the end walls.

Along the building the lateral load resisting system relies on the in-plane capacity of the double brick walls

- **Damage Assessment**

The building was observed to be generally in a good structural condition. Minor seismic shaking damage was evident in the top course mortar joint and there was minor environmental deterioration specifically on the southern side.

In 1976 the eastern end was rebuilt, with the (assumed) brick construction replaced with timber framed construction. It is not known why this was done and no significant seismic or wind events were recorded at this time.

- **Structural Assessment**

The seismic assessment of this building was generally undertaken as prescribed in the guideline document Assessment and Improvement of Structural Performance of Buildings in Earthquakes prepared by NZ SEE Guidelines. Part C Unreinforced Masonry Building C8.

The assessment process is as outlined in C8 5.2.

The seismic demand was estimated using NZS 1170.5 2004, with specific reference to section 8 Requirements for Parts and Components Post Earthquake Seismic Capacity of Building.

The analysis of the frames as undertaken using a plane frame computer programme with the in-plane capacity of the masonry wall confirmed by conventional masonry design procedures.

The failure capacity of the buttress was evaluated from first principles with consideration given to the load required to topple a buttress.

The out-of-plane masonry wall capacity was also checked and was shown to be 75% of NBS with the walls tied with a Helifix system.

The attached details, when complete will ensure that the % NBS of the building will be greater than (30%).

5.2.5 Recommended Strengthening

Upgrade Truss to wall connection with a 300PFC along each wall

Upgrade out of plane capacity of walls with Heliflex Masonry wall ties

Upgrade connection of timber framed walls to masonry walls.

Ensure adequate connection of roof diaphragm to end walls.

This report is a preliminary assessment and will be required to be peer reviewed.

If you have any queries please contact the undersigned.

Your Faithfully

Peter Bond CPEng