HARDING CONSULTING ENGINEERS LTD
CIVIL & STRUCTURAL ENGINEERS PROJECT MANAGERS

P.O. Box 24 119
Christchurch 8642
38 Berkshire Drive
Christchurch 8042
Telephone: (03) 358 5021
Fax: (03) 358 5023
Mobile Phone: 0274 320 303
Email: hce@xtra.co.nz

File 4335
21 June 2013

Mr J Gartly
Gillian Properties Ltd
P O Box 37 300
Halswell
Christchurch

Dear Sir,

Detailed Engineering Evaluation
33 Foremans Road, Islington

Further to your request, I enclose our Detailed Engineering Evaluation of the buildings at 33 Foremans Road, Christchurch, as follows.

1. Site Location

The site is in the north western area of Christchurch, in an industrial area adjacent to the Main South Road. As the area is zoned Industrial, it is not included in the Department of Building and Housing Residential Foundation Technical Categories. However it is adjacent to areas which are in Technical Category 1 (TC1). This is for areas in which future land damage from soil liquefaction is unlikely, and ground settlements are expected to be within normally accepted tolerances.

2. Geotechnical Report

At the time of building design, a Site Investigation Report on the property was prepared by Geotech Consulting Ltd. This report, Ref No 3007, dated 10 November 2005, is enclosed as **Appendix one**.

This report noted that the site is not regarded as being potentially liquefiable.
The report also identified that " the site is underlain with predominately gravely silt fill, silty gravel fill and sandy silt fill. It contains some brick, concrete and timber debris, as well as charcoal, demolition materials, metal, glass, wire, plastic and polystyrene...."
The test pits all terminated in natural gravels between 2.6 and 4.2 metres depth.
The report recommended using a piled foundation below walls and floor slabs.

3. Building Description

There are three buildings on site, which are subdivided into eight separate units.
All buildings are of similar construction, and were built at the same time.

They were Architecturally designed by Robin Vesty Architect, and structurally designed by Harding Consulting Engineers Ltd. The civil drawings, 3369/C1 and C2, and the structural drawings, 3369/S1 to S30 are enclosed as **Appendix two.**

These buildings were granted a building Consent, ref no 10061071 by the Christchurch City Council in early 2006. The buildings were constructed by CBD Construction Ltd, and structural observation was carried out by this office between April and December 2006. It is considered that the buildings have been constructed substantially in accordance with the design drawings.

Two of the buildings are approximately 40.16m long x 17.08m wide, and the other is 60.96m long x 16.04m wide. They are single storey precast concrete industrial buildings with steel roof framing and small concrete mezzanine floors for offices and services.
The building occupancy is assessed as importance level IL2.

4. Seismic Structural System

The building construction is summarised below

Roof	Zincalume steel cladding on DHS purlins and UB portal frames
Walls	120mm precast panels with bar reinforcement
Mezzanine Floor	75 insitu topping, prestressed concrete ribs, mesh reinforcing
Ground Floor	150mm slab, bar reinforcement on driven precast piles
Foundations	Reinforced concrete pads on driven precast concrete piles

Seismic loads across the buildings are resisted by steel Universal Beam portal frames, and by in plane shear on the precast concrete party walls between units. The portal frame columns on the boundary walls are concrete encased and are designed to cantilever to provide stability during a fire.

Seismic loads along the building are resisted partly by fire resistant concrete cantilever columns at the party walls, and partly by steel cross bracing between the portal frames.

Seismic loads on the concrete mezzanine floors are resisted by the reinforced concrete panels below and adjacent to the floors.

5. Foundation System

The building, including the ground floor slab, is supported by precast prestressed concrete piles, driven through the filling to the natural gravels below.

The ground floor slab is reinforced with draped steel bar reinforcement.
The wall panels and mezzanine floor columns are supported by reinforced concrete pile caps supported by the driven piles. There are no tie beams, but all pads are tied into the continuously reinforced ground floor slab.

6. Building Damage

A level two Structural Survey of the buildings was carried out by Fraser Thomas, Consulting Engineers in October 2011, at the request of MWH Mainzeal. This report considered the

buildings to be structurally sound, with some minor damage including minor cracking to the precast wall panels, cracking to the concrete floor, and elongation of the steel rod diagonal roof bracing. It is understood that this has now been repaired by epoxy grouting the panel cracks, sealing the floor cracks, and tightening or replacing roof bracing rods.
Some non structural damage to gib board linings has also been repaired.

No evidence of building settlement or soil liquefaction was noted.
A recent inspection of the building indicates that the building is still in good condition.

7. Building Capacity

The building was designed in 2005. At that time the Loadings Code, NZS1170.5, included a hazard factor of 0.22 for Christchurch. This factor has been raised since the recent Earthquakes to 0.30. Accordingly, it would be expected that the buildings would comply with 0.22/0.30 or 73% of the New Buildings Standard (73%NBS).
In order to check this, I have carried out structural calculations to check the main structural seismic resisting elements of the building. These calculations are enclosed as **Appendix three.**

For seismic loading **across** the buildings, the building capacity is limited by the lateral fly bracing to the portal frames, to **86%NBS**. This may be improved to 100% NBS by adding additional fly bracing at selected areas of the buildings. This has not been included in this report.

For seismic loadings **along** the building, the building capacity is limited by the capacity of the steel cross bracing in the roof plane, to **70%NBS.** This capacity may be improved to 100% by upgrading this roof bracing. This may be either by replacing some of the existing braces, or by including an additional bay of cross bracing within each building. Again, this is not the subject of this report.

Seismic loadings on the concrete mezzanine floors are resisted by the precast concrete walls, which are reinforced with bar reinforcement. These walls are typically massive, and symmetrically arranged such that the torsional loading on the mesh reinforced floor diaphragms are relatively low. Accordingly it is considered that the walls providing seismic restraint to the floors comply 100% NBS.

8. Critical Structural Weakness

A number of building elements have been assessed to determine whether they comprise a critical structural weakness to the building.

8.1 The reinforcement in the insitu topping to the mezzanine floors is of potentially non ductile steel mesh. However, as noted above, it is considered that the loads on the floor diaphragms are relatively small, and that the supporting walls are relatively symmetrically arranged. Accordingly, it is not considered that the mesh comprises a critical structural weakness.

8.2 The stairs providing access to the first floor have been designed as free standing structures provided by the structural steel contractor, R Auton Ltd, who was also the building developer. These stairs have their own steel columns, and their stability is not affected by the seismic deflections of the mezzanine floor. Accordingly, the stairs are not considered to be a critical structural weakness.

8.3 The precast concrete wall panels are relatively thin, and they are singly reinforced, with one layer of bar reinforcement in each direction. However this is a low rise building, and the loading on the panels is substantially that induced by their self weight. This is not a multi-storey building, the panels are well restrained by ductile fixings which remain in good condition, and the panels appear to have sustained very little damage. Accordingly, these are not considered to be a critical structural weakness.

9. Recommended Building Strengthening

As the building presently appears to comply with at least 70% of NBS, it is considered that building strengthening is not necessary.

However, as noted it is possible to upgrade the compliance of the building relatively simply, by providing additional steel fly bracing to laterally support the portal frames, and by upgrading the steel bracing in the roof plane of each building.

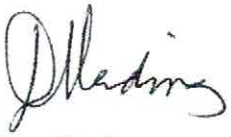
Details of this possible strengthening are not the subject of this report.

10. Summary

This is a relatively modern building which has suffered little damage in the recent earthquakes. The building complies with at least 70% of New Building Standard, and accordingly it is considered to be safe to occupy.
However it would be possible to upgrade the building to 100% NBS in future if required.

If you have any queries regarding this report, please contact Dave Harding at this office.

Yours faithfully



Dave Harding
Harding Consulting Engineers Ltd