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MEMORANDUM

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To: Ian Bisman

Company: Warren & Mahoney Ltd

From: John Hare

Project No: 100521 Date: 4 July 2007

Subject: PGC Building Review - Study Findings

Ian

I have now been through the conceptual study as discussed, and we have several conclusions and recommendations for you, as follows:

OPTION A – ADDING FLOORS

I have reviewed briefly the findings of our 1997 study when PGC purchased the building. At that stage we concluded that there were severe deficiencies with the exterior columns at the upper levels, but that the basic shear wall system was reasonably robust. Assuming the column failure were mitigated in all cases by placing secondary steel props behind them, the capacity of the building was judged at the time to be in excess of 2/3 of current seismic code loading at the time.

The loading code has subsequently been updated, and probably represents a 10% increase for this building, but this is not significant in the context of an existing building. It is certainly not considered earthquake prone, which is at a threshold level of 1/3 of current code loading.

The addition of extra floors would be considered a significant alteration. Generally the Building Act requires in the case of alterations that the building comply with the NZBC at least as much after the alterations as before, for structural matters.

In this case, I believe that a possible way forward would be to consider the addition to be a lightweight structure and take the approach that it does not add significant extra load to the building. On the basis of a quick analysis, the addition of a lightweight structure over the entire existing roof would add 3.2% to the overall base shear, and 5% to the overturning moments. I would consider this a negligible addition, although this would need to be negotiated with the CCC.

Alternatively, if additional levels were to be added, further strengthening would be required, as it would not be feasible to justify the added weight as an insignificant increase. Strengthening would need to take the form of either added strengthening to the existing concrete shear walls, either with carbon fibre jacketing, or concrete,

or could be achieved via an external bracing system as described in Option B below.

OPTION B – NEW ADJACENT STRUCTURE

In reviewing the proposed plans, I have considered two approaches. The first, to use the new building to add strength to the existing building. The second, to strengthen the existing building with an independent structure.

On reflection, I believe the latter approach offers several advantages, and the former is not practical. Using the new structure to strengthen the old is impractical because:

1. The stair/lift area is ideally positioned for the function of the building, but creates a sever necking point which would be too difficult to take loads through.

2. The distance from the new structure to the south edge of the existing is too far, resulting in sever torsional actions that would be hard to mitigate.

3. The difference in height it too great. This would result in significant seismic inertial forces being transmitted into the upper levels of the new structure.

Considering the buildings separately, we have the following conclusions:

Existing Structure

The existing building has an unusual structural form that may work to our benefit. The columns step across at the first floor to create the structural set-back that is a part of the existing architecture.

This is a severe weakness seismically as this discontinuity has the potential for severe failure. However, it allows easy access to install new foundations in the line of the existing perimeter, so that we can provide an external bracing system. This would allow the complete removal of the interior shear walls, which could be replaced by simple prop columns on the line of the existing floor support beams.

Using an external bracing system would necessitate the removal of the existing edge beam and columns, and replacement with a new steel frame structure. Although the removal of the columns has cost implications, the temporary propping is easily accomplished by propping down to the line of the ground floor inset columns, which can remain.

A possible advantage of removal of the exterior columns is that at the time of construction, concrete and concrete covers were not as well understood as they are currently. The existing columns are 250mm square, with 37mm of cover to the steel. Although we have not conducted any investigations, it is likely that the concrete may have deteriorated to the extent that these elements will require extensive repair in the short to medium term

Removal of the existing façade would also allow ready replacement with a new energy efficient façade system that could offer significant advantage in heating and light management.

The form of bracing that we would recommend is a buckling restrained brace frame (BRBF) that is in common use in Japan and the US. This system allows concentric bracing, which may be more aesthetically pleasing, and reduces foundation loads to a manageable level.

This information is presented in sketches attached. We can provide further information for the QS as required.

The New structure

The building is characterised by a long relatively narrow floor plate, and offset floors for carparking at the lower levels. Due to the width of the site, the carparking is tight.

To minimise the intrusion of columns into the floor space, we propose a long-span flooring system, either 450 Double tees plus 75mm topping, or 400 Hollowcore plus 75 topping. The floors span across the building to an exterior frame each side, which can carry both gravity and seismic loads as far as the carparking levels, below which a shear wall system may be required.

A transfer beam system will be required above the carpark level to remove the columns that are dropping over the aisle space. From the elevation, it appears that there may be additional height at this level to accommodate a deepened beam, which could also extend partly above the slab.

Depending on the amount of window area required, we recommend use of a couple shear wall system for the end walls. This allows a reasonable window area while maintaining much of the stiffness of a walled system.

Given the height of the building, and in order to minimise differential settlement with the existing structure, piled foundations are likely to be required. This will need to be verified by a full geotechnical investigation.

Refer to sketches 100521.00 PB-01 to 03 for conceptual layout and notes.

PART 2 – AMENDMENTS TO EXISTING GROUND FLOOR

A number of minor amendments are proposed for the existing ground floor. It is desirable to create openings in a number of walls to allow access and visual impact for the tenants.

On review, we believe that the requested openings can be achieved, but will require added strengthening to compensate for the removed strength, in each case. The recommended strengthening is a new 200mm concrete skin wall applied to the face of the existing concrete.

Opening sizes are limited by the required stiffness and strength of the new pier elements created, but come close to what has been requested.

Refer to sketches 100521.01, Sk-1 to 4.

John Hare
DIRECTOR

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