IN THE MATTER OF
THE CANTERBURY EARTHQUAKES ROYAL COMMISSION

BRIEF OF EVIDENCE OF DICK CUSIEL

Dated 2 February 2012

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1. My full name is Dick Cusiel**,** I am a Structural Engineer living in Christchurch.

2. I graduated from the University of Canterbury in 1964 and I have been working as a structural engineer since that time. In 1967 I moved to Melbourne and worked there for three years before returning to Christchurch in 1970 to take up a position as Project Engineer for the development of the QEII pool complex. I was at that stage working with Bill Lovell-Smith Sullivan & Associates. I took over the practice in 1980 and the company has become LSC Consulting Limited. Since 1970 I have been involved in a wide range of commercial and industrial engineering projects throughout Canterbury.

3. I am giving this evidence to the Canterbury Earthquakes Royal Commission in relation to a building at 43 Lichfield Street, known as the Anderson Building ("the building").

4. Counsel Assisting the Commission, Mr Zarifeh, wrote to the company by letter dated 25 November 2011 and I briefly responded on the matters raised by letter dated 12 December 2011. I wish to expand on those matters by way of this brief and provide what further information I can to the Commission at the hearing.

The building

5. The head contractor for the construction of the building, for Ballantyne & Co. Limited was CS Luney Limited. LSC Consulting was engaged by CS Luney as structural engineers for the project. The architects were in-house architects with CS Luney. I was personally responsible for the design of the structural elements for the building.

6. The design work was undertaken in June 2000.

7. The Anderson Building consists of five storeys above the ground level. The ground level and Level 1 were retail premises for Ballantynes. Levels 2, 3, 4 and 5 were all parking. The building also had a basement.

8. The Commission has provided me with photos of the building which I can refer to. These were taken after the February 2011 earthquake. I produce as **DC1** two photographs of the building prior to the earthquakes.

9. The building is a ductile concrete framed structure, with precast pre-stressed proprietary concrete floors. The building is described in the Design Features report I prepared for the CCC dated 8 December 2000 (BUI.LIC43.0023.1).

10. The carparking levels had fascia panels around the perimeter, as shown in DC1. These were precast concrete panels fixed to the columns with four NO-M20 cast in ferrules.

11. As previously advised, the design codes used were NZS3101 Concrete Structures Standard and NZS4203:1992 General Structural Design and Design Loadings for Buildings.

12. I refer to the drawings labelled SP7 for the precast spandrel panels (BUI.LIC43.0023.18). The drawing details a typical section through a precast spandrel panel for both the corner spandrels and the spandrels which run the full length of the face of the building as can be seen in the photos taken from ground level on Lichfield Street. The relevant drawings are the two drawings at the bottom left of SP7. I return to what might have been the failure mechanism further below.

4 September 2010 earthquake

13. There was no issue with the building in so far as I am aware in the period from its construction to the earthquakes in 2010/2011.

14. I was overseas at the time of the 4 September earthquake. I am aware that my son, who is in practice with me, Matt Cusiel, was requested to inspect the building by other engineers who had carried out an initial inspection. There was a relatively minor issue in relation to the ramp which connects the CCC Lichfield Street carpark to the Anderson Building carpark. On inspection on 23 September 2010, it was observed that the concrete had spalled at the connection on one of the columns at the top of the ramp. No flexure or shear cracking in the column was evident. There was ample core concrete in the column to support the vertical loads from the parking levels above and the ramp could be safely used.

15. Matt was also involved in a brief inspection of the floor at Level 1 of the retail section of Ballantynes. A small area of the floor on Level 1 was visible because some lino had been lifted for replacement. A surface crack in the floor was visible but by the time Matt inspected it, the lino installer had ground the surface of the floor and the edges of the crack had fretted. This caused the crack to look more severe than it really was.

16. As a consequence of this, a further inspection was undertaken from the ground floor by removing the ceiling tiles and looking in to the ceiling space for any damage which could be observed from beneath Level 1. There was no damage which was able to be seen from the underside of the floor.

December 2010

17. I refer to a report from Powell Fenwick dated 14 December 2010 (BUI.LIC43.007.1). This report refers to several Ballantynes buildings, therefore including the Anderson building. I have noted the description of the damage to the building and have no further comment other than to note that it was effectively non-structural in nature.

18. My firm prepared a report for Ballantynes dated 22 December 2010 (BUI.LIC43.008.1). This report is in relation to the September 2010 inspections.

19. I inspected the building on 23 December 2010, 19 January 2011 and 2 February 2011, and observed a crack in the wall adjacent to the ramp and observed several diagonal cracks, estimated to be not wider than 0.3 millimetres. I also observed a diagonal crack in the ground floor slab over the entrance from Lichfield Street. I did not consider the cracks to be of significance and the cracks did not compromise the structural integrity of the building.

20. We have had no engagement with CCC other than the issue concerning the ramp between the Lichfield Street carpark and the Anderson Building noted above. The building had been "green stickered" by the Council.

21. I note for completeness that on 20 October 2010 I had a walkover with another engineer from our firm, with Philip Richards of Ballantynes, as there was some discussion about the possibility of building office accommodation on the top level. I did not notice any damage to the spandrels during that walkover.

Mesh in the floor topping

22. In the preparation of my brief of evidence I have had an opportunity to consider other documents which have been filed with the Canterbury Earthquakes Royal Commission. There are two documents I wish to refer to at this stage.

23. There was a meeting held with CERA on 3 August 2011 to discuss the demolition methodology for the building. At that meeting, comments were made in relation to the mesh in the top 65 mm of the slab. I refer to the minutes of the meeting regarding the floor slab of the Anderson building (BUI.LIC43.0016.1). In the second bullet point at section 2.1 of the minutes, it is noted as follows:

> *"Investigation has shown that there is a lack of topping steel in the top 65 mm of the slab leading to the redundancy of the slab being significantly reduced."*

In a document prepared by Mr Winterbourn of W2 Design, also dated 3 August 2011 (BUI.LIC43.0015.1) at paragraph 2, Mr Winterbourn says:

> *"Intrusive surveying has confirmed that no reinforcing extends from the concrete beams into the floor topping, and no reinforcing steel (**other than mesh**) passes over the concrete beams at the ends of the floor units … It is also evident on site that **the mesh** does not behave in a ductile manner where bars have sheared with little elongation."*

24. The CERA document refers to a lack of "topping steel". That phrase is often used to describe "mesh". The CERA minutes tend to suggest that there was no, or at least a lack of, topping steel (mesh) in the slab. However, the W2 Design report confirms that there was mesh present (highlighted in bold above). There therefore appears to be an inconsistency between the two documents. I have reviewed the drawings for the building and confirm that there was mesh (topping steel) in the top 65 mm of the slab. I produce as **DC3** the relevant drawing which confirms this. I conclude that the reference in the W2 Design report is correct and the CERA minutes are in error. It is possible that the reference to "topping steel" was intended to be a reference to "reinforcing steel", other than mesh, which is correct. It was suggested (BUI.LIC43.0016.1) the lack of topping steel reduced the redundancy of the floor slab. Whether that is a reference to "mesh" or to "reinforcing steel", as the floor consists of flange supported TT section, moment redundancy by the provision of more topping steel/mesh (or reinforcing steel) would have been negligible. This issue however is not directly relevant as it has nothing to do with the spandrels.

Design and connection of the concrete façade spandrels and possible failure mechanism

25. The design concept for fixing the spandrels to the structure was to have cast in ties into the floor topping. So, the ties were cast into the precast façade panels and then on site were to run into the concrete topping. The floor topping was to be poured over the ties, thus locking the façade into the structure.

26. This design concept is detailed in the drawing entitled "Typical Section Thru Precast Spandrel Panels" S1, S2 and S3 on drawing SP7 (bottom left-hand detail) (BUI.LIC43.0023.18). This construction method was carried out in relation to the corner spandrels which can be seen on Levels 3, 4 and 5 in the photos before the Commission (BUI.LIC43.0027.9 and BUI.LIC43.0024.5).

27. From the photos that were initially provided to me by Mr Zarifeh after the event, all of the spandrels facing Lichfield Street have been removed (e.g. BUI.LIC43.0024.5), so I am not sure which panel or panels actually fell off the building during the 22 February earthquake (it appears from BUI.LIC43.0027.8 and 27.9 that two may have fallen). However, the three levels of spandrels facing Lichfield Street appear to have all been constructed in the same manner and according to the details on SP7. In particular, the drawing entitled "Typical

Section Thru Precast Spandrel Panels" S4, S5 and S6 (BUI.LIC43.0023.18). This is the drawing second from bottom left on SP7. What is not detailed, is the precast tie from the spandrel to the floor topping.

28. It is, regrettably, this omission which in my view has contributed, with the significant force of the earthquake, to the spandrel falling away from the structure. The panels were affixed with weld plates and angle cleats to the columns (BUI.LIC43.0024.5 and 24.8). However, they were primarily there for the purposes of construction to put the panels in place while the floor topping was poured. They were unlikely to have been sufficient to keep the panels in place in the event of a major earthquake.

29. It was not until I received the letter from the Commission dated 25 November 2011, that I became aware that a woman who was sitting in her vehicle on Lichfield Street was killed in the earthquake when a concrete façade spandrel fell from the building and landed on her vehicle. This came as a considerable shock to me. Having since considered the drawings, and noted the omission, the matter has weighed very heavily on me and will always. I extend my very sincere condolences to the family of the victim for this extremely tragic event.

30. This statement is true to the best of my knowledge and belief and was made by me knowing that it may be used as evidence for the purposes of the Canterbury Earthquakes Royal Commission of Inquiry.

Dated this 2nd day of February 2012.

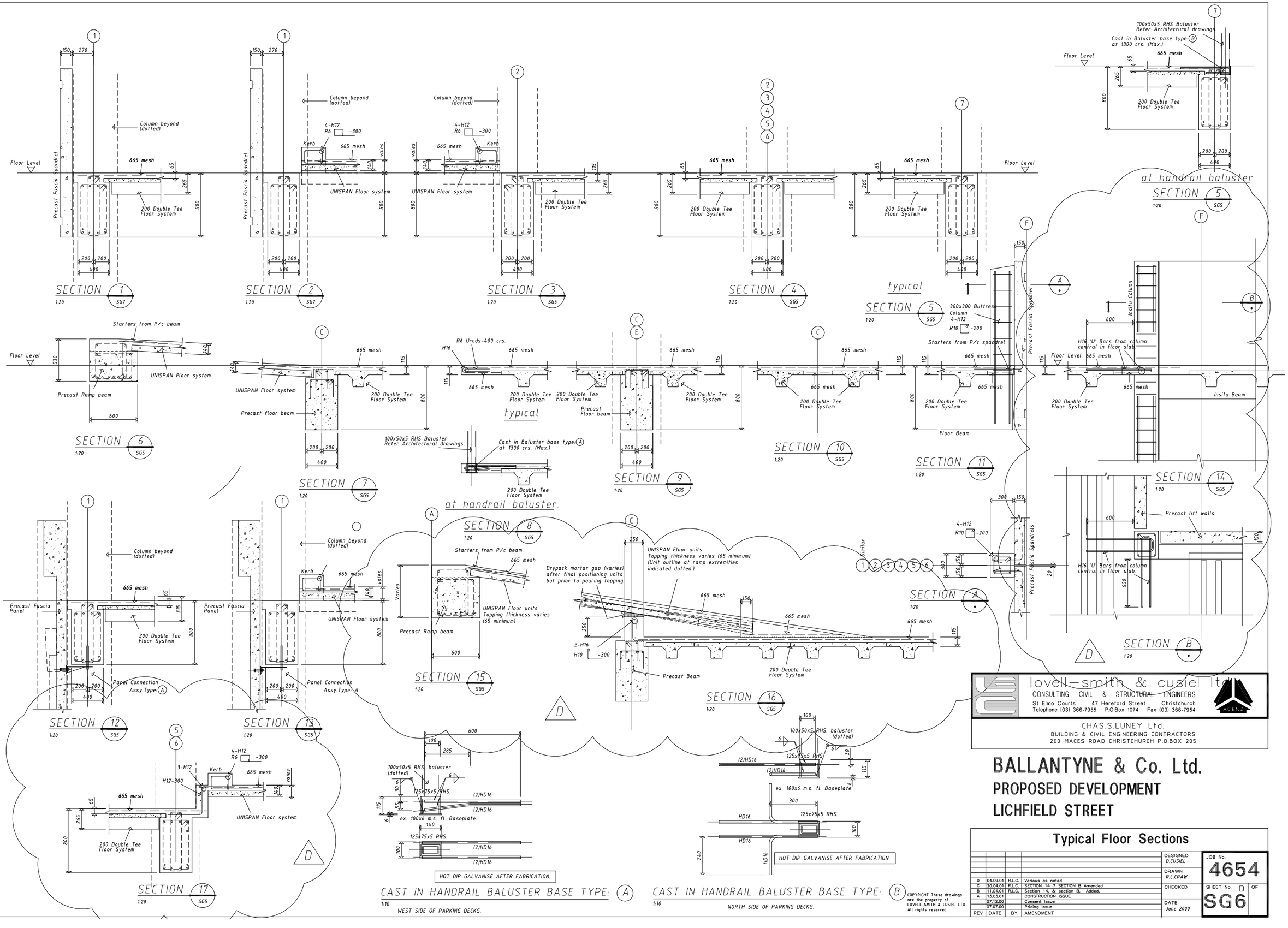
Dick Cusiel

DC1

Building prior to earthquakes

Photo 1

Photo 2



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PROPOSED DEVELOPMENT

LICHFIELD STREET

Typical Floor Sections

REV	DATE	BY	AMENDMENT
D	04.09.01	R.L.C.	Various as noted.
C	20.04.01	R.L.C.	SECTION 14.7 SECTION B Amended
B	11.04.01	R.L.C.	Section 14. & section B. Added.
A	13.03.01		CONSTRUCTION ISSUE
	07.12.00		Consent Issue
	07.07.00		Pricing Issue

DESIGNED D.CUSIEL
DRAWN R.L.CRAW
CHECKED
DATE June 2000

JOB No. 4654
SHEET No. D SG6 OF

DC3