

Dave Harding



File CERC  
21 February 2012

Stephen Mills QC  
P O Box 14053  
Christchurch 8544

Dear Sir,

**Royal Commission of Enquiry  
Information Request**

Further to your letter of 10 February 2012, I enclose information as requested.

**Items 4-10**

1. I do not recall this letter from Mr Tapper. I assume that if I had responded to this letter, then there would be a copy of such a letter in the files of the CCC or ARC.
2. I have no way of knowing whether the drawings provided include any amendments made by ARCL as a consequence of Mr Tapper's letter.
3. I do not agree that the drawings provided "do not show any detailing for the diaphragm shear core connection other than the 664 mesh" as stated in paragraph 8 of your letter.
  - 3.1 The floor plans and cross sections on sheet S16 show D12 at 400 centres slab ties between the core walls and the floor slab.
  - 3.2 The floor beams on line 4, including beams 23,24 and 25 all engage with the reinforcement in the shear core. The connection of the wall with the precast beam bottom bars are shown on details 5 and 9 on sheet S19. The four top bars in the insitu beam topping are continuous through the shear core and connect to it as shown on the floor plan on sheet S15.
  - 3.3 It may be considered that the Hi Bond steel tray decking is effectively a steel diaphragm which connects all of the floor elements together. This steel diaphragm is well restrained against buckling by the concrete floor, and where it is discontinuous at the precast floor beams, the H12 at 120 saddle bars over the beams provide continuity for tension loads in the HiBond flooring. The HiBond itself has been found to have good anchorage into the insitu concrete over the precast beams.
4. I have no doubt that Mr Tapper's concerns would have been met. Mr Tapper was a very capable and thorough engineer, and was not one to have his concerns easily dismissed. I had a good relationship with him, and generally his concerns were well founded. My approach was always to acknowledge any perceived non-compliances which he found, and to work with him to resolve them satisfactorily.
5. I had not heard the term "drag bars" used until I was telephoned by Dr Reay in about 1990. I have no doubt that if Mr Tapper had requested Drag bars, then they would have been added to the drawings.

6. The calculations I have are those forwarded to me by ARCL on 1 May 2011. These appear to include references to the connections between the diaphragm and the shear core on sheets S56 and S57. I assume that these sheets would have been forwarded to Mr Tapper.

**Items 13,14**

1. The structural design of the building was prepared following an analysis of the building structure which was prepared using the ETABS program on a computer at the University of Canterbury. I believe that this was the best program available at the time.
2. My current understanding of this program is that it assumed rigid floor diaphragms, and made no allowance for flexibility of the diaphragm or for the extent of reinforcement in the diaphragm.
3. I believe that the program also assumed rigid foundations to each of the vertical wall elements.
4. The stiffness of the wall elements which was assumed appears from the calculations to be 0.6 times the stiffness of the gross concrete section. This makes no allowance for the extent of wall reinforcement, the extent of cracking in the wall, or the vertical accelerations due to earthquake loading. This is clearly not as accurate as the finite element analysis carried out for the Royal Commission.
5. The building was designed for the drifts calculated from the ETABS program as above. The calculated drifts are on sheet S15 of the calculations. It was believed that these were below the limits at which ductile detailing of the columns was required.

**Item 15**

1. I expect that all concrete control test results would have been sent to me. I expect that I would also have sighted the receipts from the concrete supplier in the foreman's office. I have no records of either of these items. I would not have been on site during pouring of any concrete and would not know if additional water had been added to the concrete on site, which may have reduced the strength of the concrete provided.

Yours faithfully

Dave Harding  
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