

04/06/2011

Natural Log Homes
PO Box 25
GERALDINE
(via email)

Attention: Graeme Mould

Dear Graeme,

RE: 5 LAPWING LANE, MT PLEASANT, CHRISTCHURCH
NATURAL LOG HOME - PRELIMINARY STRUCTURAL ASSESSMENT

As requested we have inspected the above log home on 10 March 2011 and provide a preliminary report as follows.

General Description:

The house is a two storey natural log home with the upper floor created in the large attic space and is located on an elevated site approximately 110m above the Heathcote Valley. External walls are all of log work construction with a mix of timber framed and log walls to the internal walls on the ground floor. First floor walls are conventional timber framing and the roof is a light steel pressed tile system supported on timber framing. The house is supported on an on-grade concrete floor slab.

The site has expansive views across the valley toward Christchurch city in the North West and is approximately 3.7km due North from the epicenter of the 6.3 magnitude earthquake of 22 February 2011.

February 22 Earthquake:

As you will be aware the 22 February 2011 earthquake caused devastating damage across a large part of the Canterbury area with central and eastern parts of Christchurch city suffering severe damage. Almost all structures, residential and commercial, old and new, suffered damage ranging from minor cracking to complete collapse.

The reason this relatively small magnitude event caused such wide spread devastation relates to the close proximity of the epicenter at 5km depth and 10km from the city center. To put that in context – if 1000 kg of explosives was detonated 10km away it would make you sit up and take notice however it is unlikely to cause any damage to your property. By contrast – 1 kg of explosives detonated right under your house would cause significant damage.

Earthquake magnitude is effectively a measure of total energy released by the event, whereas ground acceleration is a more appropriate measure of the intensity of shaking experienced at the ground surface. Given the elevated nature of the site and the very close proximity to the earthquake epicenter the house at 5 Lapwing Lane was subjected to very large ground accelerations.

Typical seismic design for a house of this construction in this location would allow for forces generated from a ground acceleration of 0.3 to 0.4g. Based on data from the

Geonet website it is likely the site experienced peak ground accelerations of approximately 2g vertically, 1.0g horizontally. This means the house is likely to have experienced seismic loads of up to 2.5 times the design loads which is significantly well outside the design envelope.

Earthquake Damage:

Structures in the Heathcote, Mt Pleasant, Redcliffs area generally sustained severe damage. Viewed from the air the pattern of devastation is clearly evident with houses on elevated sites suffering some of the worst damage.

On approach to the site the extent of damage to houses includes complete loss of roof tiles and brick veneer cladding with major damage sustained to the supporting timber frame structure. Many houses in the area will likely be demolished and the remaining houses will require extensive repairs.

Damage to the log house was minor with little evidence of damage to the log elements. There has been minor lateral movement of some log walls (up to 20mm - this is especially evident in the internal log wall adjacent to the main lounge) otherwise the log walls appear to be in sound condition. Some extension of checks in logs was observed which is likely the release of internal tension. Refer to photos below.

Internal timber framed walls with Gib board linings to the ground floor toilet area have suffered some significant damage however these walls are internal partitions. The first floor timber framed walls all appear to be in sound condition with no evidence of cracking typically expected at the corners of window & door opening.

Fixings for the roof framing to the log walls at first floor level have separated slightly and there are minor indications of some log movement. Internal fixtures in the kitchen have moved slightly with the bench top separating from the log wall.

An item worthy of note is the loose hurricane rods in the log walls. All rods checked were loose and in most instances did not appear to have been tightened for a considerable time. The hurricane rods had not loosened as a result of the earthquake.

Recommended Repairs:

A detailed survey should be carried out to determine the extent of lateral movement, if any, of the log walls on the foundation slab. Log walls which have moved laterally should be jacked back into their correct location and re-fixed. This may also improve the separation of the kitchen joinery from the external log wall.

Following relocation of the log walls the hurricane rods should be correctly tightened. It is likely the loose rods enabled the log walls to move laterally and will also have contributed to the log movement evident in some areas.

Fixings for the roof framing to log walls at first floor level should be repaired. This will likely require removal of the roof cladding to provide access to the fixings and enable repair. Cracked and broken Gib board linings to the internal timber framed walls should be removed, the timber framing checked and the linings replaced.

Summary:

Overall the log home at 5 Lapwood Lane performed exceptionally well. The inherent ductile nature of the log structure absorbed large earthquake loads with comparative ease resulting in the home remaining fully functional even immediately after the

February 22nd event. This is despite the loose hurricane rods which if maintained correctly would have enhanced the buildings seismic performance.

Areas of significant damage predominantly related to the timber framed construction elements which were unable to accommodate the lateral movement associated with the ductile performance of the log walls.

It is clear that attention to detail, especially for critical elements such as hurricane rod installation and maintenance and fixings for other structural elements eg roof framing, is important for the dependable seismic performance of log structure buildings. Nonetheless, despite the loose hurricane rods the log walls performed exceptionally well and exceeded their design capacity by a considerable measure.

We trust the above preliminary report, albeit brief, meets your requirements. Please note that this report is based on a visual inspection only and no invasive or destructive examination has been carried out. Consequently there may be some hidden or latent defects present which have not been identified. The findings of this report may therefore be subject to revision pending further and more detailed investigation and/or deterioration of elements from subsequent after shocks or ground settlement.

Please do not hesitate to contact the undersigned if you have any questions or require any clarifications.

Yours faithfully,
BATCHELAR MCDUGALL CONSULTING LIMITED



Warren Batchelar
MIPENZ, MStructE



5 Lapwing Lane – General View 1



5 Lapwing Lane – General View 2



Internal Log Wall Lateral Movement - 1



Internal Log Wall Lateral Movement - 2



Internal Log Wall Lateral Movement - 3



Rafter to Log Wall Fixing Separation (note daylight between rafter & log)



Rafter Fixing Separation & Log Movement



Log Bearer Movement at Seating



Log Checking - Extension



Internal Gip Board Wall Damage