HOTEL GRAND CHANCELLOR
OPENING

Introduction

The Hotel Grand Chancellor was a 21 storey high rise reinforced concrete building located in the Christchurch CBD. Built between 1985 and 1988, it was the tallest building in Christchurch both at the time of its construction and as at 22 February 2011. The building had a 15 floor upper tower containing hotel accommodation above 12 half floors comprising car parking.

In addition to its height, the building had, unusually, both vertical and horizontal irregularities. The vertical irregularity arose from the fact that the upper tower relied on reinforced concrete frames for its seismic resistance, while the lower tower relied on reinforced concrete shear walls. The horizontal irregularity arose from the fact that the eastern side of the building was cantilevered out over an existing right-of-way.

Failure of the Building

Engineering assessments carried out following the September 2010 earthquake did not reveal any significant structural damage to the building.

The Hotel was in full use when the 22 February earthquake occurred. In that earthquake the building suffered a major structural failure, in particular the rupture of a shear wall in the south east corner of the building. As a result that corner of the building dropped by approximately .8m and deflected horizontally approximately 1.3 metres at the top of the building.

This major movement induced other damage, including column failure, beam yielding, pre-cast panel dislodgement and collapse of most of the stairs.

There was sufficient resilience within the overall structure of the building to halt the collapse. There were no fatalities or serious physical injuries.

Terms of Reference

The Terms of Reference, as they relate to this building, are set out on the Royal Commission's website. The main issues the Commission will have to consider in relation to this building are:

1. Why the building failed in the February earthquake.
2. The nature of the land associated with the building and how it was affected by the Canterbury earthquakes.
3. Whether there were particular features of the building that contributed to its failure, including the design and construction of the building.
4. Whether the building as originally designed and constructed complied with earthquake/risk and other legal and best practice requirements.
5. The nature and affect of any assessments of the building following the September earthquake and the Boxing Day aftershock.

Failure of the Building

In relation to why the building failed, there appears to be a substantial level of agreement amongst the experts.

The Grand Chancellor contained a critical structural vulnerability, namely the fact that the capacity of the shear wall in the south west corner of the building (D5-6) could be exceeded by the demand actions that could be expected during code-level earthquake shaking to the extent that a brittle and abrupt failure could occur.

The 22 February aftershock induced actions within that wall that exceeded its capacity and caused failure and partial collapse.

The factors that contributed to that critical vulnerability were:

1. The horizontal irregularity. This resulted in a disproportionately large contributing area being supported by the south east corner shear wall (D5-6). The initial design of the building was advanced on the premise that foundations, columns and walls could be constructed along (and within) the eastern side of the Tattersalls Lane right-of-way (on the eastern boundary of the property). Construction was reasonably well advanced in the western half of the site before legal action effectively prevented construction of any structure within the right-of-way. This reduced the footprint width of the building and required a structural redesign. The resulting cantilever added to the structural irregularity of the building.
2. Vertical irregularity arising from a framed structure on top of a shear wall podium with transfer beams at the interface.
3. Extremely high axial (vertical) wall actions.
4. The fact that the D5-6 shear wall was too slender for the levels of axial load.
5. The fact that there was insufficient confinement (by way of reinforcing steel) at the base of the wall.

It would appear that of all these factors, the slenderness of the wall and the low level of reinforcement confinement were probably the most significant factors leading to the wall's failure. The extremely high axial and potential axial loads required that the wall be confined like a column subject to high axial loads.

Compliance

The Commission will hear evidence that indicates that the building as designed and permitted, did not comply with the standards that were in force in 1985 -1988. In particular, in relation to the D5-6 shear wall slenderness ratio and the degree of reinforcement confinement of that wall.

Evidence will be given that indicates that this may have been as a result of the need to re-design the building so that it did not encroach the right-of-way and an omission to re-calculate any resulting change in the seismic load.

The Council, at the time of permitting the plans, relied on a designer certificate signed by a principal of the structural engineering firm that designed the building.

In my submission, this hearing will highlight important issues in the design and permitting of high rise buildings, particularly those that are irregular structures.

Assessments following the September earthquake

Whilst the building was damaged following the September earthquake, there does not appear to have been any apparent significant structural damage. Further, it seems unlikely that the structural engineering inspection of the building following the September earthquake would, in the ordinary course, have highlighted potential problems with the structural design. ie: without an in depth inspection and perusal of the building plans.

Witnesses

Tuesday 17 January 2012

1. Adam Thornton – Structural Engineer, Dunning Thornton, Consultants

   - Author of the report prepared for the Department of Building & Housing on the failure of the Hotel Grand Chancellor. (- see CV)

2. Assoc Professor Stefano Pampanin – Associate Professor of the College of Engineering. University of Canterbury. (- see CV)

   - Member of the expert panel appointed by the Department of Building & Housing to review the Dunning Thornton consultants report.

3. William Holmes – Structural Engineer – Rutherford & Chekene, San Francisco. (- see CV)

   - Engaged by the Royal Commission to peer review the DBH report

4. **Panel discussion** - involving Messrs Thornton, Pampanin and Holmes

Wednesday 18 January 2012

5. Stephen Martin – General Manager, Hotel Grand Chancellor

6. Garry Haverland – structural engineer – Structex

   - Evidence from his inspection following the September 2010 earthquake.

7. Andrew Lind – structural engineer – Powell Fenwick (by video link)

   - Evidence of his inspection of the building following the September 2010 earthquake.

8. John Hare – structural engineer, Holmes Consulting Group

   - Evidence of the design of the Hotel Grand Chancellor by Holmes Consulting Group in 1985-87.

9. Stephen McCarthy – Environment Policy & Approvals Manager, Christchurch City Council

   - Evidence of the permitting process between 1985-1988 and of current permitting procedures for similar buildings.