

UNDER THE COMMISSIONS OF INQUIRY ACT 1908

IN THE MATTER OF ROYAL COMMISSION OF INQUIRY INTO BUILDING
FAILURE CAUSED BY CANTERBURY EARTHQUAKES

AND IN THE MATTER OF THE CTV BUILDING COLLAPSE

CLOSING SUBMISSIONS OF COUNSEL FOR MR HARDING
IN RELATION TO THE HEARING INTO THE COLLAPSE OF THE CTV BUILDING

DATED 3 September 2012

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**CLOSING SUBMISSIONS OF COUNSEL FOR MR HARDING
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MAY IT PLEASE THE COMMISSION

1. In the ordinary course, Dr Reay and Mr Harding would have presented submissions on a united front, on the basis it was Dr Reay's firm that carried out the work. Submissions would be made on behalf of that firm, following evidence from Dr Reay as its principal and Mr Harding as an employee.

However, for reasons which are patently apparent, alas that was never to be.

2. Mr Harding accepts the closing submissions of Counsel assisting the Commission, in respect to engineering issues. They are balanced, technically accurate and considered. Mr Harding adopts those submissions.

3. However, there are submissions that are not accepted by Mr Harding.

4. **PARAGRAPH 13:** *"It is submitted that Mr Harding did not comply with the IPENZ Code of Ethics in acting outside his area of competence. One of the lessons to be learned from events that have occurred here is that both the IPENZ rule that applied in 1986, and the one that applies currently, which leave it to the engineer to determine when they might be working outside their level of competence, provide an inadequate restraint on when it is appropriate to an inexperienced structural engineer to embark upon work never previously undertaken."*

5. Mr Harding's role must be examined in context.

- 5.1. The criticism would be valid if Mr Harding was a sole practitioner, undertaking the work in the knowledge a client would be relying solely on him and his expertise to carry out the design, including the calculations.

- 5.2. The decision to accept the project was Dr Reay's. Mr Harding had no control over that.

- 5.3. Dr Reay knew, or ought to have known, Mr Harding was not experienced in:

- (a) design of high-rise buildings
- (b) use of the ETABS computer program.

In **PARAGRAPH 6** of Mr Harding's first Brief of Evidence ¹, he says:

"In about August 1985 I was offered an opportunity to return to Alan Reay Consultants Limited. Alan "Alan" advised me that since my earlier employment with his firm that he had expanded the firm in order to design multi-storey buildings, and at that time had designed a number of multi-storey buildings. He said that he had engaged a structural engineer and structural draughtsmen previously employed by Holmes, Wood Poole and Johnstone, particularly because of their experience in the design and draughting of such buildings. His current Structural Engineer, John Henry, was shortly due to leave the firm and Alan offered me that position. Alan understood that I had no experience in the design of multi-storey buildings which required the use of the ETABS computer program for the dynamic analysis of such buildings. He advised me that I had the opportunity to gain that experience in his office, and to become an Associate with his firm in the near future."

In an exchange with Mr Mills, the following emerged ²:

"Q. So do I take it that, or do you accept that what was being offered you was a potential associate-ship in the firm?"

A. As I said, that was an aside, that was not the main reason for going there. That was, I've explained that the reason I went was, as – what I've said in the evidence as I recall you calling it, was that I was offered the opportunity to go and learn how to do multi-storey buildings. If he had offered me the opportunity and said that I'd be doing the same thing I was doing before or as you say, cutting edge tilt panel then it wouldn't have interested me at all."

"Q. So where did you think the experience was going to come from, once that person left?"

A. From Alan.

Q. Thank you. So it was Dr Reay where you were looking for that experience to come from?"

A. Yes."

¹ WIT.HARDING.0001.3

² TRANS.20120731.39 and .42

- 5.4. Mr Harding had a reasonable expectation to rely on Dr Reay for supervision, guidance and review.
- 5.5. Mr Harding had a reasonable expectation a competent and experienced draftsman would be assigned to the CTV project.
6. Paragraph 13 should be read in context with paragraphs 72 and 73:

PARAGRAPH 72

"Although in the course of cross examination on Day 66 Mr Harding referred to needing to know there was a review process in place because when you are designing something for the first time you don't know what you don't know, there is little or no evidence that supports Mr Harding's claim that he had any doubts about his ability to work on his own."

PARAGRAPH 73

"At one stage in response to a series of questions put to him by Mr Rennie QC, he said.

Q ... the elements of structural design they were in fact all matters within your skills and expertise?

A. There was nothing new ...

Q. But at the time you considered that you were confident, you were competent to do it, didn't you?

A. I was competent to do it provided there was someone reviewing it."

7. Mr Harding's self evaluation was that he was not competent to carry out the work on a stand alone basis *"I was competent to do it, provided there was someone reviewing it."*

Mr Harding relied on Dr Reay to have continuing contact with draftsmen in the office. This I have referred to as *"implied review"*.

Mr Harding acted responsibly when the ETABS output showed excessive deflections. This led to discussion over the introduction of a south shear wall.

It is grossly unfair, in my submission, to go as far as Counsel does, in paragraph 13, in particular in relation to the context where Mr Harding was faced with a *fait accompli* in respect to design. In effect, he was introducing the calculations.

8. In paragraph 11 of his first brief of evidence ³, Mr Harding says:

“One of the first projects I was involved with, and the first multi-storey building requiring an ETABS analysis, was at 249 Madras Street, now known as the CTV building. Alan consulted with the client and the Architect, prepared the preliminary calculations and the concept design, and arranged for the preliminary Architectural drawings to be amended to meet his requirements.”

9. In paragraph 12, ⁴ inter alia he says:

“These drawings were then presented to me, and Alan advised me of the reasons for the building layout shown on the drawings. He explained that the client had seen an existing building at 299 Durham Street, which was at the north west corner of the intersection of Durham Street and Armagh Street. This is now referred to as the Contours Building. The client had been impressed by the look of the Contours building, and he wanted the CTV building to have a similar layout of the services core and the same facade treatment. In order to repeat the look and detailing of the Contours building the client engaged the same Architect to design the CTV building as had designed the Contours Building. I understood this to be Alun Wilkie Architects.”

10. Dr Reay had knowledge, from an early meeting, that the design would be:

- 10.1. shear wall stabilised gravity frame, as opposed to a ductile frame
- 10.2. beam columns to be part of a gravity frame, therefore no requirement to design for ductility
- 10.3. a high bond floors
- 10.4. off set shear core.

11. In the circumstances, it is submitted it was reasonable for Mr Harding to rely on Dr Reay for guidance.

12. Mr Harding was badly let down by Dr Reay, who displayed “*intellectual arrogance*” and, given Dr Reay’s own lack of experience in respect to high rise design and the use of ETABS, he was “*reckless*” in dismissing the concerns of John Henry.

³ WIT.HARDING.0001.5

⁴ WIT.HARDING.0001.6

John Henry's concern was "*whether the gravity load system would be adequately protected by the shear walls*". This was in relation to Landsborough House.

It is submitted that there was a duty on Dr Reay, in the circumstances, to involve John Henry, on the basis of an external review to dovetail John Henry's obvious engineering talents with the skills that David Harding did have.

I have no doubt that, if John Henry was involved, he would have identified there was a failure to carry out calculations to verify whether or not the columns would remain elastic when subjected to lateral sway of the shear walls.

Those calculations would have shown that the columns did not remain elastic and would have been designed for ductility.

This would have involved closing the spacing of the helical binding in the columns.

13. **PARAGRAPH 416:**

"By deriving drift limits from this and using the modification factor specified in clause 3.8.1.1 of NZS 4203:1984, Dr Hyland and Mr Smith identified V delta. They then carried out an assessment of column capacity. They determined that identified columns did not remain elastic at V delta and the columns should have been designed with the seismic provisions of the Code. This finding was endorsed by the Department of Building and Housing expert panel."

Mr Henry's involvement would also have probably addressed the issue, being that the diaphragm connections to the northern core shear walls were not designed in terms of the parts and portions sections of the Code.

14. The allegation relates to the IPENZ Code of Ethics. The relevant parts of the Code that applied in 1986 ⁵ are:

"Rule 18.2 of the Rules of the Institution of Professional Engineers New Zealand states:

'Each member shall so conduct himself as to uphold the dignity, standing and reputation of the Institution and of the profession'.

In furtherance thereof:

- 1. Each member shall exercise his professional and technical skill and judgement to the best of his ability and shall discharge his professional and technical responsibilities with integrity.*
- 6. He shall not misrepresent his competence nor, without disclosing its limits, undertake work beyond it.*

⁵ BUI.MAD249.0429A.2, also ENG.IPENZ.0006.1

7. *When called upon to give an opinion in his professional capacity he shall give an opinion that is objective and reliable to the best of his ability.*

14. *He shall maintain and strive to improve his professional competence by attention to new developments relevant to his professional activity and shall encourage those working under him to do likewise."*

15. The relevant part of the present code is **PART 2 – Guidelines**

"Professionalism, Integrity and Competence: Members shall undertake their engineering activities with professionalism and integrity and shall work within their levels of competence.

Under this clause you should have due regard to:

2.1 *Exercising your initiative, skill and judgement to the best of your ability for the benefit of your employer or client.*

2.2 *Giving engineering decisions, recommendations or opinions that are honest, objective and factual. If these are ignored or rejected you should ensure that those affected are made aware of the possible consequences. In particular, where vested with the power to make decisions binding on both parties under a contract between principal and contractor, acting fairly and impartially as between the parties and (after any appropriate consultation with the parties) making such decisions independently of either party in accordance with your own professional judgement.*

2.3 *Accepting personal responsibility for work done by you or under your supervision or direction and taking reasonable steps to ensure that anyone working under your authority is both competent to carry out the assigned tasks and accepts a like personal responsibility.*

2.4 *Ensuring you do not misrepresent your areas or levels of experience or competence."*

16. In **PARAGRAPH 15** of Mr Harding's First Brief of Evidence ⁶, inter alia he says:

"Alan was aware that I had not used ETABS before, and that I was relying on him for guidance in the use of the program and the resultant method of building design."

17. In **PARAGRAPH 20** of Mr Harding's First Brief of Evidence ⁷, inter alia he says:

"... Alan would regularly visit the draughtsmen to monitor progress of the work, and to view the details and information which I had given to them. If he had any concerns as to the type of detailing, my failure to use standard details, or my use of non preferred products, then he would advise me of the changes he required."

and

⁶ WIT.HARDING.0001.6

⁷ WIT.HARDING.0001.9

In **PARAGRAPH 21**⁸, he says:

My assessment as to whether the building complied with the relevant codes would be based on my previous experience with each element. In areas where I was inexperienced, I would refer to the template calculations provided. Prior to the submission of the documents for a building consent, Alan would review the drawings and calculations. In some cases Alan may redesign elements himself, or refer them back to me for amendment or redesign."

18. I do not, for the reasons given, agree the allegation should stand. There was no deliberate or intentional act on the part of Mr Harding to represent a level of competence – beyond that level in fact he had.

19. In **PARAGRAPH 44**:

"The initial contact with Dr Reay involved a meeting between Dr Reay and Mr Scott. It seems likely that Mr Brooks was at that meeting as well. The meeting was probably at Dr Reay's offices. Mr Scott thought he was introduced to David Harding at that meeting and that Mr Harding was asked to produce preliminary structural drawings from the A2 architectural sketches. As the ARCL timesheets show the first time recorded for Mr Harding is in March 2006, this may not be correct. However it is also possible that Mr Harding was introduced to the Williams Construction team at that meeting, but would not have recorded time for an introductory meeting of this kind. Mr Harding said he had no contact with the design build contractor, however this is clearly not correct as he acknowledges contact once construction started. However, in light of Mr Scott's evidence that after that initial meeting he only dealt with David Harding, and Dr Reay's evidence that he had no further contact with Williams Construction after that initial meeting, it seems likely that the contact was earlier than that and probably did commence at that initial meeting with Dr Reay."

20. Mr Harding disputes the allegation that he was involved with the contract from the outset.

He, of course, was involved with the contract after construction commenced. See paragraphs 31 to 34 inclusive of Mr Harding's First Brief of Evidence.

Either, the timesheets produced to the Commission are correct, or they are not.

⁸ WIT.HARDING.0001.9

On the assumption they are, and the initial meeting with the contractors was in February 1986, the timesheets are consistent and corroborate Mr Harding's view.

The timesheets record Dr Reay allocating two hours to the CTV project (no. 2503) and Mr Harding's first introduction to the timesheets is 22 hours in March 1986.

21. In **PARAGRAPH 578**:

"Bill Jones said that he would ring David Harding for every concrete pour except the columns, because there the steel was already 'sticking out of the columns for them to see at their initial inspection'. However he said that sometimes Mr Harding did not arrive at the site, but would ring and say 'if you don't see us, go ahead'. Mr Jones said this did not concern him. Mr Harding denied this had occurred. Unfortunately Mr Harding's site inspection records have not been able to be located."

22. Mr Harding's denial is consistent with his manner. His manner and make up is not one of being "cavalier".

Peter Nichols, in **paragraph 27** of his Brief of Evidence ⁹, says:

"I am advised that David Harding was employed by Alan Reay at the time the CTV Building was designed and was involved in the design process. I did not know David Harding well, but I do recall him being less dogmatic than Alan Reay, although still assertive. I regarded him as a very competent engineer whose design work I considered to be characterised with elegant simplicity, practicality, and economic construction."

23. The Commission shall assess issues of credibility – it is submitted that Mr Harding's demeanour giving evidence in chief and under cross-examination was that of a truthful witness.

24. In **paragraph 130**:

"In respect of this issue and others, Mr Harding proceeded blindly unaware of the risks in the design for which he had taken responsibility."

He did not take responsibility. The responsibility was joint. For the reasons averted to, Mr Harding does not accept this criticism.

CONCLUSION

⁹ WIT.NICHOLS.0001.9

25. Whilst it is for the Commission to draw the threads together and provide findings, conclusions and recommendations, it is submitted at all material times Mr Harding was (and still is) a competent engineer. He found himself in an environment that simply did not have the resources and expertise upon which he could rely.
26. Finally, Mr Harding says, in paragraphs 38 and 39 of his First Brief of Evidence¹⁰.

“STANDARDS AND CODE ISSUES

38. *I agree with many of the recommendations in the reports.*

Following observations of a number of buildings following the earthquakes, it appears that many buildings have experienced lateral sway which is somewhat larger than expected from the design calculations and computer analysis.

This may be partly due to assumptions made during the modelling of the building, such as the assumption that shear walls are rigidly fixed at the base; no allowance being made for foundation flexibility; the flexibility of the soil below the foundations in liquefiable soils; the degree of cracking in the concrete; the state of the concrete and reinforcement following earlier earthquakes; and the reinforcement content of the walls and columns.

There was no provision for vertical acceleration on buildings in NZS4203:1984. Even the current building code, “NZS1170.5:2004 Structural Design Actions-New Zealand” only requires that the vertical acceleration be assessed at 0.7 times the horizontal acceleration.


As previously noted, the paper written by Bradley and Cubrinovski, titled “Near Source Strong Ground Motions Observed In The 22 February 2011 Christchurch Earthquake” reports on the observed vertical accelerations. The vertical accelerations were three times the horizontal acceleration at the Pages Road Pumping Station. That report goes further to report, at page 189, relative to both the 22 February Christchurch earthquake, and the 4 September 2010 Darfield earthquakes,

“ it can be clearly seen that V to H ratios above 1.0 are frequently observed for distances up to $R_{rup} = 40\text{km}$ in both these events (as well as

¹⁰ WIT.HARDING.0001.22 and 23

other historical earthquakes worldwide), and hence the code prescription of 0.7 is, without question, significantly un-conservative."

39. *It would be my hope that, due to the excessive lateral movement which takes place in an earthquake, that the present Code be amended to also require that all columns be detailed for ductility, irrespective of the calculated lateral sway of the structure."*



J M Kirkland, Counsel for David Harding

Date: 3 September 2012