HEARING RESUMES ON MONDAY 30 JULY 2012 AT 10.00 AM

JUSTICE COOPER ADDRESSES MR KIRKLAND THE COUNSEL APPEARING FOR MR HARDING

MR MILLS:

Just one matter before Mr Kirkland calls Mr Harding and that's Mr Wilkie. You'll see that we've got a brief from him. It's not actually listed in today's schedule but he is actually, theoretically, the first witness.

JUSTICE COOPER:

Yes.

MR MILLS:

Now the arrangement is that after discussion with other affected parties when his brief was being put together that he would be a read only. I don't know whether you want it read but he's not being called.

JUSTICE COOPER:

I think it should be read.

MR MILLS:

All right.

JUSTICE COOPER:

Yes.

MR MILLS:

Well I don't think he is represented by counsel so I'll have to do that.

JUSTICE COOPER:

Right. I'm sorry Mr Mills.

MR MILLS:

But in addition to that we are reserving the possibility that depending upon how the evidence proceeds this week we may require him to come and be available for cross-examination.

JUSTICE COOPER:

Yes well I'm pleased to hear that and he's available I take it.

MR MILLS:

Well he's been overseas. I think he's back now but in any event I think if he isn't he's not far away. So if that has to be arranged it will be arranged.

JUSTICE COOPER:

Very good. Thank you Mr Mills.

MR MILLS:

Sir, would you like me to read that now?

JUSTICE COOPER:

Yes, unless you wish to delegate it to one of the other counsel assisting.

MR MILLS:

No I, unless I have a paroxysm of coughing I think I can do this.

JUSTICE COOPER:

Very good. Thank you.

MR MILLS READS BRIEF OF EVIDENCE OF ALUN TREVOR WILKIE

My full name is Alun Trevor Wilkie. I am a registered architect living in Christchurch.

I have been in practice as a registered architect for 36 years. I worked as an architectural graduate for four years prior to becoming registered having

graduated from Auckland University in 1972. Apart from one year working in London during the early part of my career I have worked exclusively in Christchurch.

I am currently a director and shareholder of Wilkie Bruce Registered Architects Limited. At the time of the construction of the building at 249 Madras Street I was trading under Alun Wilkie Associates Limited of which I was the sole director and shareholder.

I have been asked to prepare this brief of evidence for the Royal Commission of Inquiry into Building Failure caused by the Canterbury Earthquakes, particularly 249 Madras Street, CTV building. I set out below my recollection of my involvement with the building and respond to queries which have been put to me by counsel assisting the Commission.

After 26 years since the building's construction in 1986 I am struggling to recall many of the details relating to the people engaged with the development of the building. I confirm that I have no files at all relating to the design and construction of the building. I do still retain the original architectural plans. I may have previously advised the Department of Building and Housing investigators, assuming they were Messrs Hyland and Smith, but I did not hold the plans. I cannot recall whether that question was asked of me. I do not think that it was as I would have responded that the plans may have been stored in our offices which at that time were still in the red zone of the CBD. Since the time of the DBH investigation I have retrieved the plans from our old office [and I just interpolate to say that we received those some time ago].

Prior to 1982 I was employed by Industrial Holdings Limited, a company which was engaged in the construction of a number of small office developments in Christchurch. From 1982 I formed my own practice and for a period of some years after that continued to do the design work for Industrial Holdings Limited. It was during this period that I met a gentleman whose surname I cannot now recall but his first name was Neil who was a property manager for

Waitaki Refrigeration Company who, through their pension fund, invested in Industrial Holdings Limited developments [and I think I can say it won't be disputed that that will be Mr Neil Blair of Prime West]. At about the time I commenced my practice Neil started his own property investment company and my recollection is that it was called Prime West or similar.

In the period from the early to mid-1980s there was a reasonable level of development of office buildings in Christchurch City. This period saw a move away from owner/occupier buildings to leased office space. As a consequence the design and construction of office blocks became more orthodox or more generic in nature. There were fewer purpose-built buildings for owner/occupiers.

In Mr Mills QC's letter to me of 27 March 2012 [and that document is attached to the brief but I don't think it's necessary to go to it] he alluded to a comment attributed to me when I was interviewed by Mr Hyland Mr Smith on 5 April 2011 in relation to the CTV building. I understood them both to be consulting engineers [This is Hyland and Smith] and I now understand were advising in respect of the DBH investigation although I am unclear on that. The notes apparently record me as referring to the CTV building as a, "Standard developer's office building." I have been asked what the characteristics of that description might be. I respond as follows.

The CTV building was rectangular in plan, each floor was a repeat. It had standard suspended grid ceilings, the second exit stair was external and all ventilation was achieved with opening windows. It had a small entrance foyer. The building was constructed with exposed aggregate panels to the exterior.

The above description describes a building that does not have a complex form. It was not air conditioned. It had no feature ceilings and it did not have any other architectural embellishments. It was, therefore, what I earlier describe as a standard developer's office building. It was a building which was very much in the mould of what developers constructed during that

period. In my view it was similar in its overall architectural design to others constructed in the 1980s.

My description as above is reflected also in the comments noted in the Holmes Consulting Group structural report dated January 1990 under the heading "Conclusions" at section 3. [and this as the Commissioners will be aware relates to the retrofit drag bar issues when they emerged in 1990]. In particular at sub-paragraphs 1 and 2 the authors of that report stated:

(1) [these are quotes from the report] "The building is in a condition appropriate to its age and the contractor-as-developer form of construction."

(2) "The layout and design of the building is quite simple and straightforward and generally complies with current design loading and materials code."

As to who I received my instructions from to proceed with the architectural drawings for the building I cannot now recall whether it was the gentleman Neil to whom I have referred to above or someone else. It has recently been suggested to me (Mr Mills QC's letter dated 27 March 2012) that I might have had some involvement with Mr Michael Brooks the managing director of Williams Construction at the time the CTV building was designed. It is my understanding that Mr Brooks has advised counsel assisting the Commission that after he had prepared what was referred to as a "back of the envelope sketch" showing a plan view he, Mr Brooks, approached me with this sketch and instructed me to prepare the architectural drawings for the building.

Given the period of time since these alleged discussions took place I cannot recollect what has been suggested. I can recall Mr Brooks. However, I do not recollect Mr Brooks instructing me to prepare architectural drawings. Unfortunately again given the effluxion of time I simply cannot recall the exact nature of the original briefing process. The reality of the situation is that at that time there was a considerable volume of work in the Christchurch market. There were a large number of office blocks being designed and built at the time, many of which I was involved with, in addition to a large residential

design practice. I would of course [I think it should be have been assisted] by reference to my files but they have long since been destroyed.

In terms of the contractors until recently I could not recall the firm engaged.

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Messrs Hyland and Smith reminded me that the contractors were Shirtcliff & Scott.

In about 1981 when I was the company architect at Industrial Holdings Limited I designed the Contours building, previously sited at 299 Durham Street North. That building has now been demolished [and I will, Commissioners, take you to a photograph of that later on so that you can see it]. The building has now been demolished. The Contours building was a three storey building and had a different plan configuration and a different parapet roof design than the CTV building. Its exterior column, spandrel and fenestration composition had similar architectural features to the CTV building.

By Mr Mills QC's letter to me of 27 March 2012 I was asked to comment on whether I was asked to design the CTV building with the same architectural features as the Contours building. I cannot recall whether I was given that instruction.

I have been referred to a letter dated 27 August 1986 from Mr G L Tapper on behalf of the city engineer. I understand from advice received from the Commission that Mr Tapper was the person at the City Works & Planning Department who had principal responsibility for dealing with the permitting of the CTV building. My office may have applied for the building permit but I cannot recall this. It is not uncommon now, as it was not uncommon then, for architectural consultants to submit applications for a building permit (now referred to as building consents) on behalf of building owners.

I have no recollection of dealing with the City Council during the processing of the permit and dealing with the questions raised by Mr Tapper in the letter referred to.

The letter is addressed to Alan Reay Consulting Engineers. There is no indication that it was copied to me and it would have been highly unusual for it to have been copied to me during that period. Further, all of the matters in the letter relate to the building's structural design which did not require any input from me as architect.

Prior to the design for the CTV building I had not worked with Alun Reay Consulting Engineers as far as I recall. I did not have any knowledge relating directly to the specifics of the engineering and structural design or calculations. It is likely that I would have worked with the structural engineer in respect of how he was designing the overall structure. That is, the column centres, the lengths of the walls, the floor to floor heights et cetera. In other words the general spatial characteristics of the building structure. As a registered architect I had no legal mandate to do any specific "design work" on the structural aspect of the building. This was always exclusively done by the structural engineer, as with this construction project. As I did not have any knowledge relating to the specific structural design issues, at no stage did I have any concerns about any aspect of the structural design. It was simply not an area that I was engaged in at all.

I have been asked by Mr Mills QC (his letter of 13 September 2011) about the question of supervision during the construction period. To the best of my recollection neither I nor anyone else in my practice supervised the construction work on site. I have no recollection of regular site meetings. Unfortunately I cannot recall attending the site during construction at all, but even if I did, and evidence to that effect emerges, this does not constitute supervision. At most my office may have been involved with "contract observation". At no stage throughout my 36 year career working in Christchurch City have I supervised a project. That term implies a high level

of site attendance at very regular intervals for all facets of the work. Architectural observation, if we were engaged to do that, only entails observing architectural elements which are primarily incorporated within the building beyond the structural construction phases. I reiterate that I had no involvement in any observation of any structural work.

As I was not engaged in supervision of construction (nor can I recall even the contract observation role for architectural work) I cannot comment on any concerns I may have held about any aspect of the work being carried out by the contractors. Suffice to say, to the best of my recollection I cannot recall having any concerns about any aspect of the contractors' work."

Then he refers to the Holmes report January 1990 and says, "I have referred above to this report. I have no knowledge of it and had not seen a copy of it prior to it being provided to me by counsel assisting the Commission."

Then turning to the north shear core he says, "The floor plan layout for the CTV building had a north core located abutting the northern face of the building.

The location of the entrance to the building on the north side ensured that the lift shafts' walls, toilets and main staircase were grouped on the north face of the building. It is standard design practice to group these elements together.

I have no recollection of receiving any instruction as to where the lifts/stairwells were to be located. Again, it was common design planning practice for a building of this gross floor area to locate the vertical access elements and toilets to one side. This is particularly so when the floor plate was of a size that did not efficiently permit a central core design such as the Price Waterhouse Centre or the Clarendon Tower.

The balance or distribution of any building's shear walls: their location, length, thickness, configuration, reinforcement and foundation design is solely the structural engineer's decision.

I cannot recall any discussion about the reasons for locating the north core shear wall in the position it was located, but that is not surprising because it was a common design practice to locate the core services in such a location. The principal reason for designing a non-central core building, I believe, is related to achieving a single open plan-type office space. The overall gross floor area of each floor is really much the same, whichever concept a client adopts.

The floor plan layout adopted for buildings of this type can be a functional collaboration between the client and/or a tenant, a structural engineer, a fire engineer (for example maximum lengths to exit ways) and the quantity surveyor. I cannot recall any discussion or consideration in relation to the CTV building about the location of the north core shear being driven by achieving maximum lettable space, a question posed to me by Mr Mills QC in his letter dated 27 March 2012.

Prior to designing the CTV building I had designed other buildings with the same configuration, namely a shear core outside the four walls of the building. For example, before the design of the CTV building I designed a multi-storey building at 123 Victoria Street which later became known as the Pacific Brands building. It had a two lift shaft and a main stairway configuration extending out from the south side and an opposing structural wall on the opposite northern face of the building. The northern face also had an external second exit stair.

In addition, I designed two three storey rectangular buildings near the corner of Victoria and Kilmore Street. The latter building was known as 161 Kilmore Street adjoining Riverlands House. Both of these buildings had projecting

lift/stair/toilet cores on one side and a structural wall on the opposing side of the building.

I cannot recall any discussion about the seismic performance of the CTV building. As a registered architect I have no knowledge or any design mandate to carry out structural engineering calculations. The seismic performance of a building is always for the structural engineers to calculate and determine. It is their specific field of expertise. Following the determination of the structural elements we would as architects then follow his design parameters/requirements and introduce these design requirements into the overall plans. As I have already noted architects generally and

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specifically for this project play no part in the structural calculations whether they be wind loading, dead or vertical loading or seismic loading.

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 and just as a formality I produce that evidence to the Commission.

MR KIRKLAND:

May it please the Commission, I have a brief opening which I have done in rather cryptic and short form. I hope that will give some structure to my opening, I'm going to speak to each of those paragraphs albeit briefly. Just before I do Sir, there have been letters posing questions by Mr Mills to Mr Harding. Those letters, answers have been given, by and large they are incorporated into Mr Harding's evidence so I'm not going to refer to those on a standalone basis. Also in opening Sir, Mr Harding like everyone else here is very anxious to get to the bottom of what has happened, the one point that I do agree with Mr Rennie from his opening, engineers do not design buildings that fall down and Mr Harding has indicated to me that he wishes to give a personal address at the end of his evidence and I'm not to be part of that.

So going back to my opening Sir, Mr Harding has provided two briefs of evidence, one that I've referred to as primary brief and two, his supplementary brief. In his supplementary brief he refers to the evidence of Mr Henry and I think it's pronounced Mr Strachan who was one of the draftsmen in Dr Reay's office at the time, and then in paragraph 2 I have provided these notes to the Commission.

JUSTICE COOPER:

We have them.

MR KIRKLAND:

Paragraph 2, Mr Harding will discuss his experience as an engineer in his early days following graduation at Hardy Anderson, that was 1973 to 1977. He will talk about the work that he did there, in the main domestic engineering work, low-rise buildings and then the second tranche, he moved across to Dr Reay's office that was in 1978 to 1998, 1980. Again Sir mainly domestic work and low-rise buildings and then his next tranche of work was with the Waimairi District Council 1980 to 1985. He will talk about what he was doing at the Waimairi District Council and in the main that was roundabouts, bridge maintenance and that type of work and it's my understanding Sir there's the distinction between structural engineering on the one hand and civil on the other. It was the latter that he was mainly involved with at the Waimairi District Council and the only structural work that he did was involved with a hydro slide at the Jelly Park complex here in Christchurch. Then he comes back to Dr Reay's office again, November 1985 through to November '88.

Three, Mr Harding will talk about following on from his early experience in making the distinction between structural and civil work, that he will proceed to give evidence in terms of the CTV building being his first high-rise building and he will also give evidence that when he came across to Dr Reay, apart from this being his first high-rise building, he had no experience at all with the ETABS system which I understand is a computer programme that analyses the structure when it is subject to dynamic loads in an earthquake as opposed

to the equivalent static method which Mr Harding also he did have evidence with, my understanding the system applying horizontal load Sir to a building. He will talk about his latter days at the Waimairi Council that Dr Reay asked if he would carry out some work prior to working his time out at the Council. I think from memory that was a Hospital Board building and Mr Harding's evidence he was able to undertake the calculations in respect of that building because he was able to do that using the equivalent static method. Mr Harding will then give evidence as to the draftsmen that were involved in the CTV building, a Mr Strachan and a Mr Horn. I think there is some dispute as to the involvement. Mr Harding's clear evidence will be that Mr Strachan was the draftsman who did most of the work on the CTV building as opposed to Mr Horn and I understand Mr Strachan was the lesser of the experienced men between the – himself and Mr Horn in terms of being draftsmen. Mr Harding will carry on his evidence and he will say that he was looking for Dr Reay for guidance, supervision and review. In particular he was leaving a Council where he was doing mainly civil work as opposed to structural work and he will refer to the Code of Ethics and his areas of competency and his evidence will be that his competency on a standalone basis was not at a level where he could have completed the CTV building if he was left to his own devices. He will refer in terms of specifically to the CTV building in terms of the code. It is his understanding of the code which I'll refer to as a document, the 1984 Standards Council, that on the basis that the CTV building was an irregular structure, more than four storeys high, those two factors caused it to be a building that required the ETABS programme and I understand an irregular structure is a building with torsional eccentricity and that will be that part of Mr Harding's evidence. He will then talk about office protocol in respect to the CTV building, there is a floor plan by Mr Smith who I understand from memory was a draftsman in the building. He will refer to that floor plan in terms of how the parties, the employees moved within the building, the dialogue with Dr Reay and the physical set out of that office plan in terms of parties being able to be heard. In his evidence at paragraph 4.1 to 4.3 inclusive there are a number of paragraphs that commence, "It was considered," "It was agreed," "It was determined." In putting questions to Mr

Harding, I will be asking him to expand on that in terms of, if I take the first one, "It was considered," it was considered by whom, who was involved in the consideration, and likewise for agreed and determined. I think those introductions to each of the relevant paragraphs need to be discussed in a bit more detail.

Moving to paragraph 5, Mr Harding will give evidence in respect to an instruction if I could call it that from Dr Reay to himself, that is to Mr Harding to have no contact with Mr Henry, who I understand was a, or he was an engineer in Dr Reay's office and effectively Mr Harding replaced Mr Henry. There will be reference to paragraphs 56 to 64 inclusive of Mr Henry's evidence which may give some explanation to the instruction that was given by Dr Reay to Mr Harding. My understanding briefly from those paragraphs were that Mr Henry's concern was about the proposed eccentric configuration of the shear walls and he discussed that matter with Professor Paulay and my understanding reading the documents that it was Professor Paulay's caution to minimise torsional resistance. Now Mr Harding's evidence will be that he had no knowledge whatsoever of the contact between Mr Henry and Professor Paulay.

Paragraph 6, there will be further evidence by Mr Harding in terms of
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discussions with Dr Reay throughout the CTV project, in particular the directions given from time to time by, by Dr Reay and there were discussions by way of example in terms of structural elements within the building, the Hibond steel tray versus pre-cast concrete floor, just one of the examples that will be, that will be brought out by Mr Harding.

At paragraph 7 Mr Harding's evidence will be that he had no contact at all throughout the CTV project with the owner of the building or the architect of the building. He had no involvement in respect to the preliminary calculations/concept of design and Mr Harding's evidence will be that Dr Reay gave him calculations and I understand these calculations were Mr Henry's

calculations for Landsborough House which was a former template and it'll be Mr Harding's evidence that effectively he was given these calculations and said, "Please use those as the template as you carry on through the design in terms of (a) the drawings and (b) the calculations in respect to the CTV building." I just interpose at this point and, and just say to the Commission with Mr Mills this morning he wished me, it was his preference and I think it's paragraphs 22 on, that's nine paragraphs from, which addresses the issue of permit, not in any detail, that we leave that over to the next section. It was my preference and I made that reasonably clear to Mr Mills that given the syntax that I wanted to keep with Mr Harding's evidence that those paragraphs will be read by Mr Harding and there will be reference to what I've referred to as the Tapper letter and the reason I want to do that, that's the letter of 27 August 1986, is there seems to be a lot of difference, there's no doubt about that in my mind, in terms of what Dr Reay has said so far, in terms of his evidence as to what Mr Harding is going to say and it's an unfortunate situation that we've found ourselves in but the Commission are going to be left, unfortunately there may well be issues of credibility that need to be determined but if that has to be done it has to be done and the first one that I point to is the notation which, 8.1, received a day or so after the letter was sent. This is a notation as I recall just below the top left-hand corner of the Tapper letter and Mr Harding is in no doubt whatsoever that that is Dr Reay's handwriting which leads to the next question. The letter sent or received a day or so after the letter sent. That letter sent does not seem to have found its way into the evidence from Dr Reay's records or from the Council records. That's my understanding. I can find no letter to dovetail that comment. There is a small note at the top right-hand of the Tapper letter. Mr Harding's evidence will be that in fact is his handwriting. Also Mr Harding will express some surprise there was no design certificate. This as I understand it in modern parlance is a producer statement whereby an engineer when sending a producer statement or in those days a design certificate off to the Council basically was certifying or undertaking to the Council that the engineer on reasonable grounds reasonably believed that the Council could rely on the calculations and the, and the drawings as complying with the code. So again Mr Harding is surprised and disappointed

that certificate is not in evidence but it's a document that just has not turned up.

JUSTICE COOPER:

Does he say that (1) there would have been one? Is that why he's surprised that it's not in the documents we have?

MR KIRKLAND:

He, he, he's surprised Sir. He, he says two things about that. He'll say, (1) that he's surprised that there was no design certificate and there should have been, but the second thing that he will say from his, my understanding of his evidence will be that it wasn't uncommon in those days because of the pressure on, on engineers to get their documents off to the Council knowing that there were going to be requisitions. Now that's a procedure, I've got my own views of that, and if that procedure was followed a design certificate would not be sent to the Council. In fact his evidence will go as far as to say that often design certificates in those days were held back until the client actually paid the bill. It was a tool that was used but in the perfect world a design certificate, for the very reasons that I have said, because it shows or says and certifies, or undertakes, that the engineer to his reasonable belief believes that these plans or drawings and calculations comply with the code. The letter that Mr Tapper, I've called it a requisitions letter, Mr Harding will, will discuss those requisitions.

JUSTICE COOPER:

But I understand all that but is Mr Harding saying that there was one or there wasn't one, because presumably he would have signed it?

MR KIRKLAND:

Or Dr Reay may have signed it Sir. He cannot recall whether there was one or not Sir.

JUSTICE COOPER:

Okay.

MR KIRKLAND:

At paragraph 9 there is reference to the Holmes report. This is the report by Mr Wilkinson, as I recall, in 1990. Mr Harding will discuss paragraph 6.3 of that report which I'll put to him. This is the discussion, the connections to the walls, in particular at the north face and the introduction of drag bars. I think I've also seen them referred to as drag ties. I think they're one and the same thing. And there'll be discussion over why they were left off floors 2 and 3. It is to be noted the Holmes' report is actually dated 1 January 1990. Mr Harding by this stage had left Dr Reay's office; and I just make the note there, the engineers in terms of scrutiny on, on this building as at 1990, we had Messrs Harding and Reay at the early stages of the design, Mr Tapper and Mr Bluck from the Council and now we've got Mr Wilkinson. It's my understand and Mr Wilkinson's report, that was a report for a prospective lessee of the building. He certainly makes the structural criticism if I can call it that in paragraph 6.3 but it's my understanding in reading the Holmes report there is no other structural criticism found in that report and there is no reference in particular to the columns within the building. At this point Sir in Mr Harding's evidence I'm going to, when I say move away from the referential, there's about 12 or so documents that I put on a schedule that you may have.

JUSTICE COOPER:

Yes we have that thank you.

MR KIRKLAND:

They're the only documents that I wish to refer to and then Mr Harding will continue with his evidence and discuss the Hyland report, in particular vertical acceleration. It's Mr Harding's view as I understand him Sir, in a nutshell, one, this building from his point of view did comply with the code and, secondly, that it was the, the phenomena of the vertical acceleration which he says was the, the dominant cause. Going back to September he says the

building was designed and it did exactly what it was designed to do in terms of the September earthquake which was, was one of horizontal acceleration. He will refer to his calculations, design issues and his brief conclusion on the standards in the code. At 13, this is moving now to Mr Harding's second brief, he will refer to the evidence in that brief of Mr Strachan and Mr Henry. There will be some duplication in respect to that because I would have addressed those paragraphs I've referred to in Mr Henry's evidence before I actually get 1040
to the second brief.

In paragraph 14 Mr Harding shall respond to Dr Priestley's best practice to state of current knowledge conclusions. Those are the short conclusions I think it's about seven or eight conclusions. Mr Harding wishes to respond to those. In particular he is of the view there is a contradiction or Dr Priestley is saying one thing at paragraph 44(h) where he says column failures tend to indicate failure at the top of the splices against in paragraph 83 the beam-column joint damage will be initially concentrated in the bottom region of the joint.

At 15, Professor Shepherd refers to vertical acceleration and Mr Harding wishes to pick up on what Professor Shepherd has to say and in particular I think it's Professor Shepherd refers to the vertical accelerations of one, I think it should be G, not KG from memory, compared to Mr Harding's evidence where the column capacity's reached at .65 G at vertical acceleration.

Then at paragraph 16, as I've referred to earlier on, there will be reference to the office layout, the physical office layout and how business was conducted on a day to day basis within the office.

At 17 Dr Reay, 17.1, supervision and review, and the transcript of 12 July 2012 there'll be reference to that and in particular I refer to my friend Mr Rennie's opening and page 70 from line 9 and I read this, "Dr Reay's evidence will be that he was not principally involved in the design of the

project." Mr Harding does not agree with that. It was a project undertaken by Mr David Harding, an experienced engineer. Mr Harding's evidence will be he was not an experienced engineer in (1) high-rise buildings or (2) as I've earlier said, using the ETABS system. This was his first high-rise building as defined by him, a building over four storeys who joined the practice with an interest in undertaking such work. He certainly had an interest in undertaking such work and in fact his evidence will be that when Dr Reay called him, he was keen to come over and have a second tranche of work with Dr Reay doing this type of work. Mr Harding was considered capable and was prepared to undertake the work. Dr Reay would have ensured the appropriate resources were available to assist Mr Harding. Mr Harding will agree in part with that but not completely. Dr Reay confirms that Mr Harding, a registered engineer was appropriately qualified in experience with the project. Unfortunately I have to say to the Commission Mr Harding refutes that allegation, or note in Mr Rennie's opening.

At pages 75 onwards, Mr Rennie says, "Finally Dr Reay produces time records from ARCE, from the time of the CTV building project which identifies the number of hours worked by various staff members on the job. The time records are that Dr Reay recorded 3.5 hours for the job and Mr Harding 304 hours. Mr Harding clearly disagrees with that. Unfortunately he doesn't have any contemporaneous records like time records to do so. His evidence will be that Dr Reay certainly spent a lot more time than 3.5 hours, and the converse applies there because if it's Dr Reay's intention to say basically that Mr Harding was a lone ranger I would have thought that those time records in fact tell against Dr Reay because as I've earlier stated (1) Mr Harding was simply not experienced in his evidence to carry out work on a building of this nature. In cross-examination of Dr Reay by Mr Elliott at page 131, one of the answers, "Yes, like other engineers every day and I look back and I think that if it was you know, and I look back and try and remember what the circumstances were at the time in my life when I was doing that, and well when I was running the firm because I do not accept my firm is ultimately responsible for the design should Harding have any shortcomings in his work." Mr Harding –

JUSTICE COOPER:

I do accept, you read I do not accept –

MR KIRKLAND:

Do not accept sorry.

JUSTICE COOPER:

Dr Reay's evidence was that I do accept.

MR KIRKLAND:

I do accept sorry, that my firm. At 18 Mr Harding Sir will make reference to the time records, for what use they will be to him but he will indicate as I've earlier stated. There is a memorandum Sir, I don't know if the Commission have that, it was provided to me a few days ago.

JUSTICE COOPER:

Yes I do have that. Whether my colleagues do or not I don't know. This is the schedule of other buildings on which Mr Harding worked.

MR KIRKLAND:

Yes, I think Dr Reay once again has found some time sheets that refers to five hours or thereabouts. Mr Harding will address that memorandum Sir. I don't have it in front of me but I think there was one building referred to –

JUSTICE COOPER:

This is a list of buildings with more than five hours work by Mr Harding.

MR KIRKLAND:

Correct Sir, starting at Broadway and finishing at the Montreal Street buildings, yes Sir. Mr Harding will talk to that document Sir, he will say that Westpac Tower for example, he did work on that but he certainly worked on that being an eccentric building, after the CTV building and he has no doubt in

his mind that the – that the CTV building was the first high-rise building he had worked on and – but he will speak to that document Sir and I will put it to him and lastly, at 18.3 from Dr Reay's briefs of evidence, that's briefs 1 and 3, there are certain paragraphs that I would wish to put to Mr Harding just for clarification. That by way of short opening Sir in short form, I now call Mr Harding Sir.

MR KIRKLAND CALLS

DAVID HARDING (SWORN)

Q. Your full name is David Harding?

A. Yes.

Q. Yes, and Mr Harding, you're an engineer, registered engineer practising in Christchurch. Is that correct?

A. Yes, the terminology's now chartered professional engineer.

Q. Thank you.

A. Used to be registered but they've changed the legislation.

Q. Thank you. Could you please read your evidence, your brief from paragraph 1 thank you.

A. Part of my evidence involves my professional opinion. I've read the Code of Conduct for expert witnesses. I agree to comply with that code.

Further in preparing this brief of evidence I have not read any brief of evidence already filed before the Commission.

I have deliberately from doing so on the basis of wishing to provide this brief of evidence from my own recollections of events, calculations and professional opinion.

Following the filing of my brief of evidence I shall read other relevant briefs. I propose to file a supplementary brief, if there is any point arising that should be addressed to assist the Commission.

From November 1985 to November 1988 I was an employee at Alan Reay Consultants, consulting engineers of Christchurch. At the early stage of this employment I worked on the structural design of the CTV building. I also later had a role in visiting the site during its construction.

Qualifications and experience - at that time my qualifications were

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Bachelor of Engineering (Civil) with Second Class Honours from Canterbury University dated the 1st of May 1973

Post-graduate Diploma in Business Administration from Canterbury University, 2nd of May 1984

Member of the Institute of Professional Engineers New Zealand, 25th November 1985 and became a registered engineer in May 1976.

My experience at that time was as a civil and structural engineer. After graduation I was employed by Hardie and Anderson Consulting Engineers, between February 1973 and 1977. Work at that firm included the design of domestic buildings and foundations, site levelling surveys, storm water design and structural design of single-storey factories, offices, warehouses and school buildings, structural strengthening of brick buildings and full-scale testing of fibreglass structures.

1978 to May 1980. I was employed by Alan Reay Consultants Limited between 1978 and May 1980 as a civil and structural engineer designing structural elements of residential buildings and single or two-storey industrial and commercial buildings particularly of pre-cast concrete construction. This also involved site-levelling surveys and site soils investigations for low-rise buildings. I left in May 1980 to gain experience in civil engineering.

5th of May 1980 to 22nd of November 1985. I was employed by the Waimairi District Council as their design engineer between 5th of May 1980 and 22nd of November 1985. This position was to run the design office and included responsibility for a traffic engineer, three civil engineering cadets and two draftsmen. The work included principally civil engineering including the design of roundabouts, the reconstruction or shape correction of district roads and the reconstruction or diversion of main roads such as Johns Road and Prestons Road. I carried out cost benefit analysis for the Northcote/New Brighton Expressway and designed the first stages between Mairehau High School and Travis Road.

I designed the landfill access road through Bottle Lake Forest and carried out preliminary designs and cost benefit studies for Fendalton Road four-laning.

There was some structural engineering related to the annual survey of bridges and the maintenance of bridges. I carried out preliminary investigations and then designed the Jellie Park Waterslide and associated platforms and swimming pools.

August 1985 to contact from Alan Reay Consultants Limited.

In about August 1985 I was offered an opportunity to return to Alan Reay Consultants Limited. 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 draftsmen previously employed by Holmes, Wood, Poole and Johnstone, particularly because of their experience in the design and drafting of such buildings. His current structural engineer, John Henry, was shortly 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 programme 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.

While I was working out my three months at Waimairi Alan rang me to see if I could reduce that notice period as it appeared that John Henry was leaving imminently and he was left short-staffed for current projects. These included a low-rise residential building for the Hospital Board. I was unable to shorten my notice at Waimairi but on enquiry of Alan it appeared that the proposed Hospital Board building was a regularly proportioned concrete masonry building which was relatively low-rise so it did not require a dynamic analysis using ETABS. Accordingly it was possible for that building to be designed using the equivalent static

method with which I was experienced. I offered to prepare the calculations for this building for him while I was working out my notice. This I did and I then forwarded by calculations to his office for his draftsmen to complete the structural drawings.

November 1985 – employment with Alan Reay Consultants Limited.

This second period of employment with the firm started in November 1985 and finished in November 1988. The nature of my responsibilities was initially the same as it had been during my earlier employment with the firm. Alan would have contact with the clients and with the architect and Alan would then determine the structural concept for the building and prepare preliminary calculations. At this time Alan decided which materials to use in the building construction, the location of major structural elements and the likely method of construction. After I was shown the preliminary drawings I would prepare the final structural calculations and provide information to the structural draftsman in order for them to complete their final drawings. These drawings were typically prepared to a standard format, in many cases using standard details which had been developed within the firm over time. Alan would decide which materials were to be used, such as concrete, structural steel or timber and if concrete which elements of the building were to be constructed with pre-cast concrete or in situ poured elements, the type of proprietary floor system to be used and whether a mobile crane or a tower crane was to be used to construct the building. He would also direct whether steel mesh or bar reinforcement were to be used in the wall panel construction.

Alan would have separate discussions with the structural draftsman and would specify the layout of the drawings and the purpose and extent of the drawings. This would vary between minimal drawings for regular design build clients with specific requirements, more extensive drawings for less regular clients and shop drawings for each element for other clients.

The draftsmen would prepare the carcase drawings and then I would provide information to them from my structural calculations. Alan would regularly look over the shoulder of the draftsmen during the drawing production and if he saw any structural details on the drawings which did not comply with his requirements then he would request changes accordingly from myself and the draftsman.

After completion of the drawings Alan would review them and present them to the client for approval prior to building permit application.

After building permit approval I would be involved in the site observation of the structural elements of the building construction. Typically I would visit the site prior to each concrete pour to inspect the reinforcement placement and after pours to view the concrete after form removal and to view the supply documents for the ready-mix concrete as supplied to site.

Toward the end of my employment after I'd built up relationships with some of the firm's clients and architects and had become more aware of the firm's standard procedures I had input to the preliminary design of structures. I worked for Tony Scott from Williams Construction who I'd met during the construction of the CTV building by carrying out the preliminary design of a number of buildings and I provided him with preliminary construction details to facilitate costing of other design build projects.

CTV Building.

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.

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 façade 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.

The features of the Contours building which were to be replicated included the services core arrangement where the core was to be located to the north of the main building and off-set away from the main building so that the service core walls were visually separate from the main building office areas. It also required the same façade details including the same diameter external columns, pre-cast concrete spandrel panels, glazing set back behind the

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perimeter columns and layout of internal columns. The CTV building would be higher and of different overall size but this would just involve more repetition of the same details.

It was considered that the shear core walls were too high to be constructed as precast concrete panels and that the shape of the building and its proximity to other buildings would make it impractical to construct using mobile cranes. Accordingly the shear core walls were to be constructed from in situ poured concrete and it was expected that the building would mainly be constructed using a tower crane.

Q. If I could just stop you there please Mr Harding. Just the introduction to paragraph 13, where you've said, “It was considered,” it was considered by whom?

A. Well it was Alan’s consideration, I mean he had previously designed a building at Aged People’s Welfare which he had been able to make that with precast concrete walls and he would have preferred to do that on this building but he believed that these walls would have been too high so that he asked for them to be made as in situ concrete.

Q. Was there discussion between you and him about that?

A. No, I had no experience with that. That was his instruction.

Q. Thank you, if you continue please.

A. It was agreed that the building could not be designed using the equivalent static method as it did not meet the criteria set out in NZS4203:1984 for the use of this method. As the building was more than four storeys high and had an irregular layout of walls, it was decided to design the building using the modal response spectra method using the ETABS computer programme.

Q. Again Mr Harding, the introduction to paragraph 14, where you've used the word, “It was agreed,” it was agreed between or among or with, whom?

A. No, Alan had decided that it – we would use the ETABS programme for that building.

Q. Can I please have the first document brought up. I can't read that, Mr Harding can you read that?

A. I've got the hard copy here.

JUSTICE COOPER:

We can make it bigger, which bit do you want to refer us to?

MR KIRKLAND:

Refer Sir to bottom right-hand corner, paragraph 3.4.71(c).

EXAMINATION CONTINUES: MR KIRKLAND

Q. Could you read that paragraph C please Mr Harding?

A. For irregular structures more than four storeys high, horizontal torsional effects shall be taken into account by the three-dimensional modal analysis of clause 3.5.2.2.2.

Q. It's your view that the ETABS programme was required for this building?

A. That's my belief. I believe that it was an irregular structure.

Q. Continue please at paragraph 15?

A. Alan was aware that I had not used ETABS before and that I was relying on him for guidance in the use of the programme and the resultant method of building design. Accordingly Alan provided me with a set of structural calculations and computer input and output sheets which had been prepared by his previous structural engineer, John Henry. These calculations were for a recently constructed building designed in Alan's office which was located at 287 Durham Street at the northwest corner of Durham Street and Gloucester Street. This is now referred to as Landsborough House. I was to use these calculations as a template, as a method template for modelling the CTV building on the computer.

These calculations appeared to be well set out and clearly done by a person experienced in multi-storey building design. The calculations for the gravity elements, seismic resisting elements and foundations were in separate sections and the assumptions which had been made in terms of the separation of gravity elements and seismic elements and the calculation of section properties were evident. The computer input sheets and the output files were in the form of concertina pattern continuous sheets. I do not recall seeing a set of drawings for Landsborough House and I was not expected to copy any details of the design of that building.

I recall no contact with the client or the architect during the design process. Alan told me that he did not want me to contact John Henry as I prepared my calculations but to ask Alan if I had any queries and to

keep him apprised of my progress with the design. I accepted this requirement and acted accordingly.

Q. Mr Harding, on reflection do you know why this direction was given to you by Dr Reay that there was to be no contact with Mr Henry?

A. No, I asked myself that question quite a few times immediately after I was given that instruction. I still don't know why, I understood it at the time perhaps to indicate that he had had some kind of disagreement with John Henry before John left, and that he didn't really want me to be contaminated by any of John's views I gather and that he wanted Alan to be the one, the sole director of how I should proceed.

Q. Can I have the next letters brought up please, it's HENRY15 to 21, starting at paragraph 56, could that please be brought into –

A. Do you want me to read that?

Q. Yes, if you could read that please, I think we're going to have – thank you Mr Harding?

A. "Before commencing detailed design and as part of my review for the concept design for the shear core structure for Landsborough House, I also sought an overview comment from Professor Paulay at the University of Canterbury. I remained concerned about the proposed eccentric configuration of the shear walls and I wanted his opinion on the fundamental configuration with regard to the eccentricity and possible torsional effects. I was not looking for a detailed review."

JUSTICE COOPER:

Just to make it clear this is paragraph 56 of Mr Henry's proposed evidence WIT.HENRY.0001 at page 15.

EXAMINATION CONTINUES: MR KIRKLAND

Q. If you could just carry on Mr Harding?

A. "I especially wanted Professor Paulay's opinion because I considered he was expert on torsional issues and building layout and reinforced concrete shear walls. I was aware from his lectures that in certain cases depending on the torsional stiffness of the whole system the

response of some structural configurations can cause unexpectedly poor performance once ductile yielding has commenced under earthquake loading. Ductile yielding of structural elements is a key factor in limiting earthquake forces in buildings, but although the earthquake load is limited, the deflection of the building is not. The energy dissipation occurs as a result of the building deflecting and at the same time yielding the reinforcement. The more yielding and displacement the more energy dissipation. The design codes utilised this aspect to dissipate seismic energy by controlled ductile yielding of the reinforcement in selected elements such as the base of the shear wall and diagonal reinforcing beams and coupled shear walls."

Q. If you could continue Mr Harding through to paragraph 63 inclusive, thank you.

A. Just got 57 in front of me here.

Q. Paragraph 58 now.

A. Sorry, it's not on the screen. "The 1984 design loadings code defined the ability of a structure to dissipate energy by yielding of the structural type factor. The commentary to the loadings code," this goes on for some time.

Q. If we could carry on from the word, "explains, that the S factor," if you could carry on from there please?

A. "…That the S factor takes into account the ability of the structural type to dissipate energy in a number of cycles '… on the assumption that the bulk of the chosen energy dissipation members in all the principal resisting elements, resisting elements of a given structural type will participate in the dissipation of seismic energy'."

Q. Fifty-nine.

A. "The structural type may refer to individual elements if they vary throughout the building or to the building as a whole if a uniform

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structural system is used. For uniform response and yielding of the building under earthquake loading, a uniform structural type in the direction of loading under consideration would be ideal. However it is

not always possible to have a uniform system. Combinations of structural types were common and the code made some provision for that.

"Clause C.3.4.2 of the commentary outlines a method for dealing with differing S values, but warns that as at 1984 this method was not fully researched and therefore should be used with prudence, particularly for buildings over three storeys high.

"Professor Paulay had mentioned in his lectures the example of a building with a wall on each end and otherwise little torsional resistance which could lead to the majority of the yielding occurring on one of the walls. I had a clear recollection of him saying this. The yielding demand is primarily made of the first wall to yield rather than being shared between the two walls. This becomes more pronounced if there is unequal stiffness between the two walls. I will come back to this issue but it is my opinion this example applies to the configuration of the north and south shear walls of the CTV building.

"Professor Paulay did not raise any such fundamental issues with regard to Landsborough House but he did comment on the eccentricity of the building and a possible loss in stiffness and consequent increase in deflections arising from cracking of the shear walls under earthquake loading. I was aware of this possibility and I had used reduced properties in the ETABS analysis to take account of the loss of stiffness due to cracking in the relevant structural elements. This was my normal practice but Professor Paulay still cautioned me about this issue.

"I discussed my concerns and Professor Paulay's caution with Alan Reay. He was dismissive of this aspect and we proceeded with the design. While I thought the design for Landsborough House was at the limit of acceptability, I believed that it met the code deflection requirements and as a result I accepted that the design would proceed."

Q. After reading those paragraphs Mr Harding and giving some thought to them does that now bring you to some sort of focus of the direction given by Dr Reay to you?

A. Well I still, I would've been very grateful to have had that discussion with John Henry, and certainly to be aware of Professor Paulay's concerns. I, Professor Paulay was a major influence on all of the engineers going through Canterbury University. He used to be a consulting engineer as well as having been a professor and an academic. He had a really good feeling for structures and any advice he would've given would've formed the basis of whatever you did. So I do not know why I wasn't given that advice. I can't explain it.

Q. At paragraph 14, the introduction to that paragraph, you've used the words "it was agreed". It was agreed between whom, among whom?

A. Paragraph 14?

Q. Yes? First line.

A. Well that was Alan's requirement but I mean I don't think there was any dispute about it but it was required to be used for that building. I fully agreed.

Q. Continue from paragraph fifteen please.

A. Alan was aware that I had not used ETABS before and that I was relying on him for guidance –

JUSTICE COOPER:

Q. I've got a feeling that you've read that certain –

A. Yes I have done that.

Q. I think –

A. 16 I think.

Q. Yes.

JUSTICE COOPER:

So and maybe the question that you've just asked, you intended to pose in relation to the commencement of paragraph 16 did you Mr Kirkland?

MR KIRKLAND:

I will pose that question after Mr Harding's read that paragraph Sir.

JUSTICE COOPER:

Very well, one behind Mr Harding, paragraph 16.

EXAMINATION CONTINUES: MR KIRKLAND

A. It was determined that the gravity elements and seismic resisting elements for the CTV building were to be separated in the same way as for the template calculations. The reinforced concrete walls would be designed to resist all lateral wind and earthquake loads and these would cantilever from a foundation beam. The circular columns were to be the same size as the Contours building and would be designed as gravity resisting elements only. They would be detailed in such a way that they were not to attract any significant lateral seismic shear loads. This appeared to be a sensible arrangement as the walls were to be made much stiffer than the round columns and this would avoid the complication of designing the floor beams and columns as ductile frames.

Q. Again Mr Harding the introduction to paragraph 16. You've used the words "it was determined" by whom?

A. That was Alan's requirement. That was his instruction.

Q. Was there any discussion between you and Dr Reay about that?

A. No. No I mean it's a system which he had used before. It was basically standard details to use precast concrete beams and to make the gravity elements separate, apparently, because he'd done it before and he believed it was a good system and required that to be used here.

Q. Paragraph 17.

A. The computer to be used was located at the University of Canterbury. This was at a time when the ETABS programme was too large to be run on a desktop computer. By removing the internal frames from the seismic model of the building the model became simpler and easier for the computer to manage. The calculated lateral sway of the building

would be calculated using the strength and stiffness of the wall elements only, without any assistance from the columns.

It was understood that the ETABS programme included the assumption that the cantilever walls were rigidly fixed at the ground level and the suspended floor diaphragms were rigid with no deformation within these diaphragms.

I recall a number of visits to the university to provide input data for the seismic analysis. I would leave my input data at the university where it would be loaded onto the university mainframe computer by the staff. About a week later I would pick up the output data sheets and return to the office to assess them. The main design criterion which was checked on each output run was the inter-storey deflection of the building under the most severe combination of design loading. This was to be kept below the limit in section 3.8.3 of NZS4203, which is equivalent to 0.83% of the inter-storey height. For the first computer runs I recall that the inter-storey deflection was excessive and I tried unsuccessfully to correct this by increasing the wall thickness.

Q. Just for the record, Mr Harding, the university you refer to is Canterbury University?

A. Yes.

Q. Paragraph 18.

A. I recall discussing this with Alan and I recommended that we should add an additional shear wall on the south face of the building to help to resist the torsional rotation of the building. Alan was concerned that a wall in this location was not present in the Contours building so the addition of this wall on the CTV building may not be acceptable to the client. I believe Alan then discussed this with the owner and the architect and it was agreed by them and relayed to me that this wall could be added if it were limited in size such that it would be concealed behind the external egress stair on the south wall. This required the south wall to be constructed as a coupled shear wall with holes in the centre of the wall

at each floor level to facilitate egress to the stair landings. This wall was added to the seismic model of the building and the wall thicknesses were again adjusted, including the additional south wall. By this means the building was made stiff enough to reduce the inter-storey deflection to below the limit set out in the building code.

Q. Mr Harding, in line 3 you say, "Alan was concerned that a wall in this location was not present." What were his concerns? His specific concerns?

A. Well I think the brief from the client, as I understand it, was that the building was to look like the Contours building and there are no walls like that on the Contours building. Obviously the intention was to comply with the brief as he'd been given it by the client and I guess to add walls in that situation would be seen as admitting that you couldn't provide the client with what he wanted, so he would prefer not to have something there.

Q. Is this a reference to the appearance of the building, the physical appearance of the building?

A. The physical appearance, but from the architect's point of view he doesn't want walls there that will (a) effect the look of it from the outside and (b) block of the view I guess from the office part of the building.

Q. Paragraph 19.

A. After the wall thickness had been so determined, the detailed design of the structural elements of the building was completed. This included the design of the reinforcement in the structure.

At this time I do not recall the existence of a block wall on the west boundary. This may have

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been added later in the design after it became evident that a fire rated wall was required on that side of the building. The western block wall was to be designed as a non-structural partition which would be isolated from the floor diaphragm at the top of the wall within each storey.

The structural draftsmen would have prepared carcase drawings for the building according to directions from Alan and based on their earlier experience with drawing multi-storey buildings. I would have provided details of reinforcement in order to complete the drawings. Alan would regularly visit the draftsmen 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.

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.

Q. I'll stop you there Mr Harding. If we could go to the last of Mr Henry's documents. I think it's paragraph 81. Could you please read that paragraph Mr Harding?

A. "I resigned after about one year of working at ARCL. During my time with Alan Reay I found that he preferred to work as the principal consultant with other design disciplines such as architects being engaged by him. He exercised tight control of the office and was very much in charge of the projects. I found that I was essentially relegated to the role of back room structural designer with my role limited to technical design and production of documents."

Q. If I could just stop you there Mr Harding. Was your role in the office similar to that as described by Mr Henry?

A. I couldn't have described it better.

Q. Paragraph 22.

A. The documents required for the building permit application were prepared by various people in the office. Normally the draftsmen would

prepare the drawings and I would prepare the structural calculations. Alan would normally complete the design certificate as the principal of the firm.

Any correspondence from the Christchurch City Council would normally be viewed by Alan upon receipt and then referred to me or to the draftsmen for action. If there was any contentious element then Alan may become involved but otherwise the drawings or calculations would be amended to comply with City Council requirements.

I do not recall discussions with the City Council on the CTV project. I've recently read the letter received from Mr Tapper dated 27 August 1986. I do not recall answering this letter myself but it appears to be typical of the kind of letter which is expected from the structural checking engineer. If I had replied to the letter I expect that I would have prepared a written reply but I have not seen such a letter at this time. I expect that all of Mr Tapper's requests would have been complied with. Mr Tapper was an experienced and thorough engineer with a good eye for detail. He had assessed drawings for many office designs. He would not have approved any documents which had an omission or contained a detail which he was not satisfied with. My normal reaction would be to welcome his ability to note such details and to amend them accordingly.

Q. Mr Harding if we can take you to Mr Tapper's letter of 27 August 1986. It's the next document on the schedule. Read that document. Mr Harding. You've got it as I've described it the Tapper letter in front of you?

A. Yeah.

Q. The top right-hand corner of that letter is the numbers 2503 and it looks like received 1 July 86. Whose handwriting is that?

A. Well it may well be mine, it looks like mine. I can't be sure though.

Q. And on the left side of the document, a third of the way down there's handwriting, 'received a day or so after letter sent'.

A. Yeah.

Q. Whose handwriting is that?

A. That's Alan Reay's.

Q. Are you absolutely certain about that?

A. Yes.

Q. Have you found any corresponding letter that you can match with what's said in that handwriting?

A. I haven't been asked to do that actually but I haven't really looked. I may be able to find some.

Q. And the Tapper letter Mr Harding is a what, a form of requisition from the local authority?

A. Yes, what's happened, the consent drawings or building permit drawings have gone to the Council and he's noted a number of things where the drawings were incomplete and he's asked for additional details.

Q. In your opinion Mr Harding the details that Mr Tapper has called for, are in the ordinary course, nothing out of the ordinary?

A. Well the impression I get reading the letter is that the drawings may not have been complete drawings when they were submitted for the consent. Some of the things which they are asking for, particularly on the next page I think, are things which would normally expect to be on the drawings at the time they were submitted, so I get the feeling that they were, the drawings were whipped out from under the draftsman's pen and submitted to the Council in order to shorten the period taken to get the building consent and be able to start the building, so that while the Council was processing the consent, the drawings would be proceeding to completion in parallel.

Q. And on page 2 and particularly referring to sheets 15 and 16.

A. Yes, well that's again, those are details which look as if they hadn't been added to the drawings at that time. It refers to reinforcing and spandrels and fixings and various things which normally Wayne Strachan would not have allowed – he would normally have all that detail on the drawings.

Q. In effect Mr Harding, is the firm calling on the Council to be the back-up system or the checking system?

A. Well it's hard to say. I mean this is something that goes through on every job. The Council always checks every job before it is – whether that's the only reliance I don't know. I expect that Alan would normally review the drawings before they go to the Council but I can't ...

Q. And following that review Mr Harding would they be accompanied with the design certificate?

A. Yes, normally the Council wouldn't give you a building consent or building permit unless they had a design certificate. They would require at least the drawings. In those days they didn't always ask for the calculations, but where they were concerned they would ask for calculations for specific things, but normally they wouldn't give a building permit until they had the design certificate.

Q. And has it come as a surprise to you that no design certificate has been uncovered?

A. Well yeah, I would imagine that if the drawings were being submitted for a building permit, on incomplete drawings, then you would not issue a design certificate with those incomplete drawings so it wouldn't surprise me that, in that situation that the incomplete drawings were submitted without a design certificate. That would be quite normal.

Q. And any other reasons for not submitting a design certificate?

A. I can't think of any reason, I mean normally once those items had been completed if a design certificate hadn't been provided there'd be a follow-up letter from the Council requiring that before they would get the building permit.

JUSTICE COOPER:

Q. You I take it don't really remember receiving this letter?

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A. No Sir.

Q. There's a sentence in the, on the first page at the end of the first full paragraph which says, "There's no indication on the plans that they

have been checked and approved for issue and construction." What do you take from that sentence?

A. Well again I, it confirms my feeling that at the time they were sent to the Council for the permit they weren't complete. Again, at the bottom of each drawing there's a space where the drawings are to be signed by the designer and sometimes by the person who checks the design and there's no way I would have signed any drawings if they weren't complete. So if they'd been submitted to the Council in advance of being complete in order to speed things up they would not have been signed and I think Mr Tapper probably picked up on that.

Q. We've seen plans which, which appear to have your initials on them under the word "approved." For example, if we look at BUI.MAD249.0284.14 and if you could just blow up the box at the bottom right-hand corner.

A. Yeah, my signature, my initials where it says approved.

Q. Approved.

A. Yes.

Q. The Council's letter that we've been looking at just a moment ago talks about them being an indication that the plans had been checked as well but there doesn't appear to be any space for that to be indicated on the, on the, on these plans.

A. No.

Q. Which I, I wonder if it was standard practice for such checking to occur, how would it be noted on a plan like this?

A. At that time it probably wasn't noted. Before the days of –

Q. Well why would the, can you explain why Mr Tapper would be seeking an indication that that had occurred then?

A. No what, what I'm suggesting is that the initial drawings which I expect were submitted for the building consent in the first instance prior to him producing that letter –

Q. Yes.

A. – would not have had any initials in that box where it says approved.

Q. Yes.

A. That would have been blank. That would have given Mr Tapper the indication that they weren't completed drawings. So I'm suggesting –

Q. So when the box approved is signed with your initials that is all the indication that the Council would receive that the, that there had been a design and checking process. Is that what you're saying?

A. Well yes that's, that's an indication that the engineer who's designed it believes that that drawing is complete. So I suspect that what may have happened was there was an initial set of drawings which was submitted to the Council which were obviously incomplete, not only that it didn't have the signature but it didn't, obviously left out certain details. So that, that was no doubt remedied and I think that was the follow-up letter of the document transfer form which has been produced.

Q. Yes.

A. And at that time I'm assuming that the drawings would have been completed and initialled and reviewed and that they would have then been accepted by the City Council.

Q. Reviewed by whom?

A. Well normally by Alan but that's not indicative on the drawings. Normally the process is before any completed drawings leave the office Alan checks them.

Q. That's your memory of the normal process but you're not telling us that happened in the case of this building?

A. I believe that happened in this building. Alan was –

Q. Why do you believe it?

A. Because that was very much Alan's procedure. He, he was very much in control of everything that happened in the office.

HEARING ADJOURNS: 11.35 AM

HEARING RESUMES: 11.50 AM

EXAMINATION CONTINUES: MR KIRKLAND

Q. I'll just ask for the document that you called for to be brought up again Sir. The bottom corner again please. Now Mr Harding just carrying on from the questions His Honour put to you, the date at the bottom of this document with your initials is August 1985?

A. '86 I think.

Q. '86 sorry, '86 and I'll come to the next document which is the document transfer form but that is signed by you and it's dated 5 September 1986. That's before you now?

A. Yep.

Q. My first question: is that document in response to Mr Tapper's requisitions?

A. It does appear so, yes.

Q. Is that in your handwriting?

A. Yes.

Q. And under item (1) file 2503, third line, where you've got the words, "Including amendments as requested –"

A. Yep.

Q. Is that the amendments, or being the answers to Mr Tapper's requisitions?

A. I would hope it would include those. There may have been other amendments or other requests as well by that date. I, I don't know but that appears to be the, the drawings which were submitted at that time. I mean I don't know how many times it was resubmitted.

Q. And if I could just go back to the, the earlier slide please and, and the bottom right-hand corner please. That document pre-dates the document transfer form Mr Harding and my question is your initials are under the word "approved". I just want to be clear on the office practice of sending documents over to the Council with the word "approved" initialled.

A. When you say pre-dates, that's approved by the Council on the 30th of September which is after the date of the document transfer.

Q. That was my next question, thank you, you've answered it. Thank you.

A. Yeah the date which is on the drawing is the date when the draftsman started to draw that sheet. So it could be well in advance of when it was submitted to the Council.

Q. Thank you, you've answered my question. Go back to your evidence now please Mr Harding. I think we are starting at paragraph 25.

A. I have been asked if I recall any contact with Bryan Bluck of the City Council at this time. I do not. In any case Bryan would not have short-cut Graeme Tapper by talking to me directly. As I recall Brian was more involved with policy than details of specific building permits. I cannot remember talking to Bryan Bluck about detailed design on any project I've done.

In specific regard to the floor connection to the wall system it appears that the connection of the pre-cast beams to the ends of the shear walls and the provision of slab ties between the walls and the mesh reinforcement were accepted by Graeme Tapper as an accepted connection.

At that time mesh was an accepted form of floor reinforcement. In this case the steel Hibond decking would have contributed additional strength to the floor diaphragm. It was effectively made continuous by the use of saddle-bar reinforcement over the pre-cast beams.

The remark in Mr Tapper's letter about the restraint of the Hibond refers to his concern regarding the fire rating of the floor system. The floors were required to have a 1.5 hour fire rating between the floors. Where the floor is to be constructed with a Hibond steel tray system there's concern that the floor is exposed to a fire from below.

If no other measures are taken then the heat of a fire could cause the Hibond to overheat so that the steel loses strength leading to failure of the floor due to the fire. In order for the floor system to have the required one and a half hour fire rating, one option is to longitudinally

restrain the Hibond so that it can support load by membrane action. Clearly that was not possible in this case as the steel is cast into the side of a concrete beam using end caps to avoid grout loss and without continuity of the Hibond through the beam. This appears to be the concern Mr Tapper has.

A second alternative for fire rating the floor is to coat the underside of the floor with an insulating layer which may be a specialised sprayed coating or an additional ceiling made of fire resistant material. This option was not preferred in this case.

A third option which was chosen for the CTV building was to provide fire emergency reinforcement in the floor in addition to the Hibond and the mesh. This reinforcement is located within the concrete floor above the level of the Hibond at such a depth that it is insulated from the heat of the fire by a suitable thickness of concrete. In this case if the fire should weaken the exposed Hibond then the mid-span tension loads would be carried by the fire emergency reinforcement and the floor would retain sufficient strength and integrity to be able to support a reduced loading for the required fire rating period. The provision of this reinforcement appears to have been accepted by Mr Tapper at the building permit stage.

The letter to Williams Construction dated 19 of August 1987 advises Williams Construction of the agreement that had been reached between the City Council and Alan Reay Consultants at the time of the building permit application with regard to the method chosen to fire rate the floor. It appears that Mr Bluck thought we were using the first alternative described to fire rate the floor when we were actually using the third alternative. I appear to have met with Mr Tapper in August 1987 to confirm that my understanding of the building permit correspondence was correct.

Williams Construction.

The first time I met the agents of Williams Construction was at the beginning of the building construction. At that time I met the site foreman, the quantity surveyor Tony Scott and the construction manager Gerald Shirtcliff.

Prior to each pour of concrete the site foreman would have advised me and I would have visited the site in order to inspect the reinforcement placement and the form work construction. I would also have inspected the concrete supply dockets from previous pours to confirm that the specified strength of concrete had been supplied to the site. The practice was that a handwritten record of each site visit would be left on site. This would record any instructions to the builder for remedial action and may request of authorise variations to the building contract. A carbon copy of such instructions was then returned to the engineer's office where it was typed and distributed to affected parties.

For this project I was requested by the builder to design a base for the tower crane which was to be used on the site in order to construct the building.

After the CTV building was constructed I had no further involvement with it while employed at Alan Reay Consultants Limited. I left the firm in November 1988. My only involvement after I left was a telephone call from Alan in about 1990 to say that the building had been peer reviewed by another engineer as part of due diligence prior to leasing. This report had queried the connection of the building to the shear core. Alan asked me if I had authorised the inclusion of any additional reinforcement such as drag bars during the building construction. I replied that I could not recall having requested anything additional. I had no further contact with Alan and no contact with Geoff Banks or the reviewing engineering.

Q. If I can just stop you there please Mr Harding. If we could bring up the Holmes report please and that schedule. Could you please read out paragraph 6.3 of that report Mr Harding.

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A. "Resistance, lateral load resistance.

Resistance to lateral loads is via reinforced concrete shear walls. The shear walls themselves appear to have been generally well designed to the requirements of the correct design loading and materials codes. The building was apparently analysed using the three-dimensional computer analysis programme checked by a static hand analysis.

"An area of concern however has been discovered in the connection of the structural floor diaphragm to the shear walls. While this is not a concern on the coupled shear wall to the south of the building, connections to the walls at the north face of the building are tenuous due to penetrations for services, lift shafts and the stairs as detailed on the drawings.

"The result of this would be that in the event of an earthquake the building would effectively separate from the shear walls well before the shear walls themselves reached their full design strength."

Q. My understanding Mr Harding of this paragraph is referring to drag bars or drag ties. Is that correct?

A. Well I think it proposes drag bars as a recommended improvement. It doesn't specify them as such. It just basically says that I think two of the four walls haven't got a very good connection between the floor slab and the walls.

Q. And your thoughts on that matter?

A. I agree that it could be improved. I don't – I don't agree that the connections are tenuous, I think he may not have quite looked at the drawings properly to see how the beams and the reinforcement in the beams and the reinforcement in the two strongest walls was detailed but for two of the four walls in the north-south direction, drag bars would be a good way to improve that connection.

Q. And following this report I understand with Mr Banks' assistance you had gone to Dr Reay by now, that drag bars were included in the structure in floors, or on floors 5 and 6. Is that correct?

A. I believe so. I've – I'm only just going from the evidence I've read.

Q. And can you comment on why drag bars would not be inserted on the lower floors?

A. No I can only assume that was an agreement made between Grant Wilkinson and Geoff Banks as to what was required in order to satisfy Grant Wilkinson's concerns, but I can't comment as to why it wasn't done at all for all levels. I mean the floor levels are very similar and I would have thought if you'd done it at one level you'd have done it at all levels.

Q. Right. And you've read the Holmes report?

A. Yes.

Q. Is there anything else in that report that was of concern to you or any criticism of the drawings?

A. No I couldn't see anything else. They made no comment about the columns.

Q. Thank you Mr Harding, if we can go back to paragraph 35 please?

A. Hyland report

Description of CTV building.

I generally agree with the description of the building in the Hyland report.

On page 43 the internal beams are referred to as moment resisting frames. I would not call the internal beams moment resisting frames. The beams were designed to be continuous beams and as such were designed to be moment resisting only between adjacent beams for gravity loading. The columns were not intended to be part of a moment resisting frame and the ends of the columns were designed as pin joints. Consequently the beam column joints were not designed to carry any bending moment from the columns, and any contribution which these

columns may make towards the building lateral stiffness was not relied upon.

On page 46 the construction of the concrete masonry wall on the west boundary is speculated upon. I do recall that the top course of this wall was left unfilled during construction. While the builder was constructing the wall below an existing beam in the floor above, he noted that it would be practically difficult to fill the top course of the masonry.

The wall was being constructed from the inside of the building as access to the outside was restricted by the presence of a neighbouring building. I consider it unlikely that the outside of the vertical isolation joint could have been filled with mortar at that time. This joint may have been filled from the outside at a later date after the adjacent wall was removed, as it may then have become a waterproofing issue for this building.

I have no knowledge of any works carried out after the construction of the building.

Section 8 collapse scenario evaluation.

On page 88 it is acknowledged that other collapse scenarios to the four postulated in the report cannot be discounted. I believe that the scenarios in the report make insufficient acknowledgement of the effects of vertical acceleration on the building.

Vertical acceleration

The report acknowledges on page 92 that the vertical ground accelerations may have increased the axial loads on the columns and thereby reduce the column drift capacity. I believe this is the key to why the building failed as it did.

A photograph taken by Ross Becker through a window of the adjacent IRD building shows books stacked up on steel trestle tables.

Q. Is that the photo you referred to Mr Harding?

A. Yes, that's one of them. He's taken a number of photos and that's one of them.

Q. Thank you.

A. Most of the books are still sitting on the tables after the earthquake as it appears that the lateral design forces have not been sufficient to dislodge them. However the tables have a major sag in the middle as if the books have at some time tripled in weight. This shows the effect of vertical acceleration and it shows that this site was subject to very high levels of vertical acceleration.

The loadings code of the day NZS4203:1984 makes no provision for vertical accelerations on a building. The commentary to the code states at page 17:

"Although significant vertical acceleration components of ground motions have been recorded during earthquakes, for example .2 to .3 G in the San Fernando earthquake, no vertical acceleration load terms have been included in the design loads of this standard except for parts such as horizontal cantilevers and anchorage of machinery because there is at present no certainty about the damage potential or combined dynamic effects."

The design loadings for Christchurch in NZS4203:1984 appear to be predicated on an earthquake epicentre, maybe 100 kilometres away and maybe six kilometres deep. The radiated seismic energy arrives at the site close to horizontal and causes predominantly horizontal shaking. The vertical component of the ground acceleration is relatively small and is insignificant compared to the vertical live loading the building is designed for. Consequently this is not normally a critical case that will determine a building's design. However for the Christchurch earthquake in February 2011, the epicentre was about 8 kilometres away and 6 kilometres deep. It can be expected that the vertical acceleration will be of similar magnitude to the horizontal acceleration. The vertical

acceleration will be highest closest to the epicentre and certainly the CTV building is closer to the epicentre than the three centres at which records are used for the Hyland report.

The magnitude of vertical accelerations at various sites in Christchurch are described in a report titled 'Near Source Strong Ground Motions observed in the 22 February 2011 Christchurch earthquake," by Brendon Bradley and Misko Cubrinovski.

Table 1 shows peak ground accelerations at the CCCC and the CHHC sites which were both used in the Hyland report page 233. These show vertical accelerations of .79 G and .62 G respectively. These are nearly double the horizontal accelerations at each site. The closest site to the west which is not in the Hyland report is the Pages Road Pumping Station, PRPC. This recorded a vertical acceleration of 1.88 G or three times the horizontal acceleration at that site.

The report at page 193 states that:
"the ratio between vertical and horizontal ground motion amplitude is strongly dependent on source to site distance and weakly dependent on source magnitude or faulting style."

In hindsight the structural design of the CTV building was vulnerable to the effects of severe vertical acceleration. The floors are relatively heavy weighing four KPA. The live load which the building was designed for is 2.5 KPA, but for the cumulative effect of large areas on many floors, this load is reduced to close to 1.25 KPA due to the low probability that all floors will be fully loaded at the same time.

The effects of vertical acceleration not only act on the mass of the building itself, but also on the live load or building contents. A 1g vertical

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acceleration doubles the load on a column and a 2 g acceleration trebles it.

The following calculation illustrates the effect of vertical acceleration on a typical internal column on lines 2 and 3.

The loads on the internal columns on lines 2 and 3 are derived from the figures in the design calculations, pages G36 to G39 as set out below at ground floor level.

So what that's saying is the dead load of the building is 1522 kilonewtons, the reduced live load is 352. So you add those two together and that gives you the total unfactored load of 1874 kilonewtons which that column was designed for. Now for the code at that time you use load factors of 1.4 times the dead load and 1.7 times the live load to get the ultimate design load on the column. So 1.4 times 1522 and 1.7 times 352 added together gives you 2729. And the capacity of the column, as it was designed, was 3100 kilonewtons which is obviously above the 2729.

The actual loads on this column with the associated vertical acceleration was below. So basically with a 0.65 g vertical acceleration you magnify the unfactored loads of 1874 by 1.65 you get 3100. So what that's saying is with 0.65 g vertical acceleration those internal columns have reached their capacity. Now at the CCCC site, as per that column, the vertical acceleration was 0.79 g which meant that the column axial load was 3354 which is obviously a lot higher than the 3100. If it had been higher than that, if it had for example been the same as the PRPC the Pages Road Pumping Station, at that point it was 1.88 g vertical acceleration which would've given an axial load on the column of 5397 kilonewtons which is double the design load on the column and well above its capacity.

So it's noted that the column capacity with no drift is reached with 0.65 g vertical acceleration. The axial loads induced by the vertical accelerations recorded at two strong motion stations adjacent are shown to be well above this figure and are high enough to initiate column failure.

It's accepted that the actual column capacity will be lower than the figure shown, where the concrete strength is less than specified and may also be lower if there's drift up to the code specified limit.

Other columns in the building will have a similar factor of safety in their design as the column diameter is the same throughout the building, being limited to 400 millimetres diameter by architectural considerations. The concrete covers are limited by durability concerns for the exposed columns. At the time of design the concrete strengths were adjusted to match the design loading by adjusting the concrete strength and the vertical column reinforcement. These figures in the 1982 concrete code are independent of the transverse reinforcement in the columns.

Consequently it's possible that failure could've been initiated at any level as the design factors of safety were similar. If one particular floor level had been affected by a bad batch of concrete, then all columns at that level poured at the same time would've been affected, and that's the level at which failure may have been initiated. Once one floor failed then the floors would've pancaked and affected all floors leading to vertical collapse of the floors, the south wall falling into the middle and the floors rotating away from the lift shaft.

As stated on page 88 of the Hyland report the four collapse scenarios are postulated with a common thread, that collapse of an internal column triggers progressive collapse. The investigation then seeks to find capacity issues within the building which support these scenarios.

To be sustainable, these scenarios require that the building did collapse progressively. They also appear to require that the building may have prematurely separated from the shear core. That the south face of the building suffered excessive sway in the east-west direction, and that the spandrel panels interacted with the columns to increase the ductility demand on the columns.

With regard to the progressive collapse, the overriding common thread among the eyewitnesses in the Hyland report is that the collapse happened quickly. It appears to have been a sudden collapse rather than a progressive one. Many witnesses referred to a bolt upwards at first which is a manifestation of upwards vertical acceleration. The reported sensations are in my view consistent with vertical acceleration effects overloading all of the columns on one storey at a similar time causing sudden and rapid collapse rather than a progressive collapse, but with one side of the floor holding up on the connection to the shear core.

In regard to the separation of the floors from the shear core, it appears from the description of the building debris, as set out in the Hyland report on page 89, that the slab connection did not fail prematurely. To quote that report:

"Review of the physical collapse evidence indicated that failure may not have occurred at the drag bar connections to the north core at levels 4, 5 and 6 prior to slab pulling away. The slabs at levels 3 and 4 were seen to have hung up on the north core with their line 3 ends resting on the ground after the collapse, as seen in figure 95. This would not be expected to have occurred if they had first lost their support adjacent to the north core. It was therefore concluded that the slab failures observed at levels 4, 5 and 6 had most likely occurred due to the floors losing their support along lines 2 and 3 as those columns collapsed."

On page 264 it's noted that the slab appeared to rotate downwards and prying the drag bars off the wall. This failure is more consistent with vertical acceleration affecting the internal columns.

With regard to the excessive sway of the south wall in an east-west direction, witness 6 had the impression that the building moved in that direction. The overriding consensus appears to be that it just went in on itself, collapsing vertically within its own footprint. Witness 12 in the Hyland report reported that the façade of the building appeared to come off prior to the collapse. This is consistent with the spandrel panels separating from the building due to vertical accelerations and then rotating outward from the edge of the floor slab. This may have been closely followed by failure of the columns at once, also due to the vertical acceleration.

If it is accepted that the western block wall was in fact isolated effectively from the structure during construction, then the torsional eccentricity of the building for a north-south earthquake is relatively small. For an east-west earthquake the torsional loads on the building are resistive substantially by the northern east-west wall of the shear core and the coupled wall on the south face. Given the disparity and stiffness of the two walls it would be expected that if there had been significant east-west sway, then the south wall would've moved the most and that there would've been significant damage to the coupling beams in that south wall.

However, as noted on page 78 of the Hyland report, there was very little cracking of the coupling beams. Not the extensive cracking that would be expected. This would indicate that the south wall was performing its function of restricting the lateral east-west sway and was providing adequate lateral support to the gravity columns. The failure condition of the south wall is consistent with it being dragged down and inwards by

the floor slabs following failure of the internal columns due to vertical acceleration.

With regard to the effect of the spandrel panels coming into contact with the columns and reducing the effective length of the columns, this appears to be speculation based on the acceptable construction tolerances as set out in the concrete construction code. There appears to me little evidence to support this theory. The cracks in the south wall columns which were reported in the September earthquake damage report in appendix K were not linked to contact with the spandrel. It would've been evident to the inspecting engineer at that time if they had been linked.

The method used to construct the building was such that the columns were constructed first, and then the spandrel panels were site measured to fit between the columns as built. Where the contractors expected to manoeuvre a large, wide and heavy precast element into place between two rigid columns, where the operators at the top of a tower crane and probably unsighted of the location of his load, then the contractor's going to make sure he had more tolerance available to him not less. He would've site measured the gap between the columns and would've constructed the length of the spandrel panels accordingly. It was known during construction that a gap of up to 16 millimetres wide each side between the column and the spandrel beams, spandrel panels, could be filled by a fire rated sealant which would still maintain the fire resistance of the

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completed spandrel construction. The builder would have used all of this tolerance and would have located the spandrel centrally between the columns with an equal gap each side. There was no reason for him to leave a small gap on either side as that gap would then be impractical to seal and make weather proof.

Design Issues.

In section 9 a number of issues are raised in terms of the compliance of the building which are discussed as follows.

Building Inter-storey Drift Limits.

The building was required by NZS 4203:1984 to comply with a drift limit of .83% of the inter-storey height. The building did comply with this requirement as set out in the structural calculations provided on pages S15 and S18. This is accepted in the Hyland Report in Appendix F.

JUSTICE COOPER:

Q. S16?

A. S16?

Q. You read 18.

A. Sorry S16. My apologies.

Q. "It is inferred."

A. It is inferred in the Hyland Report that closer tolerances on drift are required by the commentary clauses to NZS 4203 for secondary frames. It was considered at the time of design that the commentary clauses were not mandatory and that in any case the internal beams were not designed to be moment resisting frames and they were designed accordingly.

Drift Capacity of Columns.

The drift limit for the building as required by the code was achieved due to the strength and stiffness of the wall elements and with no contribution from any concrete frames. The internal beams are not considered to be frames, rather continuous beams with simple props below. So detailing as for a frame is not required. If this building had been similarly constructed using structural steel rather than concrete the columns would have been fixed with a simple bolted connection. In this case the bottom bars in the beams were made discontinuous and shear

reinforcement in the beam column joints was omitted to achieve the same purpose.

Minimum Shear Capacity of Columns.

As previously noted the columns were designed to be pin-ended with no contribution to the horizontal shear capacity of the building. Accordingly shear reinforcement was not considered to be necessary.

Spandrel Panel Separation.

There is no evidence that adequate separation between the columns and the spandrels was not provided. It is noted on page 110 of the Hyland Report that a minimum gap of seven millimetres would have been required. The specified gap was 10 millimetres and the most likely construction gap would have been closer to 16 millimetres on both sides of the columns.

Beam Column Joints.

The internal supports are not considered to be moment resisting frames. Accordingly, reinforcement of the beam column joints to provide moment resistance is not required. The horizontal reinforcement at the top of the floor beams is continuous through the beam column joints which would have ensured that the beams could not become separated from the columns.

Plan Asymmetry and Vertical Irregularity.

The then building code, NZS 4203 provided limits on plan irregularity insofar that a building may not be designed by the equivalent static method if certain regularity criteria are not met. If a building exceeds those criteria then it shall be designed by another method such as the modal response spectrum analysis. Accordingly, the building was designed by the modal response spectrum analysis using the ETABS programme.

The internal lines of support were not considered to be secondary moment resisting frames and were not included in the seismic analysis.

EXAMINATION CONTINUES: MR KIRKLAND

Q. If I could just stop you there Mr Hardie, Mr Harding just to be clear in terms of if the building exceeds those criteria. Is that the criteria earlier referred to where (a) a building is irregular and (b) it's over four storeys?

A. Yes.

Q. Thank you. Continue.

A. Wall on Line A.

The top course of these walls was seismically separated from the floors above. It's accepted that this requirement was not adequately shown on the drawings but this factor was rectified on site and the walls were constructed in accordance with the design assumptions. With regard to the existence of mortar in one of the vertical construction joints rather than flexible sealant it's been explained that the outside face was inaccessible during construction so it would have been difficult to provide flexible sealant in that position at that time. There was no structural connection between the masonry wall and the previously poured column such as by horizontal reinforcement. Vertically placed mortar on the far face of the wall would have been very weak and it's not expected that it would have made a significant connection between the two elements.

Diaphragm Connection.

The floor diaphragm was connected to the shear wall in the core in a number of ways. Three of the pre-cast beams on line 4 are built into the end of two outstanding walls. The four bottom bars in each beam pass between the vertical bars and the ends of the shear walls and the four top bars also pass through continuously through the joints. There are a number of slab ties cast into the face of the shear walls which lap with the mesh in the topping.

The steel Hibond tray decking forms an effective floor diaphragm as it is well-restrained against buckling by the adjacent concrete. Where the Hibond is discontinuous at the pre-cast beams there are additional saddle bars over the beams which provide effective continuity. There's fire emergency reinforcement in the Hibond trays as well as mesh throughout the floor.

The beams on the perimeter of the building were constructed with exposed stirrups and the mesh in the floor was effectively lapped with that reinforcement prior to pouring the topping.

It's accepted that current best practice recommends that bar reinforcement be used in floor slabs in preference to welded wire mesh. However codes at the time allowed the use of mesh in this location as did the current code until very recently.

As previously noted the inspection of the floor slab connection to the shear core suggests that the connection between the floor diaphragm and the shear core did not fail in tension, and it performed its function as designed until the columns failed, in my opinion under excessive axial loading.

Robustness.

This is a difficult concept to quantify. The building was designed such that the shear walls would provide lateral shear resistance to the building with no assistance from the internal columns or beams. I believe that the walls and their foundations were designed adequately to carry out that function. The main shear walls remain standing with little damage and the south wall was substantially undamaged until it was brought down by the floor slabs following failure of the columns due to vertical accelerations.

I am not aware of any section in the current building code which prohibits a design concept with similar features to the CTV building.

Documentation.

Construction Joints. The preparation of construction joints is included in the concrete construction standard along with many other details for concrete construction. It is contended that it is not necessary to repeat all details of such a standard in the specifications for a specific project.

Block Masonry Separation. It's accepted that the top course of the block walls was not detailed to be isolated on the drawings. However, this was rectified on site during routine pre-pour inspections and the top joint was isolated as required to comply with the design assumptions.

Starter Bars in Beams. Starter Bars were not required in beams 18 and 22 as the stirrups in these beams were exposed and were lapped with the mesh in the floor before pouring the floor. This provided an adequate connection to the beams.

Spandrel Panel Separation. An adequate gap between the columns and the spandrel beams was shown on the drawings and as previously discussed it's likely that this gap was constructed wider than this.

Standards and Code Issues.

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 design calculations and computer analysis.

This may be partly due to assumptions made during modelling of the building such as the assumption that shear walls are rigidly fixed at the

base but no allowance is made for foundation flexibility, the flexibility of the soil below the foundations and liquefiable soils, the degree of cracking in the concrete, the state of the concrete and the reinforcement following the earlier earthquakes and the reinforcement content of the walls and columns.

There was no provision for vertical acceleration on buildings in NZS 4203:1984. Even the current building code, NZS 1170.5:2004 Structural Design Actions New Zealand only requires that the vertical acceleration be assessed as point seven 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 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 earthquake

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"it can clearly be seen that vertical to horizontal ratios above one are frequently observed for distances up to 40 kilometres in both these events, as well as other historical earthquakes worldwide and hence the code prescription of .7 is, without question, significantly un-conservative."

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.

Q. Thank you Mr Harding. Mr Harding I now take you to your second brief which is entitled supplementary brief. Could you please commence at the introduction to that brief?

A. Supplementary brief of evidence in relation to the CTV building.

I reply to the evidence provided by Wayne Strachan and by John Henry. At the time of preparing my main brief of evidence I had not read these documents.

Wayne Strachan – I refer to paragraph 16 which refers to an initial set of drawings apparently prepared by Alan Reay. I do not recall this set of drawings and I do not know if they were sent to Mr Tapper. Paragraph 17 –

Q. Sorry Mr Harding, if I could just stop you there, if we could please bring up the next slide, that's the – it's STRACHAN number 4. WIT.STRACHAN.0001, that's after the one you've got there. Thank you. Could you read paragraph 14 please Mr Harding?

A. "I can tell from my review of the drawings that I've not worked on every aspect of the drawings. I do not recognise the style of some of the steel reinforcing detail on the foundations and some of it does not include dimensions. I would have put dimensions on. I think that Terry Horn might have done those parts or supervised another draftsperson."

Q. And throughout your contact with the draftsmen, who did you spend most of your time with Mr Harding?

A. With Wayne Strachan.

Q. Are you able to break that down into a percentage, 70/30, 80/20, something along those lines?

A. Well no, I would have thought 95 percent by Wayne. If Terry did any, I don't actually recall dealing with Terry at all on that job.

Q. Thank you, just continue please at paragraph 2.

A. This, paragraphs 17 to 22. This is a reasonable summary of the detailed design process in the period after the architectural drawings have been prepared and accepted. This is the time at which Wayne and myself would have been introduced to the project. However the process described by Wayne does not include the earlier meetings and correspondence between the client, the architect and the engineer which would have led to the production of concept drawings, preliminary structural calculations and preliminary architectural drawings. I describe

the process in some detail in paragraph 8 of my main brief of evidence dated 5th of June.

Paragraphs 22 and 23. I accept that Alan would have left Wayne alone to a greater extent than the other draftsmen due to Wayne's experience and his familiarity with Alan's way of doing things.

John Henry, paragraph 3a.

Q. Sorry can I just stop you again Mr Harding, who in your view or opinion was the more experienced of the two draftsmen, Mr Strachan or Mr Horn?

A. Well at the time I did this job I believe they were both experienced but it's really only after reading their evidence that it becomes clear that Terry Horn's the one who's had the experience on multi-storey buildings and that John Henry was sufficiently concerned that there was nobody that – well that there wasn't a draftsman in Alan's office that was experienced in it, which is why he head-hunted Terry Horn to come from Holmes to join Alan's team, so yeah, I'm surprised that Wayne was doing the job when Terry was the expert.

Q. So are you, in very simple language, saying to the Commission Mr Harding, that there were two inexperienced members in Mr Reay's team allocated to this project?

A. Well from reading Wayne's and Terry's evidence that would appear so.

Q. Thank you. Paragraph 3 please.

A. So John Henry –

Q. Paragraph 4, excuse me.

A. It is not correct that the design features for the CTV building were to be modelled on Landsborough House. As set out in my main brief of evidence at paragraph 12, the design features were to be modelled on the Contours building.

Paragraphs 27 to 29 – I accept John's description of the design method and of the structural model as a shear wall protected gravity load system.

Paragraphs 32 to 34 – I accept John's description of the early form of ETABS.

Paragraphs 46 to 48 – it appears that the layout of the shear walls as shown on the preliminary architectural drawings which John was given for Landsborough House was essentially the same as that shown on the preliminary architectural drawings I was given for the CTV building. Both concepts comprised a single wall along the north side adjoined by several short internal walls at right angles alongside the services area. It appears that for both buildings it was evident to us that the layout would not work because of the eccentric configuration.

John's solution for Landsborough House was to relocate the shear core within the body of the office and to configure the walls as a box with torsional stiffness.

With regard to the CTV building the solution was to provide a coupled shear wall on the south wall of the building. It was not an architecturally acceptable option to relocate the shear core in the CTV building. Both alternatives involved the use of a coupled shear wall as the torsionally rigid box is still perforated by door openings and the coupling beams over the openings in the box are subject to similar loadings to an isolated coupled shear wall.

Q. Mr Harding, can I just – in line 4 you said coupled shear walls, should the word shear be inserted between coupled and wall?

A. Sorry say again.

Q. In line 4 –

A. Of the last paragraph?

Q. Yes, you said the use of a coupled shear wall. Your evidence is coupled wall. Should I insert the word shear between coupled and wall.

A. Oh, it's the same thing, I should have said shear wall but a shear wall –

Q. You did say shear wall.

A. - is just a terminology. Sorry.

Q. Paragraph 8 thank you.

A. I'm surprised to hear that John was so concerned about the eccentric layout of the walls for Landsborough House that he discussed them with Professor Paulay of Canterbury University. In particular because John states that he later shared his concerns and Professor Paulay's caution with Alan Reay. Later when I was at Alan Reay Consultants Limited and working on the CTV building, none of these concerns or words of caution were conveyed to me. I believe I certainly would have remembered had they been conveyed to me.

I've reviewed the calculations enclosed by John for the calculation of the corner deflections. I do not believe that I've seen these calculations before or I would have followed their process. It may be that they were not bound into the main set which was given to me.

As I've stated in my main brief of evidence I was specifically told by Alan Reay at the time of my introduction to the CTV building that he did not want me to contact John Henry to discuss his (Alan's) calculations for the CTV building. I still do not know the reason for that instruction.

Paragraph 76 to 78 – I understand that the code at the time did not require an ETABS analysis for a four storey building but given John's concerns about the marginal nature of the design of eccentric shear core buildings and his expression in paragraph 63, that the Landsborough House design was at the limits of acceptability, then I'm surprised that John did not perform an ETABS analysis on the Aged Concern building. He did do an analysis by hand methods but as stated in paragraph 50, the building deflections could not be accurately

assessed by hand methods and as stated in paragraph 55, it is essential to calculate them.

Paragraph 81 – I emphasised with John in regard to the mode of operation at

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Alan Reay Consultants Limited and of his perceived role as a backroom structural designer.

Paragraphs 87 to 89, as I've stated in my comments on paragraphs 46 to 48 it was not architecturally acceptable to configure the CTV building as for Landsborough House. I'm comfortable with the decision to provide a coupled shear wall on the south wall and given its distance from the northern shear core I believe it to be at least as good a solution as to create a perforated shear core on the north wall.

I refer to a commentary in the loadings code NZS4203:1984:

"Well proportioned ductile coupled cantilever shear walls could well be the best earthquake resisting structural systems available in reinforced concrete. The overall behaviour is similar to that of a moment resisting frame but with the advantages that because of its stiffness the system affords a high degree of protection against non-structural damage, even after considerable yielding in the coupling beams. In addition the coupling beams usually carry only small gravity loads and are reparable.

"The major difference between simple cantilever shear wall designed for ductile flexural yielding and the ductile coupled shear wall is that in the latter the coupling system can be made the major energy dissipating device.

"Permanent damage such as misalignment of the building is thus delayed and disaster due to instability is unlikely even after all the overall ductility has been utilised."

Paragraph 97. I agree that the performance of the south coupled shear wall was critical in protecting the gravity system against horizontal loading. As stated in my main evidence I believe that the substantially undamaged condition of the coupling beams in the south shear wall is evidence that this wall performed it function satisfactorily.

Paragraph 99. It is noted that the shear core is connected to the floor diaphragm by reinforcing from the walls and by the connection of floor beams. The concrete slab surrounds more of the core but the type of reinforcement connection is the same as the CTV building and it does not include drag bars.

Paragraph 100. The gravity beams in either of these buildings will stand in one direction or the other. In either building the columns will be more susceptible to unintended bending due to lateral drift in the direction of the beams than in the direction transverse the beams.

In the case of the CTV building the gravity beams extend the full length of the south wall and the large diameter steel reinforcement in the top of the beams provides a strong diaphragm connection between the gravity columns and the southern coupled shear wall which protects them.

Paragraphs 102 and 103. I've covered the block boundary walls and the spandrel beams in my main evidence.

Paragraph 104. The columns in Landsborough House are rectangular and at the time it was normal to use rectangular ties 10 millimetres diameter in a rectangular column. The columns in the CTV building are circular and at the time it was normal to use 6 millimetre diameter helical wire binding in circular columns.

It's accepted that the CTV columns were not designed for ductility. I note when looking back at page G41A of my calculations for the CTV building that I calculated the spacing of the helix which would be appropriate for ductile detailing, as a 6 millimetre helix at 40 millimetre pitch. There's a note in the calculations that these do not apply as the columns are non seismic. I do not recall what discussions took place at the time leading to the decision not to provide this additional degree of column protection.

Paragraphs 107 to 113. I accept that the CTV calculations are based on the output deflections given by the ETABS computer program. I do not recall seeing John's calculations on slab rotations before reading his evidence.

It's clear that John is an expert on the dynamic behaviour of buildings and that he's accumulated a lot of experience in computer modelling of buildings.

It appears that the early versions of ETABS had some shortcoming which John was aware of and for which he was able in some ways to compensate. Improved versions of ETABS are available today and with modern computers they provide more comprehensive outputs which show drifts at any point on the floor slabs. These modern programs have been used by John and by Clark Hyland in retrospectively analysing the building.

Note also that there are other shortcomings of the earlier ETABS program which have not been compensated for and which would've led to the calculation of further increased deflections. The earlier program assumed that the shear walls were fixed at the base, and did not calculate the increased deflections which result from rotation of the base of the walls due to flexure of the foundation beams, or due to the deformation of the subsoil under seismic loading.

The program also did not allow for the degree of cracking to which the structure may be subjected under seismic loading or due to previous seismic events. This cracking has the effect of reducing the stiffness of the structure, increasing the liveliness of the building, and increasing the potential lateral deflections.

The program also assumes that all diaphragms remain rigid and that they do not deflect internally under load.

Paragraphs 114 to 147. I'm not an expert in the dynamic analysis of buildings. I've not used ETABS program since I left Alan Reay Consulting Engineers in 1988, and I'm not in a position to comment on these paragraphs in John's evidence. However, the analysis of the CTV building in hindsight, and my comments on paragraphs 107 to 113 above support my contention that the calculation of building deflections is still subject to considerable uncertainty. During the earthquake many buildings have deflected further than was expected from the computer analysis. This increased deflection has resulted in buildings on adjacent sites hitting each other and generating additional loads on the structures.

I remain of the view that the lack of damage to the coupling beams in the southern coupled shear wall indicates that it performed its function of protecting the gravity columns from deterioration due to excessive lateral deflections in the east-west direction.

Q. Thank you Mr Harding, just I think it's line 7 in paragraph 18 which you've just read, you say "during the earthquake". Just so we can be absolutely clear, which earthquake are you referring to in that paragraph?

A. The February earthquake, the second one.

MR KIRKLAND:

That Sir, the Commission, is the two written briefs of Mr Harding. He now wishes, we've read through a lot of documents. From a lawyer's point of view in another language, Sir, but it's Dr Priestley's conclusions that Mr Harding would like to briefly comment on if I could move to that?

JUSTICE COOPER:

Yes.

EXAMINATION CONTINUES: MR KIRKLAND

Q. Priestley page 23.

JUSTICE COOPER:

Now we've heard this evidence so it won't be necessary for Mr Harding to read it out.

EXAMINATION CONTINUES: MR KIRKLAND

Q. Mr Harding I'm just going to read a small part of paragraph 77 at line 2, this is Dr Priestley speaking, "However, in my view it is clear that in 1986, the date in which the structural drawings were submitted for permit, many of the details used in the building would fail a test of best practice to current state of knowledge. These include…" Your comments on paragraph A?

A. Well it's agreed that there's no ductile detailing of the columns as I've previously noted. The columns are not part of the ductile load resisting system of the building so it was not considered necessary. They're gravity elements only.

Q. Paragraph B?

A. I agree that the spacing would be excessive if it was intended to be a ductile column designed as a part of a ductile frame. But as I say, because it was basically a gravity column with no shear in it and no bending moment due to earthquake loads, it was not designed as a ductile, part of a ductile frame and the close spacing in order to make the columns ductile was not required.

Q. Paragraph C?

A. Well I don't believe that the cover was excessive. These columns are external columns. They're not inside a building, so that you have to protect the reinforcement against corrosion due to weather effects which they're exposed to. The 40 millimetre cover is still a requirement under today's code for concrete of the strength that we specified for a 50 year building durability. So I don't see the cover as being excessive. I believe that that was what we had to have for columns in that situation.

Q. And paragraph D?

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A. Well I mean that's a subjective comment. The columns were designed for the axial loads that were specified in the code and it was definitely practice within the office not to make things any bigger than they needed to be, you had to justify anything. You couldn't build things above the code or you had your hand smacked so nothing was, you know – the fact that they are high but they're within the code requirements I believe was satisfying the brief I was given.

Q. When you were talking about having to justify, could you just expand on that, justify what?

A. Well Alan –

Q. That was within the office I think you –

A. Yes, Alan gained his reputation by making buildings no stronger or no more expensive than they had to be and that the first thing you find when you're an engineer working in that office is that if you design something overly conservatively and put extra steel in or mesh or anything that's not required, you very quickly got him saying, "Well why do you need that, what's the justification for that," and you'd have a discussion or an argument or what have you as to why you couldn't delete it. So you didn't ever put anything into a building which you weren't prepared to justify as it being required. If you couldn't justify it being required you were expected to leave it out.

Q. So within the office you're saying that cost played an important role?

A. Well costs and simplicity of construction, I mean this idea of having precast beams and gravity columns is a system which had been used on many buildings previously including Landsborough House and many lower rise buildings. It wasn't new, it was a standard detail which we were expected to use and that lack of reinforcement in the beam column joints is a saving that you can make by not having it be part of the seismic resisting system, so yeah. Sorry you asked me about the –

Q. Still on paragraph D.

A. D, yeah.

Q. Anything you wish to add on justifying within the office?

A. No, that was just, that's – I've asked myself when I've looked back at my calculations where I've seen the transverse reinforcement that I specified and said, well why wouldn't I have made it bigger and I have made that comment in my notes in the calculations that it wasn't required. Whether that results from a discussion with Alan I truly can't remember.

Q. Paragraph E.

A. The lack of transverse reinforcement in the beam column joints – again because as I've said before they are not part of a ductile frame, there's no bending moment going from those joints into the column, so there's no requirement for transverse reinforcement in the joints.

Q. Paragraph F.

A. Well I disagree with that. He maybe – the way the drawings have been done, the precast beams have been detailed separately from the floor so the reinforcement shown on the precast beams is basically the bottom reinforcement which sits – the beams sit on the column and the bottom bars, which is the lower bars in the beams extend into the column and they have a 90 degree hook which is anchored on the far face of the column, and then there's additional reinforcement, the top reinforcement in the beam which goes across the beam, that's as – that's poured with the floor slab so that that top reinforcement is actually shown on the floor slab plan, so I suspect that Mr Priestley may well not have realised that that top reinforcement exists because it wasn't shown

on the precast beam detail, but in fact it is shown on the floor plan of the floor so that the bars which extend, there's four large bars giving you negative bending moment continuity over the column and they extend well into the beams on each side, so they provide a really strong connection between the precast beams and the columns.

Q. Paragraph G.

A. Yeah, well I guess it comes back to what was adequate, I mean it was believed at the time of the building consent that the connection was adequate. I mean I guess this – any designer will tell you of situations where he's had a design of a building and it can be the same design for the same buildings that he's designed and had in three separate Council areas, you'll submit the same drawings to three different local authorities and have three different engineers checking it. Each one will come up with a different list of things which they perceive as things which are missing and you do your best to either put those in if you've missed them or to explain to him your logic of designing your building. So in this case it would appear that it was checked by Mr Tapper and that he accepted that what we had was adequate. It's arguable that Bryan Bluck had also looked at it and decided that it was adequate. In this case it appears that Mr Wilkinson had decided that it could be improved and rather than argue about it Alan Reay Consultants agreed to improve it.

Q. And Dr Priestley toward the end of paragraph G talks about when this firm, he's talking about Holmes, carried out due diligence for a prospective purchaser of the building, the serious problem was only partly rectified.

A. Well – yeah well I haven't done any more calculations on those diaphragms and I've only found about what was done by reading evidence so I haven't addressed that particularly.

Q. But other than the implied requirement, the drag bars / drag ties, I think it's paragraph 6.3 of Mr Wilkinson's report from Holmes, you've found no other criticism in that report. Is that correct?

A. No, he didn't – yeah I've asked myself a few times is what would have happened if he had made a comment about the columns because if there was concern, if he had identified the stirrups and the helical binding in the column as being insufficient, that could have been easily repaired. I mean as Nigel Priestley will be aware that it's been done a lot of times in California where motorway bridges have had failures in earthquakes and following the earthquake, or sorry, the columns have been strengthened by wrapping carbon fibre around the outside of the column and I'm sure if Grant Wilkinson had identified the columns as being a concern that could have been done at that time, but again it wasn't identified, it didn't appear. I guess I'm talking about item 78 now really.

Q. And if carbon fibre was introduced to the columns Mr Harding, would that have any difference to the outcome or made any difference to the outcome of this building?

A. I don't believe it would. I think that the carbon fibre tends to give you the ductility that you need if you have bending in the column but I can't really see how it would improve the axial load carrying capacity of the column. That's more a function of the diameter of the column and the vertical reinforcement. Certainly by having additional helical binding and carbon fibre it may enable the concrete to behave as if it had a higher compressive strength by confining it but I'd be reluctant to say that that would have saved the building.

Q. And the introduction Mr Harding to paragraph 78, Dr Priestley says, "Of particular concern to me is the poor detailing of the columns, combined with the high axial load levels." Your comment on that which is (overtalking 12:59:38)?

A. Well again that particular book and certainly other books by Park and Paulay which I have, they particularly deal with buildings which are designed to have ductile frames and that they are supported by ductile frames which are designed to have columns which are stronger than the beams and which will carry a bending moment from the beams to the

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columns. That's not how this building was designed. This was designed using shear walls to support it. I mean it's a bit like if you have a house you have big deep beams in the floor and you have those beams supported by little timber posts and you provide the vertical load carrying capacity on those little posts. Elsewhere in the building you have braced walls which provide the lateral load resistance to the building. So it's the same concept as this whereby you have a wall providing the lateral restraint. To argue that we should have had this kind of detailing in the column when the walls were providing the lateral restraint is like saying you can hold a house up by putting a few extra nails between a four by four post and a 350… 300 by 100 beam. It's just not going to happen. The lateral restraint is taken by the walls so that the requirements for ductile frames did not apply.

Q. And just finally on that paragraph, I think it's over the page and I'll just read it, "Designers have a duty to design not only to the code but also to the state of accepted knowledge applicable at the time of design." It seems to me Dr Priestley is saying that the code is but one aid if I could put it that way and good engineering practice is to go outside the square. What do you say to that Dr Harding?

A. I agree that that is absolutely true. I design not only to the code to, and to the developer and to the current owner but you've got to bear in mind that your responsibilities to future owners of the building and to the people who use the building and that's something that all engineers will always have in their mind but I think what Alan is saying here is that using the pre-cast beams and the in situ columns it's extending accepted knowledge.

Q. You said, "Alan is saying here," you mean Dr Priestley is saying here?

A. Well I'm, I'm not arguing with what Dr Priestley's saying.

Q. Yes.

A. I'm saying that sometimes you go beyond the accepted knowledge. You find another way of doing things. Like I'm not saying that we don't comply with accepted knowledge, I think the accepted knowledge he's

referring to is designing the beam as a ductile frame and I'm saying that's not what we're doing here.

Q. And just lastly on that point Mr Harding so I could be clear, is going outside the square in Dr Reay's office at the time, would that be precluded by cost and the protocol that Dr Reay employed at the time?

A. I've never known any design to be done that because of costs was made not to comply with the code. The object was always to comply with the code but to reduce the cost where possible while still complying with the code.

MR KIRKLAND ADDRESSES JUSTICE COOPER

MR HARDING:

If I could make this one comment?

MR KIRKLAND:

Yes, yes by all means.

MR HARDING:

So further on that report, sorry I –

MR KIRKLAND:

We haven't finished this report. We're going to talk about some more sections after lunch if that's all right. Thank you.

HEARING ADJOURNS: 1.03 PM

HEARING RESUMES: 2.15 PM

EXAMINATION CONTINUES: MR KIRKLAND

Q. Mr Harding before the adjournment we were addressing the conclusion, or conclusions of Dr Priestley. Just finally with Dr Priestley – may I bring up document 14 please. At paragraph (h). Mr Harding where it says photos of column failures tend to indicate failure at the top of the splices, probably due to high vertical compression force. I just wonder if you can keep that in mind. I can repeat it for you but if we can go over now please to document 25 please. I'll just repeat again to save you going back Mr Harding so it's fresh in your mind. Paragraph (h) on page 14, "Photos of column failures tend to indicate failure at the top of the splices, probably due to high vertical compression force." When you compare that statement to the statement in 83, half way down, in paragraph 83, this beam column joint damage would be initially concentrated at the bottom region of the joint and the consequent spalling of concrete would reduce the column capacity to support the vertical loads and the lateral displacements. Are those two statements in your view contradicting each other?

A. Yes I think they are. I think that it's, it's probably something else that's in the Hyland report, they come up with a theory as to why it failed and then try to justify that by looking at the evidence when the evidence is showing you something quite opposite and I think that's pretty much what's happening here. They, he says there that the photos of the column indicate that failure of the column occurred at the top of the splices which is half way down the depth of the column and that that is where you would expect to see failure with a, with a vertical load and then reverts back to discussing the fact that it's at the join whereas that's not where the failure occurred.

Q. If I could bring up document 15, Professor Shepherd now please. We've got document 15, Dr Priestley, yes, thank you. Would you please read the second paragraph Mr Harding.

A. "Actual records from the 22nd of Feb, 2011 event showed that at several sites in the CBD the maximum vertical peak ground accelerations were of the order of 1g.

JUSTICE COOPER:

This is Professor Shepherd is it?

MR KIRKLAND:

Yes Sir.

JUSTICE COOPER:

Yes, you said Dr Priestley.

MR KIRKLAND:

No, Dr Priestley, a document came up earlier Sir, it's changed. It was the same pages Sir.

EXAMINATION CONTINUES: MR KIRKLAND

Q. Your response to that paragraph Mr Harding?

A. Yes, well that's obviously slightly higher than what's used in the Hyland report at those two nearest stations. One of them was .69g I think and the other about 78. So 1g is, is higher than that which would definitely be more than enough to cause the compression failure of the column. I think that, I mean anecdotal evidence is that if you have more than 1g vertical acceleration then things tend to leave the ground and there has been some reports of that from people at various different parts of the, of the city.

Q. Now I won't refer you to the volume specifically Mr Harding but it's been referred to I think in Dr Reay's evidence. This is the, the conference if I could call it that back in July 1986 under the heading Design of Concrete Structures. You've seen the booklet haven't you?

A. Yes.

Q. Yes. Can you recall going to that conference?

A. I can't recall going to it but I'm prepared to accept that I did go.

Q. And if we could bring up document 3 please under sketch design. There was a question put to Dr Reay by counsel for the families and

you're aware that last week your lawyer produced copies of papers from a seminar apparently attended by Mr Harding in 1986 with notes apparently made by Mr Harding relating to a wall arrangement that may have been relevant to the CTV. Are those your notes, is that your handwriting?

A. No it's not my handwriting. It's not my mis-spelling either.

Q. Do you know whose notes those are?

A. No I don't. I don't recognise that writing.

Q. And if I bring up please the Paul Smith office layout. Does that plan accurately describe Dr Reay's office when you were there Mr Harding?

A. The layout of the walls is pretty much the same. At the time I was there, there were no computers on each desk. There was only one computer in the office and that was in a location where anybody could use it if they were having, do a structural calculation but all of the desks had drawing boards rather than computers and Geoff Banks obviously wasn't there at that time but there were a number of other draftsmen who were there whose names aren't on the, on the, on the page.

Q. And if there was conversation, for example Dr Reay speaking with Mr Strachan or Mr Horn could others hear that conversation?

A. Yes, very much so. I mean it's a small office and it was generally very quiet. Alan's view of things was that when you were on his time you were doing his work so there was no extraneous chat going on and so if Alan was having a noisy conversation on the phone everybody in the office could hear it. If Alan was having a discussion with one of the draftsmen, again, everyone would hear it and you would know that if the discussion was with somebody who was doing your job and he was asking the question, why are you doing it like that, you knew that you were going to be having a chat with him in the short, near future.

Q. And the protocol in the office over the CTV building. Would Dr Reay come to you and discuss something first or go to one of the draftsmen?

A. To the draftsmen. The only reason he would come to me would be if he saw a detail that wasn't a standard detail or if I was using a product that he would rather not use – then he would come to me and ask me to

change it. But as a rule he would monitor the job via the draftsman rather than via the engineer, looking at the, at the finished article. If I had any queries I'd certainly go and see him but otherwise he wouldn't come near me.

Q. Thank you. I want Mr Harding now, I'm just going to put questions to you from Dr Reay's first brief. If we could bring up please slide 1425 number 4 please. Paragraph 18, Mr Harding, and I'll read it out to you the latter part of the paragraph:

"Mr Harding accept a job with ARCE which was to include the design of medium height multi-storey buildings. I considered that he had the experience, was a registered engineer and was competent to undertake the work".

What's your response to that please Mr Harding?

A. Well if that implies that I was competent to do it by myself the answer would be no. I mean it's a requirement of the Engineer's Code of Ethics that if you are a principal of a firm and you're offered a commission for a job which you believe is beyond the limits of your competence then you don't accept that commission and certainly if I was going to be doing it either on my own behalf or if I was going to be operating in Alan's office as an independent contractor I would not have been doing that job. The understanding when Alan rang me was that he had an office which was experienced in multi-storey design. He'd designed a number of other multi-storey buildings in the office and certainly prior to the three I'm thinking of that he told me about, he'd obviously designed buildings himself. So I was under the impression that I would be benefiting from that experience in order to gain the experience I needed so that I would be able to do it independently.

JUSTICE COOPER:

Q. Which were the three that he told you about?

A. The three he told me about, he just said that there were three. I found out what they were after I'd joined this firm. One was Landsborough

House, one was Nair and Company, which apparently is a reduced version of Landsborough House, and the other was Aged People's Welfare building. So all three of those are buildings with offset shear cores.

EXAMINATION CONTINUES: MR KIRKLAND

WITNESS REFERRED TO SLIDE 5

Q. The latter part, Mr Harding, of paragraph 25 Dr Reay says:

"At the time Williams had a strong reputation for building quality buildings. I also verified that the engineer, in this case David Harding, considered himself capable and prepared to commit to undertaking the work".

Probably a little bit of doubling up here but your response to that Mr Harding?

A. Well I don't know what he means by verifying that I considered myself capable. I mean he brought the job to my desk after it had got past the preliminary stage and explained to me what needed to be done. I told him that I didn't know, or he knew I didn't know how to do ETABS so on that basis he gave me the calculations for this other job that John Henry had done to use that as a model but there was never at any time a discussion like do you want to do this job it was really just him giving me the opportunity to do one.

Q. And he goes on to say, "I would have also ensured that an appropriate draughtsman was allocated together with any other staff required to assist in the work the engineer was undertaking".

Your response to that?

A. Well at the time I believed that he had done that, that the appropriate draughtsman appeared to be Wayne Strachan and 'the other staff required to assist' I assume by that he means himself because there was no other engineer in the office.

Q. And in paragraph 26 he says "On the basis of my enquiries I would not have foreseen any significant issues relation (probably relating to it

meant to be) undertaking the job and would have been happy for Mr Harding to undertake the work".

What enquiries do you think he is talking about there Mr Harding?

A. I can't answer that. Certainly no enquiries of me.

WITNESS REFERRED TO SLIDE 6

Q. In paragraph 32 Dr Reay says, "There was no review procedure in place at that time. Mr Harding was a qualified, experienced and capable engineer and would have taken responsibility for the project".

Your response to that?

A. Well it's news to me that there are no review procedures in place. I guess it depends what you call review procedures. I mean it appeared to me that Alan was reviewing the draughtsman's work and, therefore, the engineering that had gone into the jobs on a daily basis.

Q. And he goes on in the same paragraph to say, "I do not recall reviewing the drawings, calculations or specifications and I would not have expected to have done so".

Your response to that Mr Harding?

A. Well that's a bit scary really.

Q. In what way?

A. Well I wonder how many other drawings have left the office that haven't been reviewed.

WITNESS REFERRED TO SLIDE 7

Q. Paragraph 36 Dr Reay says, "I am unable to recall whether any computer modelling was carried out during the design process. I was not involved in any modelling for this building".

Your response to that Mr Harding?

A. Yes I did the computer modelling after looking at John Henry's calculations of the similar job. So Alan wouldn't have done any of the modelling personally himself.

Q. And at paragraph 38 "I was not involved with the Council permit application process".

Your response to that?

A. Well I can't, huh, many of the noisy conversations you would hear coming from Alan's office tended to be arguments with Council consent officers so I can't see how that can be so.

Q. About the CTV building?

A. Any building.

Q. Paragraph 39, you've answer this but I want to put it to you again, "I do not recall" – this is Dr Reay speaking – "having anything to do with the letter or its response." – this is the Tapper letter – "I do not know who wrote the notation on the letter received a day or two after the letter sent". I just ask the question again. You're absolutely certain, Mr Harding, that it's Dr Reay's handwriting on that letter?

A. Yes.

WITNESS REFERRED TO SLIDE 10

Q. And just finally, Mr Harding, Dr Reay says at paragraph 51, "Contrary to Mr Harding's evidence I did not design the CTV building".

What do you say to that?

A. Well I did the detailed design. I certainly didn't do the concept design or the preliminary design. I mean that's what evolves from meetings with the client and the architect and I had no such meetings.

Q. He goes on to say, "The timesheets annexed to my second statement evidence the amount of time I spent on the project as compared to Mr Harding. Mr Harding said he never had a problem".

Q. You've seen those timesheets Mr Harding, haven't you?

A. Yes.

Q. And your response to the balance of that statement and the timesheets?

A. Well I'm surprised, I would have thought that his time would have been a lot more than that but I'm not surprised that he hasn't put those hours that he has done on the timesheet. As the principal I guess he's not working on a hourly rate so there's no real reason why he should.

1435

Q. Are you saying in your view that he spent a lot more than I think three or four hours on this job?

A. Well you'd have to. I can't see how he could get to the stage of discussing with the owner and the architect and the client. You'd spend three hours per meeting and there'd be a number of meetings back and forth before you could even get to the stage of completing the concept drawings.

Q. And finally Mr Harding we've received a document which you have a copy on your desk. I'm not sure if it's got a number?

WITNESS REFERRED TO DOCUMENT

Q. A memorandum from Dr Reay with a schedule of buildings. Have you got that in front of you?

JUSTICE COOPER:

I does have a number, it's BUI.MAD249.0555.1.

EXAMINATION CONTINUES: MR KIRKLAND

Q. Mr Harding, it's come up now. If I could take you through the schedule. We'll start with the Broadway building. That's a two storey commercial building, and was the equivalent static method required for that building?

A. Yes that's only a two storey building. That's the kind of building I've done very many of, even the first time I was with Alan, so that's definitely an equivalent static design.

Q. And the Drainage Board building?

A. Well that's not a building. That's a fibreglass cover to the trickling filters. They're an existing circular trickling filter that was putting out a lot of smell in Bromley and it was a case of designing some segmental fibreglass sections that made a sort of a hemispherical dome over the tank. So there's no, virtually no earthquake loads on something like that. It's a very light building.

Q. And the medical accommodation building?

A. Well when I said I'd done a building while I was working out my notice, before I left Waimairi and when I went to work for Alan that he was short handed and he needed a hand. That was the building I did. So that's a

well-proportioned building with a lot of block walls all the way around it. Plenty of walls, more than you need to hold it up in an earthquake and very straightforward to design. Certainly an equivalent static design, very simple.

Q. Now the next building is the Westpac Tower which is nine storeys but it appears to predate the CTV building. It says you were involved in January '86 while the CTV started March 1986. Your response to that Mr Harding?

A. Well, certainly I did do that job and it was definitely after CTV that I did it, and at the time that I did the Westpac Tower I was obviously familiar with ETABS, having done the CTV and following on John's example of the other job, I was then in a position to do that building. So yes, but it certainly, I mean he's got January '86 there, I don't know when it actually arrived in his office, but I certainly didn't do any meaningful work on it until well into the construction period of the CTV building.

Q. You're absolutely sure about that?

A. Yes, well I wouldn't have been able to do it. I mean if I was going to be doing the ETABS analysis of that building he would've had to have given me some other kind of building as a template to get me started and there was no such thing. The only template I received was the one for Landsborough House and that was as it related to the CTV building. So, you know, Westpac Tower was definitely afterwards. I mean you would know the sequence in which these arrived by the file number that was on the job on the sheet, because each job has a number and they're consecutively accepted into the office with a date so that the bigger the number the later the date when the job started. So I don't know what the file number for that is, but it wouldn't be hard to find out.

Q. And the Letz building?

A. Well that was just about the last building I did before I left. It was at the time… it's a eccentrically braced steel frame building and that's something that was fairly new technology at the time. It certainly wasn't around in 1986 and that building was stillborn. The foundations were built and then we had the financial downturn in about 1988 and that was

the end of it, so I wouldn't have started that building until, you know, late '87 perhaps.

Q. It's got a July 1986 date, commencement date?

A. Yeah, well I can't, I don't know how that's come about. As I say, it's very much a surprise to me that it would've come into the office at that time.

Q. And Shangri La extension?

A. Yes that's, as I said, when I developed a relationship with Tony Scott at Williams Construction, or it might've been Union Construction at that stage. He came to me with the odd design build job and asked me if I would do sketch drawings in order to make it work so he could cost it. So again that's after I developed a relationship with Tony, so that would've been after the construction of the CTV building because I didn't meet Tony until we started the construction of the CTV.

Q. And the final building on the schedule, the residential development concept?

A. I actually don't recall that job. I don't, I don't believe it's anything I had anything to do with.

MR RENNIE:

So just before I start asking questions, my friend indicated that he wished Mr Harding to traverse the matter of the permitting stage. Counsel assisting also indicated that this was not to be a matter for cross-examination at this time but was to wait until that section in the hearing and I will endeavour to adhere to that Sir although plainly it does present the situation where the witness has made assertions which will be contested at that stage and I respectfully don't wish that to become disconnected by that slightly unusual way of proceeding Sir.

JUSTICE COOPER:

I understand.

CROSS-EXAMINATION: MR RENNIE

Q. Mr Harding, in your evidence today you observed that after you left Alan Reay Consultants in 1988 you had not had occasion to use ETABS again, do you recall that?

A. Not personally, that's correct.

Q. Well when you say "not personally" does that suggest an indirect connection of some kind?

A. No it means whenever I would have a building that was above four storeys or required ETABS I'd get a separate engineer, someone who was experienced in it to do that analysis for me.

Q. And we understand that ETABS has gone on in a more refined form to be referred to as ERSA, so equally your statement would be that you'd not used ERSA in later years?

A. Correct.

Q. Now in that sense the evidence that you've given as to the CTV building which you've read and given today, and your discussion of ETABS draws on your experience of ETABS in the '85 to '88 period, is that correct?

A. In my second period of employment, yes.

Q. Yes, so when you tell us that this was done, or that was done, the background you're drawing on to give that evidence is a 1985 to '88 period of experience?

A. Which evidence are you referring to sir?

Q. The discussion that you've given of the use of ETABS in buildings above four levels?

A. That is based on my experience in that period, yes.

Q. Yes, and to be clear in the preparation of your brief of evidence you've not consulted with Alan Reay or Alan Reay Consultants, and they've had no input into your evidence, is that correct?

A. That's correct, yes.

Q. You've referred to your post '88 work on buildings which required ETABS, or more recently ERSA. Have there been many of those buildings?

A. Two.

Q. And would they be the Park Terrace and White Fox buildings?

A. No, White Fox and one alongside White Fox which hasn't been built yet.

Q. Right, and that's, to be clear, in the period from '88 down to the present time?

A. Yes.

Q. So does it follow that on leaving Alan Reay Consultants Limited you elected to go in a different direction with your engineering work?

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A. Well on a much smaller firm, I didn't want to be taking on big projects. They take up too much of my time so I was choosing to do smaller jobs which would have a quicker turn around than spend all my time on big jobs.

Q. You're referring in a sense to the 88 period onwards when you were in practice on your own account?

A. Yes, yes.

Q. And do I understand that when you left to go off into that area of work, you initially had an association with the people and the firm who followed on from the Williams Construction Company?

A. Shirtcliff and Scott Limited.

Q. Yes.

A. Yes.

Q. So in essence you went to do their primary line of work. Is that right?

A. No, when I left I didn't have them as clients. They came to me after I had started.

Q. So in that sense they perceived you as being somebody capable of doing the design work for the buildings they were building?

A. Yes.

Q. And did that include buildings above four levels requiring ETABS?

A. No.

Q. A brief of evidence has been filed from a Mr Peter Nichols who is to give evidence later, an engineer in Christchurch. Do you know Mr Nichols?

A. No I don't.

Q. At paragraph 37 of his brief, I don't think we need to go to the document, Mr Nichols offers the following observation in relation to you. He says, "He did not know you well, he recalled you as being less dogmatic than Alan Reay though still assertive, and he regarded you as a very competent engineer whose design work he considered to be characterised with elegance, simplicity, practicality and economic construction." I can read it to you again if you wish, I simply invite you to say whether that was how you yourself perceived your engineering practice?

A. No I wouldn't make such claims. I just do my best.

Q. Now Mr Harding, after your degree from university, you worked for approximately for four years with Hardy and Anderson you've told us. That's correct?

A. Yes.

Q. And you mentioned in that that some of the work you did related to the structural strengthening of brick buildings. Buildings of what type and where located?

A. A brick masonry building at the corner of Manchester Street and Bedford Row.

Q. Was that the only one you were thinking of?

A. There may have been others, there was certainly the State Trinity Centre. I think we did some shock treating inside that.

Q. And in relation to the 78 to 80 period, with Dr Reay's firm. You joined as an engineer and then left in May 180 you've told us?

A. Yes.

Q. And that was to go to the Waimairi District Council?

A. Yes.

Q. Now in your first period at Alan Reay's firm, how many engineers were there in the firm at that time?

A. I believe Philip Carter was still working there as well as, for Alan when I was there. Philip was leaving at some stage but I don't know whether Philip had told Alan he was leaving at the time I joined, but there was myself and Alan and Philip Carter there for some time.

Q. And the firm at that stage was engaged in the design of concrete structures using the current concrete and loadings code wasn't it?

A. Yes.

Q. So that at that point the firm was engaged in the construction of larger buildings but not in the sense that you came to come back to –

A. No, they were only two storey buildings at the most that I was involved with, mainly single storey, mostly single storey industrial buildings with tilt-up concrete. The odd time there'd be a mezzanine floor in them but I think the biggest one might have been the Farmers building in Blenheim which was a sort of a two storey shop. That would be about the biggest building I did.

Q. Now if we can have please BUI.MAD249.0466.5. It'll come up on your screen. This is a page of registrants from a May 1979 seminar and you will see yourself listed in the right-hand column. Do you see that there?

A. Yes.

Q. If we can go back to page 1 of that document please. I'm sorry, I didn't realise that was page 1, the next the title page. If we go to three. You recall going to this seminar?

A. No.

Q. A two day seminar in geo-mechanics and in situ testing.

A. No sir, a lot of these seminars if I – both this seminar and the other one which I was shown recently, the documents for stayed in Alan's office when I left so it's not like I've got them with me that I can refer to so I – it's a long time ago.

Q. I gave you the wrong title Mr Harding. Seismic design of ductile moment resisting reinforced concrete frames. You see that?

A. Yes.

Q. Three day seminar for which you registered?

A. It would appear, yes.

Q. Yes, and the description of you on page 5 is senior engineer and the post office box says Dr Reay's isn't it?

A. Yeah.

Q. So can we take it that in 1979 your position in the firm was senior engineer?

A. Well it's – I was an engineer. I mean it depends what you call senior.

Q. Well wouldn't you be responsible for that title when you registered for the seminar?

A. No. I mean that's not my – that's not my nomenclature. It's something that whoever registered me for the seminar would have put that in.

Q. What are you saying then, that Dr Reay's firm perceived you as being a senior engineer?

A. Perhaps.

Q. And so in 1979 you had lead or direct responsibility for particular projects in concrete structures didn't you?

A. Yes, if they were – yes two storey as we discussed before certainly.

Q. Yes. And then you went to Waimairi District which in those days was a local authority to the west of Christchurch city, wasn't it?

A. Yes.

Q. You were the design engineer there?

A. Yes, for civil works.

Q. Yes, the district had round about 70,000 people running from Hornby and Sockburn and the south-west right round to the north of Christchurch and out to the coast didn't it?

A. Yes.

Q. And you ran a design office which included three engineering cadets?

A. Yes.

Q. And you had a direct responsibility as you've said for the civil engineering works?

A. Yes.

Q. And the Waimairi District did not employ a building consents engineer, did it?

A. No, at that time the building department was run by Ted Hughes who was the chief building inspector and they had two graduates who were often used for doing building permit checks and they were under the

auspices of the waterworks engineer whose name I can't remember, who was a registered engineer.

Q. And do you recall your expertise being drawn on to assist in building consents in the time you were there?

A. No, the only time I would have been talking to them would be sometimes, like there was a situation where there was a Court case that Waimairi Council had in Cutts Road regarding a building which had foundations built on sawdust and I went along as an observer and a supporter of the building inspector to that Court case and I think there was another one in Wairakei Road involving a similar thing which I was involved in. But other than that, the only other time I would have had

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anything to do with it was occasionally there would be meetings with, well what would happen was that Ted Hughes and the chief of the building department in Paparoa and Riccarton would occasionally have meetings with Bryan Bluck to talk about building issues and I went along to a couple of those meetings with Ted Hughes when he thought there was an issue which I was involved with, and particularly that usually came back to things like filling on residential subdivisions. At that time there was a lot of rubbish fill being used by developers. When they'd demolish a building they'd spread it out on the sand dunes or they'd knock the top off one sand dune and fill in the hollow with another and create a trap for some poor engineer when he came to build a building on top of it, and I had a bit of input into stopping that sort of thing from happening.

Q. And in terms of responsibility for a design project, the one that you've nominated is the Jellie Park waterslide and related matters?

A. Yes, well as part of the, I've recently been to, I mentioned in my CV I've got a Diploma in Business Administration at the, at the Canterbury University, and one of the projects that I did then was to look at waterslides and their commercial viability, and at the time there was a couple of developers who were offering to run the waterslide in the Waimairi area and I went with Rima Goldsmith who was the manager of

the Jellie Park pool and we did a trip right round the North Island looking at the running of a lot of waterslides and we did a report as to –

Q. That's it Mr Harding, we'll just concentrate on the engineering side of it?

A. Well I, I was –

Q. You had a design responsibility for the waterslide?

A. No not particularly. There was a design being done by a local contractor called Graham Lochore and he did the hydraulic design and the design of the tower poles through a contractor in Australia, and I did the design for the exit pool and for the start tower, and we did the concept on, on where it was going to go and town planning issues and landscaping issues and such like things.

Q. Now if we can have BUI.MAD249.0468.7?

WITNESS REFERRED TO SLIDE

Q. Which this time is the Geomechanics In Situ Testing Seminar which I mistakenly referred you to before. And you'll see bottom right that you were registered for that seminar?

A. Yes.

Q. Do you recall going to that one?

A. No I don't.

Q. Would you accept that you were continuing to maintain and update your engineering qualifications throughout your period with Waimairi?

A. So far as I could, yes. It was mainly civil work at Waimairi. I didn't, I don't recall being particularly going to any structural seminars but yes I did my best. I went to some roading seminars which they'd have each year which related to bridge maintenance and highway management, pavement management.

Q. So when Dr Reay in August 1985 invited you to return to the firm, you presumably regarded yourself as current for the work that the firm would be doing?

A. Which firm, Dr Reay's firm?

Q. Correct.

A. Not at all. That's why I decided to go there because I definitely wasn't current, because he offered me, I'd got to the stage at Waimairi whereas

when I first got there the digger was down one end of the road and the theodolite was down the other end designing it. When I left I had a year's worth of work sitting in the drawer all designed ready to go and I, my next job there would've been deputy engineer or something and dealing with councillors all day, that wasn't being an engineer. So I decided that I'd rather get back to being a consultant again and he must've got wind of that, and he said to me that he was now, he'd expanded his firm to go from the kind of thing we had been doing in the past to now be doing multi-storey buildings and I saw that as something new which I hadn't done before, I had no experience in, and an ideal opportunity to get experience in that realm.

Q. And you were taken into that firm on the basis that there was a prospect of a partnership or something of that level available to you?

A. There was talk of being an associate, and that happened after a while. That was a case of being a, getting a share of the profits at the end of the year if there was one, but it was never being a partner or a director.

Q. And in that sense, becoming a senior engineering practitioner in the firm?

A. Presumably yes.

Q. And that was to be the position from the outset wasn't it?

A. Well it wasn't the position from the outset. Being made an associate was something which took a wee while.

Q. Can we have BUI.MAD249.0463.10 please?

WITNESS REFERRED TO SLIDE – TIMESHEET JUNE 1986

Q. Now if you have a look at the top of that sheet you will see that the first person on the left is Dr Reay. This is a timesheet for June 1986, you've seen these timesheets?

A. Yes.

Q. And the next person is yourself, is that right?

A. Yes.

Q. And you'll see that the hourly rate for yourself is $60 an hour, and for Dr Reay $75 an hour, do you see that?

A. Yeah it looks like the 60's been written over the top of something else to me.

Q. Yes, well we'll just go back to page 8 please?

WITNESS REFERRED TO SLIDE – TIMESHEET MAY 1986

A. If you look down there it's…

Q. We'll come back to that anyway.

A. Yep.

Q. You will see that the previous month, May, you see that?

A. Yes.

Q. And your rate at that time was $53 an hour?

A. Yes.

Q. So the rate increase which you can see between those months, would you expect that to correspond with your gaining the associate status we've just been discussing?

A. Quite possibly. I can't recall.

Q. Now just looking at that timesheet it shows two engineers in the firm at that time doesn't it?

A. Alan and I?

Q. Yes?

A. Yes.

Q. I appreciate there are names out to the right that have been crossed out but I ask for you to accept from the rates that they're obviously more junior staff. So that from the time that you joined in November of 1985 onwards the firm had two engineers, that's correct?

A. Yes.

Q. And by May/June of 1986 you'd gained associate status, charge out rate close to Dr Reay's and you were in that sense in the position that you'd aspired to get to when you joined in November 1985?

A. No I don't, I wouldn't say that. I mean that's the rate that Alan was charging them out at, at the end of the year if there was a profit over and above, after you'd paid your wages, that would be Alan's, so that that hourly rate doesn't necessarily tell all the picture.

Q. But it reflects your promotion and status and your recognition as somebody able to undertake work in your own responsibility doesn't it?

A. No I wouldn't say in my "own responsibility" at all. It depends what work we are talking about.

Q. No if we go back to August and the time of the invitation, at that stage Mr Henry was with Dr Reay's firm wasn't he?

A. I can't tell you that.

Q. Well I understood you to say earlier that the offer which was put to you by Dr Reay was on the basis that Mr Henry was there but would be leaving?

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A. Yes but I don't know when he was there and when he left. He was gone when I arrived.

Q. Yes and you indicated in your evidence this morning that you believe that there had been some disagreement between Mr Henry and Dr Reay on some matter.

A. That's total speculation by me. I was just wondering why he would have said, "Don't contact John," and I could only perceive that that was because of some ill-feeling or some disagreement. That was just me speculating. I have no reason to know what that might have been.

Q. Now while you were still working out your notice you've told us that Dr Reay contacted you to see if you could shorten your notice to Waimairi and arrive at an earlier date. That's correct?

A. That's my recollection.

Q. Yes and you were not able to do that but you were able to assist with calculations on one project.

A. Yes.

Q. And the reason for that request I understood you to say was that Dr Reay had found that Mr Henry had left and there were projects which needed to be done for which he did not have an engineer.

A. I didn't know that it was because Mr Henry had left. All I know is that it was because he was short-handed. It may have been that he didn't

want to start John Henry on a job that he wasn't going to have time to finish perhaps.

Q. Well on your arrival you found that you were expected to deal with some jobs that Mr Henry had worked on weren't you?

A. Yes.

Q. And in that sense they were incomplete and needing work done immediately.

A. I can only really think of one in that situation and that wasn't really because it was incomplete. I think, if you're talking about the fibreglass covers to the filter cover I think the design had been pretty much done, but what was required by the Canterbury Drainage Board at the time was some sort of proof that the thing was going to work. So we established a, a testing regime that we would build a couple of sections and test them to make sure that they would perform before the contract was completed but that wasn't really, it was in addition to the original, it wasn't part of the design. It was really testing the design if you like.

Q. The medical or hospital building that you did the calculations on before arriving, that had been a job of Mr Henry's?

A. I don't believe so. I don't think anyone had done that before I picked it up.

Q. Mr Henry did work on the Westpark building?

A. No.

Q. You don't recall –

A. No that was long after he left. As I say I'd been there for some time when that job started.

Q. I understood you to suggest this morning that you were now speculating that you were not to contact Mr Henry because he might to talk to you something about Mr Paulay's theory?

A. Well all I'm, there's no, my speculation as to why Alan didn't tell me about that. There's no doubt that they didn't tell me.

Q. Isn't it just the position that the terms on which Mr Henry left were such that he would not be expected to provide any assistance or guidance if approached?

A. That was the presumption that I, I had, I thought that was why Alan told me not to call him because he wouldn't expect to be helpful.

Q. Yes and in that sense if you had a matter on which you wanted information it would be a matter of your taking it up with a suitably qualified person?

A. It was a matter of taking it up with Alan.

Q. Well for example in relation to the ETABS it would be a matter that you could take up with the university people.

A. I don't recall actually talking to anybody at the university. It was a pretty informal situation. It was a case of taking in the, I'm going from memory now and I couldn't swear to how it all worked but I know that there was a situation where you would, I either filled out forms which they then transferred onto data sheets which fed into the computer and I think it was probably a case of filling out a standard form and then just dropping it in their inbox and waiting for the notification that the output was ready to pick up. It was pretty impersonal.

Q. And you'd then collect and analyse the output?

A. That's correct.

Q. And in terms of the university's role in the matter, was there a particular person at the university who ran this project?

A. As I say it was very impersonal. I just dropped off one set of paper and picked up another set. I have no idea who did it at the university.

Q. So you began by analysing what you needed to put to ETABS, writing it up on sheets provided by the university and then sent them to the university?

A. My recollection is that there were standard input data sheets. I had seen how John had taken it from his calculations and how that had translated into putting the data on these input sheets and I used his situation as a template and basically filled the sheets out the same way.

Q. You're now describing the CTV building process are you?

A. Yes I am.

Q. Now that was not something that Dr Reay was involved in was it?

A. I can't recall. I, I don't, in terms of him, no I, it's just too long ago. I, I can't, I can't describe how it all worked from a day-to-day basis.

Q. Now your counsel this morning had you read a passage, I'm not going to go to the exact paragraph because you'll remember it, from Mr Henry's brief, paragraph 81 and your response to his description of life in Dr Reay's firm was, you said, "I could not have described it better." Do you recall that?

A. Yes I do.

Q. And the description that you were referring to was one of an engineer who was tasked with being in the office and working on structural design and structural calculations. That's correct?

A. Yes once the, the, the art of engineering was removed. The, the initial concept of listening to the client, of hearing what he wanted, of being able to conceive whether you were going to use concrete or steel or timber, how it was going to fit on the thing, what the floor-to-floor heights were, what it was going to be made out of, how much it was going to cost, none of that information. By the time it arrived on my desk it was just a, a drawing, here you are, work this out, it was already conceived and detailed and dimensioned and it was a case of putting numbers in boxes.

Q. You missed the client interaction?

A. Very much so.

Q. You aspired to that from the outset of joining the firm?

A. Yes, that was, that's where the art of engineering comes in.

Q. And in your view on joining the firm you were fully competent to undertake that type of interaction?

A. For certain buildings. I, I believe that I was doing it for some buildings at the time when I left but very few. Most of the, the projects where I was having that kind of interaction before I left was, was particularly with architectural draftsmen, with houses and with soil tests and levelling surveys but in regard to the pre-cast concrete buildings virtually none at all.

Q. Now you know that Dr Reay disagrees with your view as to his involvement in the stages you've just described of the CTV project?

A. I –

Q. You've read that?

A. Yes I, I get the impression he, he implies that, yes he said he disagrees, yes I understand that.

Q. Yes, yeah. He appears therefore to have seen your role in client contact and building concept and preliminary proposal as being greater than you remember it being?

A. No that's not the case. I mean that is why I left in the first place. That's why I left to go to Waimairi. That's why I didn't stay at that stage to carry on because I was just getting these things dropped on my desk and expected to churn out another set of drawings with a different set of numbers in the boxes and I wasn't at all happy with that. The same sort of situation as when John Henry said that he left. He could see that it wasn't going to change so he left and they say you should never go back and I made the mistake of going back, thinking it may have changed but it hadn't.

Q. You were recognised as an associate?

A. Yes.

Q. And you clearly consider that you could have done the work that you've just been describing?

A. Well after sufficient experience in a particular kind of job. I know after I had been at Alan's for a while and I'd done the Westpark Tower and I'd done the CTV building and we'd done preliminary design on a couple of other still-born projects that when Tony Scott came to me and asked if he could have preliminary details for a number of jobs I, I would do them, and I would give him a, a series of sketches which showed the structural bones of the building and I was working at that time doing the

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conceptual design of the buildings and that was what I wanted to do and I was enjoying doing that but that took a couple of years.

Q. Now we were looking before, and we don't need them up again, at the timesheets. You accept that time records were kept at that time.

A. Certainly yes.

Q. And indeed they formed, in turn, part of the base for the costing of fees to be charged to clients.

A. Well I have no knowledge of that. I assume it did but I can't tell you how that happened. I didn't get involved with that.

Q. You said a little earlier today that you were surprised and then I think you said you weren't surprised that Dr Reay had not put down the hours that you remember him putting into some projects. Do you recall that?

A. Yes.

Q. And then you offered an expl-

JUSTICE COOPER TO MR RENNIE:

Q. Mr Rennie before you go on I was just recalling the evidence of Dr Reay in relation to this building that we're concerned about where he said that or he proposes to say, "I believe that Mr Harding would have been involved in setting the fee which was probably set as a percentage of the total build cost".

A. I was just going to come onto that, Sir.

Q. Well I'm surprised you put to the witness as you did a moment ago that the timesheets were used for billing on an hourly rate.

A. Well no, Sir, I said they'd be used as the basis for costing.

Q. Well….

A. And I was about to remind the witness that he had said that Dr Reay, as owner of the building, as owner of the business, it wasn't necessarily the case that he had to record all the hours that he'd done and my intended next question was to say was that because in many cases the fees for a project were fixed on some basis other than hourly rate.

Q. Yes well you might get the correct position in the end Mr Rennie but it's a funny way of approaching it if I may say so.

A. Well you may say so, Sir, and I can go now there more directly having indicated what I was doing.

Q. All right.

CROSS-EXAMINATION CONTINUES: MR RENNIE

Q. I just simply put it to Mr Harding that in many cases the fee for a particular project was defined by matters other than simply the hours put into the project.

A. Yeah I have no knowledge of how he set fees or what the fees were or what the percentages were. I couldn't tell you that. I wasn't involved in that except right at the end when I was dealing with Tony Scott and we were doing design build jobs at that stage I gave him some indicative fees but that's all I remember having to do with fees. Other than that that was definitely Alan's reserve.

Q. And in that sense the extent to which he recorded his time was a matter for his judgement.

A. I believe so.

WITNESS REFERRED TO WIT.REAY.0005.20

Q. Now this is at the back of Dr Reay's fifth brief of evidence. Have you seen this schedule before?

A. No I haven't.

Q. Well it's a version of a schedule that I think you have seen and I'll take you to in a moment but you will see that this relates to time recorded in relation to the CTV building in the year 1986. Do you see that?

A. Yes.

Q. And the second column going downwards is the time that you spent on the project and then next Mr Strachan's and then next Mr Horne. Do you see that?

A. Yes I see that that's up, I mean what about before February '86?

Q. Well we do have the timesheets for the earlier period but I'll deal with that another way by showing you another schedule in a moment. The first point to make to you is that you appeared to be mistaken as to which of the draughtsmen had the principal input into the project.

A. No I'm not mistaken.

Q. Well can you account for the fact that Mr Strachan has recorded very few hours whereas Mr Horn has clearly done the substantial part of the work?

A. I think you'd need to ask Mr Strachan and Mr Horn that. My recollection is that Mr Strachan did the lion's share of the work. I've read both of their evidence and they both appear pretty consistent and I don't have any argument with the evidence of Mr Strachan or Mr Horn. I think they're both pretty much correct.

Q. Well you were working on other projects at the time, such as the Broadway Building and the Westpark Tower and so forth, weren't you?

A. No the Broadway was probably, well I don't know if it was before or after the CTV. I don't, you'd have to see the job number and the file number to know if it was before or after but I certainly was not working on the Westpark Tower at that stage.

WITNESS REFERRED TO BUI.MAD249.0562.1

Q. Have you seen this table before?

A. No I haven't.

Q. I'll just give you a moment to look at it.

A. Yep.

Q. Now dealing first with Broadway you will see that that job got underway in December '85 and most of the time on that was complete by March '86, you see that?

A. Yes.

Q. So that job, in fact, started and was close to completion much earlier than you were suggesting before, do you agree?

A. Well as I say I've, you're asking me what happened 30 years ago and I'm going as best I can remember so if that's the case that's the case.

Q. Again if you look at the Westpark Tower, which is the fourth one down you'll that starting in January and the substantial bulk of the work being done by June.

A. That may be the case, but I'd certainly done, as far as I'm concerned it was done after the CTV building. The first one I did the ETABS for was the CTV building.

Q. Do you not recall doing ETABS for the Westpark Tower?

A. Yes, but, as I say, at the time I did the CTV I had not used ETABS before, therefore, I needed the copy of that other building to, as a template. So once I had used ETABS on the CTV building I was in a position to use it on Westpark Tower.

WITNESS REFERRED TO BUI.MAD249.0564.1

Q. This is in your handwriting?

A. Yes it is.

Q. And you'll see it has a date, March 13, at the top of it.

A. Yes.

Q. And these are, this is ETABS data for the Westpark Tower isn't it?

A. Yes it is.

Q. It's reporting ETABS outputs from the University of Canterbury ETABS program isn't it?

A. It looks like it yes.

Q. And if you go back to the schedule we were looking at before – **BUI.MAD249.0562.1** - if you look at March 1986 you appear to have spent some 79 hours in that month working on the Westpac *[sic]* Tower do you agree?

A. Yes.

Q. So, in fact, contrary to your recollection do you now accept that you had done ETABS work on Westpark before you did ETABS work on the CTV?

A. No, no, the first one I did ETABS work on was the CTV as I say because that's the one I had the pro forma calcs for so….

Q. Do you recall seeing separate ETABS work that Mr Henry had done prior to this sheet on the Westpark Tower?

A. I don't recall anything from Mr Henry on Westpark Tower. It may well be he did but I don't recall it.

1525

Q. The Westpac Tower design was substantively complete before you started on CTV wasn't it?

A. I don't recall that but are you saying that John Henry completed it before it started?

Q. No, I'm saying that you completed it.

A. No.

Q. Do you recall at any stage suggesting to anyone that you did not know how to use ETABS in the Westpark Tower design?

A. No.

Q. To the contrary has it been your view to this day that you had used ETABS correctly on the Westpark Tower?

A. I'm not in a position to comment on that. I haven't seen it for 30 years.

Q. Can we have please BUI.MAD249.0555.3. You have seen this before because your counsel asked you about this one earlier. This is the building list. Do you recall that?

A. Yes.

Q. Now in relation to the Westpark Tower in Cashel Street, do you accept that that was a nine storey building?

A. I can't recall.

Q. It was a building for which ETABS was required?

A. It's one that I expect that ETABS certainly should have been used for yes, but whether it was or not. It's a very regular building, it's totally symmetrical so it may have been that some work was done by hand, I can't recall.

Q. And you started on that project before the CTV building?

A. Well that's not how I recall it. It may have been that there was some preliminary work done, maybe some work on static, you know, hand analysis of it, some preliminary design work may well have been done. I know that was, if you like a bit unique as well in a lot of ways.

Q. And you were responsible for that project?

A. Yes.

Q. And Mr Henry had worked on it before, you're sure about that?

A. I don't recall.

Q. You don't recall that. And in relation to that you don't make any suggestion in Westpark that you lacked skills or access to expertise do you?

A. No, I've never made that claim.

Q. Now if we can go back to BUI.MAD249.0562.1 please. Just looking at the other buildings listed there, the medical accommodation building was the one where you did, it's the third one down, was the one where you did the calculations before you joined the firm?

A. Yes, yeah.

Q. The Westpac Tower we've just discussed, the Letz building ran a little later in time than the CTV building?

A. Yes, that was the eccentrically braced steel frame one that I talked about.

Q. Yes. And you don't make any suggestion that you lacked the skills or expertise to do that building do you?

A. No. Well that again, it was new technology so there was probably another seminar that I'd been to that you haven't mentioned already that related to eccentrically braced frames that I think Alan and I may have both gone to.

Q. Well you did go to a seminar in July and I'll come back to that shortly but just dealing next with Shangri-la. Again that was a building which you don't suggest you lacked any skill or expertise to do that design do you?

A. No, that was after I'd done CTV and I developed my relationship with Tony and I did preliminary sketches, but I don't believe that ever got to the stage of being an ETABS job.

Q. And the – so you see the CTV building as in effect a watershed building where you learned the skills that you needed to do the other buildings?

A. Very much so.

Q. And where do you say you learned the skills from?

A. Well, Alan showed me how to – he gave me the pro forma calcs, the – I think it was really self taught from going through John Henry's calculations for the previous job, for the –

Q. That's what I think you've described as the template.

A. Yes.

Q. From the Landsborough House.

A. Yes.

HEARING ADJOURNS: 3.30 PM

HEARING RESUMES: 3.46 PM

CROSS-EXAMINATION CONTINUES: MR RENNIE

Q. Can we now have please BUI.MAD249.0233.1. Mr Harding this is a University of Canterbury invoice from the 7th of July 1986. It's stated to be for computer charges for June 1986. Do you see that?

A. Yes.

Q. Are you able to clarify whether that is likely to be the charge for the ETABS work done in June 1986?

A. I have no idea. I assume so but I, it could have been for any number of jobs.

Q. I take it that EXTL315 is not a reference from Dr Reay's office but rather from the university?

A. I can't answer that but, yeah, I assume so. I assume it must be their reference number for him.

Q. If you look underneath you'll see the words have been written, "File 2503." Do you see that?

A. Yes.

Q. We could go back to the plans you were looking back before to see the job number but are you comfortable that that is the job number for the CTV building?

A. Yes.

Q. So does that encourage you to confirm that this is a charge for the ETABS services?

A. Well I assume so. I've not seen it before. I don't, haven't dealt with accounts.

Q. There's nothing on that I take it to indicate that you've approved its payment?

A. No absolutely not.

Q. Now if we go to BUI.MAD249.0519.1. Now you'll recall your counsel referred this document to you this morning?

A. Yes.

Q. You have had an opportunity to look at this seminar paper?

A. Yes.

Q. You pointed out that the handwritten document which is included with it is not in your handwriting. You recall that?

A. Yes.

Q. But I understand you to accept that you went to this three-day seminar in July 1986.

A. Well I, I don't recall it but if, if Alan says that I did and he's got records then I, I don't see reason to dispute it. I haven't, as I say if I had, normally I would have a copy of the, of that document that I could keep referring to but obviously when I left, if I did go, that stayed at Alan's office.

Q. Can we have BUI.MAD249.0469.23 – perhaps we might just go back to 22 first. You'll see that this is a list of registrants. Do you see that?

A. Yep.

Q. And this is for the 1986 seminar and if you look down the list you'll see yourself there. You accept that?

A. Yep.

Q. If we go to 23, can you identify that handwriting?

A. Yes that's mine.

Q. Does that encourage you to accept that you did go to the seminar and took notes at it?

A. Yes I, I don't deny that I went. I, yes if that's my handwriting that, that quite likely is what I would have written down at the seminar.

Q. Yes. If we could just quickly go through 24, 25, 26, 27 so we can show you some further pages of that. Now Mr Harding I'm not going to ask you about the detail of those notes but the position then is that you had

done the initial ETABS work for the CTV building in June 1986. You accept that?

A. I couldn't give you a date when it was done.

Q. Well the date I'm giving to you was taken off the invoice that we were just looking at, 7 July, for work done in June. You see that?

A. Yeah but that, I don't know that the invoice tell, tells me when I did the work.

Q. Now the position is that at approximately the same time you went to this three-day seminar presented by Professors Park and Paulay on concrete construction. You agree with that?

A. It would appear so, yes.

Q. And so any issues which arose from that seminar which came to your attention about the CTV building design you were still in a position to take into account in designing the building weren't you?

A. Yes.

Q. And to be clear you can see from the list of registrants that you went but Dr Reay did not. You accept that?

A. If that's what it says I don't have a dispute with that.

Q. We can take you back to page 22 and you will see that you are the sole representative of the firm in the registrants.

A. Yep I don't have a problem with that.

Q. So is it reasonable to conclude that after that seminar you were fully informed on the concrete construction issues raised in the papers presented?

A. Sorry, say that again?

Q. Is it reasonable to conclude that after going to the seminar you were fully informed on the construction issues raised in the papers presented?

A. Yes.

Q. Yes. Do you recall making any changes to the CTV plans in the light of what you learned from the seminar?

A. I don't, I think if anything it may have been, no I don't recall. I, I've recently had another look at those seminar notes since they were

produced maybe three or four days ago and I can't see anything in them that, that would have changed what I did on that job.

Q. I think your point Mr Harding is that you looked at them three or four days ago, they've been on the Commission's secure website for quite some weeks. Do you realise that?

A. No.

Q. Now after going to the seminar you would be more currently informed about these construction issues than Dr Reay. Do you accept that?

A. I'm not in a position to judge how informed Dr Reay is. He is a doctor. He's a PhD. He's designed several buildings at the time I did this. So I wouldn't pretend to be as informed as he is after going to one seminar. I think that's a, a CPD, continuing professional development issue which I was fortunate to be able to undertake.

Q. The seminar provided access to experts in this particular field including Professors Park and Paulay, did it not?

A. Yes it did.

1555

Q. Provided for discussion sections and interaction with the presenters?

A. I can't recall.

Q. Do you recall raising any uncertainties about your CTV design –

A. No.

Q. – to the seminar presenters?

A. No, I was – I wasn't sufficiently experienced in it to start raising issues, I would basically take that home and digest it over time.

Q. I understood you to say to me earlier that after the CTV building you felt you had the skill set and the expertise to design buildings of this type?

A. No I said I had familiarity with ETABS so that I could use ETABS with confidence, with more confidence.

Q. Your increasing confidence I suggest would come more particularly from the seminar rather than from working on the CTV design?

A. No I think that most of what was in that seminar was reasonably, well I can't judge too much but I mean as Nigel Priestley had already said, Park and Paulay had issued text books in the past and we had a

number of seminar notes and things from Park and Paulay over the time and a lot of that in that seminar was not new.

Q. Would you regard the seminar as presenting what was best practice at the time as you understood it?

A. For the kinds of buildings which it was describing, yes absolutely.

Q. Your counsel asked you some questions about best practice and you suggested that Dr Reay was intolerant of over-design or the inclusion of unnecessary design elements, you recall that?

A. I do.

Q. That was an attitude that he had in relation to efficient design, not an attitude as to compliance of design. You agree?

A. I agree.

Q. Now in your brief of evidence as your counsel discussed with you, when it was drawn up on a number of occasions you were to say things like it was determined, it was understood, expressions in the third person. Do you recall that?

A. Yes.

Q. Was that a wording that you selected at the time or did some other person select it for you?

A. I wrote the evidence myself. No one said anything in my evidence except me. Is that what you mean?

Q. Well indeed I'm trying to determine who used the words it was determined, it was understood and so on.

A. That's just my way of writing my evidence.

Q. Yes, and prompted by your counsel you then suggested that what you meant on each of those occasions was that Dr Reay had determined, Dr Reay had understood, Dr Reay had said and so on.

A. Well I'd have to be reminded of which particular instance. I'm not saying that that is the case always but certainly at the time when I was presented with the job, most of the major decisions had already been made and it was a case of apprising me of what they were, of what he had already told the client. I mean if the client had come to Dr Reay asking him to be the engineer for the job, that is often because of his

expertise in a particular field and it was recognised by a lot of designer builders at that time that he could design things more economically than many others and that with his systems of precast concrete they could perhaps be constructed more efficiently. So because he had developed a number of standard procedures for things like beam column joints and floor beams and various other things, I mean I couldn't pretend to list them all, he would make me aware that this is the one which we have agreed to use on this job. So if he had already for example designed a building using precast concrete walls and he knew that this one was too tall to do precast concrete, that the building was too big to use a mobile crane to build, therefore we'd have to use a tower crane, therefore we were going to have to make it out of a certain kind of product. That the flooring for example instead of using precast concrete floors as we had done in a number of other buildings, he wanted to use steel tray flooring on this job because of his previous experience with it and with his relationship with Fletcher Brownbilt, then that was a decision which he had made and agreed with the client and he was passing that on to me, so it wasn't something he was asking my permission for or my opinion of, it was an instruction.

Q. Well you talked about the main elements of the project. The layout of this building was essentially determined by the design build contractor wasn't it?

A. I can't tell you that, I had no contact with the design build contractor.

Q. Can we go please, and you won't have this on your list I'm sorry, to BUI.MAD249.0041.RED1. Now this is a letter from you to the Commission of the 20th of September 2011. You recall this?

A. Yes.

Q. If you look down to paragraph (e) second sentence you will see you said, "However I understand that the layout of the building was determined by the design build contractor." You see that?

A. Yes.

Q. And that's exactly the opposite of what you've just told me isn't it?

A. No, I said that I had no contact with the design build contractor. That's what Alan told me. He said that the design build contractor had seen the Contours building and liked the look of it. That's why he basically engaged Alan Wilkie as the architect and why he came to Alan as the engineer, I can only surmise but when Alan briefed me on the job and gave it to me, that was the message I was given, that the design build contractor had seen the Contours building and liked the look of it.

Q. Now the main elements that came from the architect and/or the design build contractor were that there was an offset lift shaft. Do you agree?

A. So I was told, yes.

Q. Façade detailing with round columns?

A. Yes.

Q. Precast façade panels.

A. Yes.

Q. Recessed glass line.

A. Yes.

Q. Layout and spacing of round columns.

A. So far as I'm aware, yes.

Q. So that your task was to establish the structural design within that architectural concept?

A. Well the first object was to model it on the ETABS computer and find out whether there were any issues regarding inter-storey deflection. So the first input to the computer would have been to use the walls exactly as they were on that drawing at the time I was given it.

Q. Which drawing are you referring to?

A. Well I can't tell you because no one's given me any architectural drawings but that's normally, like, Mr Strachan said the same thing. He was given architectural drawings and away he went from there and that's the same thing.

Q. Is it your belief you had a drawing for the Contours building?

A. No, we had no drawings for the Contours building.

Q. So what drawing do you say you're referring to?

A. A drawing which had been prepared by the architect for the CTV building, following discussions that Alan had had with the owner and with the architect.

Q. Now in relation to the work that you were to do, you've indicated that you were given a copy of Mr Henry's work on Landsborough House as a template. That's correct?

A. As a method template of how to do an ETABS analysis.

Q. I'm just going to read to you a letter you wrote on the 1st of April 2012 to the Commission. I'm not proposing to put it up and it's only a short quotation. You wrote, "It was never intended to model the structural or architectural design features of the building on Landsborough House." Do you agree with that?

A. Yes.

Q. "I was given a copy of the structural calculations for Landsborough House to use as a template for the method of how to design a building using an ETABS analysis."

A. Yes.

Q. "But not to follow the design features of that particular building."

A. Of Landsborough House no. That's correct.

Q. And again you said, "It was never intended to model the design of the building on Landsborough House. I do not recall any discussions on the differences between these two buildings.

A. Between Landsborough House and CTV, that's correct.

1605

Q. The reference Sir for the record is BUI.MAD249.0286A.RED3

JUSTICE COOPER:

Q. Can I just ask, so you wouldn't have had plans of Landsborough House either?

A. I don't recall seeing them. Like they most likely would've been there, and I think if Wayne were doing, Wayne Strachen were doing the architectural carcase drawings, it's more likely that he would've had them so that he could set out the CTV building in a similar way and use

the same kind of precast beam situation, but there was no reason why I would've seen the drawings for Landsborough House.

Q. You wouldn't have wanted to see those drawings to assist you to understand the calculations?

A. No, the calculations were very clear.

CROSS-EXAMINATION CONTINUES: MR RENNIE

Q. Now you may recall in paragraph 37 of your brief of evidence you went systematically through the elements of the design of the CTV building as it was ultimately designed by you. Do you recall paragraph 37?

A. No.

Q. Would you just like to turn to paragraph 37, or though I'm going to put the same material to you in a slightly different way.

WITNESS REFERRED TO PARAGRAPH 37 OF BRIEF OF EVIDENCE

Q. Paragraph 37 is quite a lengthy paragraph in which you discuss –

A. Yes.

Q. – each stage of the build. Now first of all do you agree that the design which you developed for the CTV building did not use standard details?

A. Do I accept that it did not use standard details? No it did use a lot of standard details.

Q. Which details do you say were standard? The beam column joints for a start were not a standard detail were they?

A. The beam column joints were, were a standard detail, yes. That's something which had been used a lot of times in not just multi-storey buildings but I mean the likes of Broadway and a lot of those would've had that same kind of detailing in them. That was one of Alan's situations where he designed it so that you could use a precast concrete bottom half of the beam and put it in place and then pour the top half of the beam with the floor. That was a standard detail.

Q. Now you understand we're not talking about the construction concept or method, we're talking about a design structural standard detail that was simply applied to this job from an office reference?

A. Yeah, I'm talking about the way in which it was done. Having a precast bottom half of the beam, an in situ column and an in situ top half of the beam.

Q. But in fact you designed, detailed and specified these joints yourself specific to this job didn't you?

A. Well as I say, the reinforcing you adapt to suit the standard and the loads but the way of doing it is a standard detail. That's one of the things that Alan would have had discussions with, with Wayne at the beginning. There were other panels like the spandrel panels and the perimeter beams were a different shape than what the main beams were on the internal. I can guarantee that all of the shapes of all of those would've been something that Alan would've had a lot of input to. Probably directly with Wayne and in a lot of cases I get the carcase drawings from Wayne with the outlines and I just fill it in with reinforcing. So that's one of –

Q. So are you suggesting that the draughtsman originates the detail, not you?

A. No, I'm suggesting that the draughtsman has a standard way of doing things, sorry the office has a standard way of doing things which the draughtsman is made aware of and then he adapts that standard to that particular job in terms of dimensions when he draws the carcase drawings.

Q. Well we have this issue about whether the draughtsman on this one was Mr Strachan or Mr Horn but I'm just going to use the neutral expression "the draughtsman" for the moment. Either draughtsman was freshly recruited to join the firm for work of this kind wasn't he?

A. Well I know Terry Horn was. I don't know about Wayne. I think, I'm only going by reading the evidence as to why they were recruited and where. When Alan initially rang me I didn't know which draughtsman he was talking about.

Q. No in the statement when he first rang you was that he had recruited draughtsmen –

A. Draughtsmen yes.

Q. – draughtsmen from Holmes Wood to do work of this type so that his office had the necessary resource?

A. That's as I recall yes.

Q. So are you suggesting that they did not apply a Holmes Wood approach but somehow applied a new Reay approach?

A. I'm not in a position to say what the Holmes Wood approach was. I've no idea what that was. I've no familiarity with that. You'd have to ask John Henry that question. I'm just going from the evidence which Terry Horn has written and that John Henry has written. John said that when he joined the firm it appeared that the draughtsmen who were there were not experienced in multi-storey buildings which is why John arranged for Terry Horn to come across.

Q. Yes, and the work record shows many hours from Terry Horn on this project doesn't it?

A. I, you know, I can only say I only recall dealing with Wayne on that job and I've read Wayne's evidence and he says that he did most of it but Terry may have done some of it, and that appears to be the same as what Terry's evidence says and I see no reason not to accept that.

Q. And the plans that we've looked at don't assist by identifying which draughtsmen drew them do they?

A. I recognise Wayne's writing on most of those drawings. I didn't actually notice Terry's writing on any of them. I didn't do, I can't actually remember really doing any work with Terry while I was there. Mostly Terry would work directly for Alan. Often doing concept drawings and getting buildings started as the chief draughtsman and then they would pass it on to some of the junior draughtsmen and then Terry and Alan would keep a good eye on what those guys were doing and how they did it, so I don't actually recall having a lot of contact with Terry at all really.

Q. Now speaking of the main elements of the CTV design. Firstly, in terms of the design concept, would you agree it was a shear wall seismic design with an elastic gravity system?

A. I wouldn't call any of it elastic. I think the ultimate load system was used on everything but I think John Henry's description of it as being a shear wall stabilised gravity beam system is as good a description as I've heard.

Q. And that was what you were setting out to design when you took this job on?

A. That's the way Alan said he wanted it done, yes, that was part of the brief when he came to me to say that it's going to work the same way as Landsborough House did, and that is how that was done. The reason for that being that you then don't have to model the beams and columns in the ETABS program. It makes the whole job a lot simpler and it makes the construction simpler because when you're building the columns and the beams you don't have to go to the extent of ductile detailing and it's very difficult to use precast panels and beams when you are required to do ductile detailing.

Q. But the ETABS test was to see whether this was feasible wasn't it?

A. The ETABS was to see whether the walls were big enough and whether they were in the right place in order to limit the inter-storey deflection to the code required limit.

Q. And the assessment you made of the first output of that was that it was not sufficient because there was only a shear wall on the north side?

A. Yes. There was, basically it was like an E shape facing downwards where there was a wall along the north boundary and then there was about four fingers facing in toward the building in the north-south direction and that configuration didn't have any torsional rigidity. It was torsionally unstable, but there's the potential that those four fingers in a row may have given some torsional strength, so the initial object was, even though there were lift shaft cores and stairwell cores beside two of those walls, to see whether it would work in that configuration and the ETABS basically indicated that it wouldn't.

Q. And having formed that view you proposed the south shear wall?

A. Yes I did.

Q. And that was a proposal you put to Dr Reay?

A. Yes.

Q. Who had to clear it off with the client?

1615

A. That's my recollection that he was reluctant to say yes until he'd okayed it with the client and the architect.

Q. The design could be described as moderately eccentric.

A. I don't know how you define moderately and major. I think my understanding of torsionally eccentric when it comes to whether you use ETABS or not is that if the shears in the walls due to torsional effects are greater than the shears in the walls due to translational effects then it becomes a torsionally eccentric building and my understanding was that's, before we put the extra wall in on the south I would have called it torsionally eccentric. Once we had the extra wall in on the south it's debateable. It may well have fallen below that threshold by then because basically in the north/south direction you just had the four walls and the centre of rigidity and the centre of mass would have lined through so in the north/south direction there was virtually no eccentricity. In the east/west direction you've got the long wall along the north boundary, ignoring the ones that come south towards you, and you've got the relatively shorter wall on the south. So there are two walls, one bigger than the other, both going in the east/west direction and if the southern wall had been big enough you could have described it as being torsionally symmetrical. The trick was how big and how flexible was that southern wall.

Q. Were you satisfied that you'd identified the solution to that with the wall you designed for the southern shear wall?

A. Well I believe so after having referred to those seminar notes which you are referring to, the 1986 one. I think there's a page in there which actually shows a layout of walls very similar to what we've got on the CTV building and it refers to it as being an acceptable solution, so that's really one of the reasons I proposed it.

Q. And you considered this investigation and the origination of this solution to be within your skills and expertise?

A. Well at that stage I'd run the thing through the ETABS programme four or five times trying to get it to work without that wall and some of those times would have been me learning how to use the programme because I think a couple of the things that came back were dud results for some reason. But so once I had actually modelled it again with that coupled shear wall in place I was reasonably proficient with using ETABS by then.

Q. Would you describe the south shear wall as a relatively new design concept?

A. No I think coupled shear walls were fairly well, fairly well used by then. I don't think that's new in any way at all.

Q. You were comfortable that was within your field of skill and expertise?

A. Yes.

Q. The foundations for this building were of a typical design?

A. Ah, well I mean, yes I don't think there's anything revolutionary about them. I think we took a very simplistic view about foundations in those days. We didn't model the flexibility of the soil like we would today so the assumption was when you had a pad there big enough that you'd assume that that foundation was rigid so that when you had lateral loads on the wall you didn't model the rotation of the foundation or the flexibility of the subsoil. So certainly the kind of design we were doing back then wouldn't past muster today.

Q. But you would describe that design as being typical of its time.

A. Yes.

Q. And you had had at Waimairi particular experience in relation to foundations, soil strengths and matters of that kind.

A. No I wouldn't say that. I think, for that particular job, we were very reliant on having a geotechnical report done which we had done and I followed the recommendations in that report. It was nothing to do with anything I did at Waimairi. I had no experience with anything of that scale.

Q. You had such a report on this occasion.

A. There was a geotech report provided yes.

Q. And you were satisfied with that.

A. Yes.

Q. The north shear wall: would you accept that as a standard shear wall design?

A. I don't know what you mean by standard. It complied in most ways with the seminar notes which you refer to. We certainly used the seminar notes when designing all of the shear walls, or if not the seminar notes at least the text books and the standard procedures available at that time. There is nothing revolutionary in there.

Q. The text books you're referring to, for example, are works by Park and Paulay.

A. Yes.

Q. Now in relation to the columns the question of drift standards, I understood your evidence, when lead by your counsel, to adopt the position that they meet the drift standards as defined by the Hyland Smith report.

A. I don't know about the Hyland and Smith report. I believe they complied with the drift standards set out in the Code in 1984.

Q. In relation to floor gravity loading would you describe that as a standard Hibond system?

A. No I wouldn't. No I was, to me the Hibond system is something which is more compatible with steel frame construction. If you've got steel columns and steel beams you put the Hibond on the steel beam and connect it to the beams with stud anchors to create a composite beam. The benefit of the Hibond is to be able to build multi-storey buildings without propping to the level below so that you can be pouring concrete on one level while the level above you're sticking the HiBond down with some studs and on the level above you're busy building a steel beam. So in this particular job it was an unusual use of HiBond. I wouldn't have picked it myself. But that was something which Alan wanted to use. He'd done a number of buildings for Fletcher Brownbilt, farm buildings. They weren't selling much of their steel flooring and he was

quite keen to have an example to the industry of how it could be used and this is, to me, a reasonably unusual situation for using HiBond.

Q. Or was it that the design building company wanted HiBond?

A. I can't answer that. If that was a factor I had no input to that.

Q. Now clearly there was an issue in fact in 1986 about the floor seismic diaphragm which was not picked up until 1990/91.

A. In terms of drag ties? Well, yeah, as I've said, for the north/south earthquake, which is really where the drag ties would do their job, most of the load is taken by the two large walls which are connected to the floor beams by the reinforcement interacting. So the lack of drag ties there means that you're not getting the full benefit from the two smaller walls in the north/south direction. In terms of an east/west earthquake, as I say, it's really the east/west part of the northern wall on the north boundary and the wall on the south boundary that are doing the job so so long as the floor slab is connected in some way to the northern east/west wall I wouldn't see drag ties as being essential. But I accept that by having drag ties you get, to some extent, a better connection to the smaller walls but, as I said, there were no drag ties on the Landsborough House job and it was quite interesting when Alan rang me in 1990 to say that, to ask me if I had put drag ties in and he'd been speaking to Grant Wilkinson of Holmes Consulting. Apparently Holmes Consulting, Grant, actually said at that time that they were aware of a number of jobs that Holmes had done which didn't have drag ties which they had thought, in retrospect, should have had them. I think the reason for not, well I don't know the reason why they weren't considered. I guess, in hindsight, maybe if Terry had been the draughtsman he would have been looking for that kind of detail. I think, as it was, it was something which, as I say in hindsight, it should have been put in and I think the fact that Grant picked it up and that they went and retrospectively fitted them, in my opinion, it was easier to fit them than argue about whether they were necessary or not.

Q. Now the point of Dr Reay's enquiry to you in 1990 was to ask you whether you had put drag ties in which were not shown in the plans, that was the point of the question wasn't it?

A. Yes it was.

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Q. In other words had the design been modified during construction by you or on site?

A. That was the reason for the question, yes.

Q. And the answer you were able to give was?

A. I didn't recall having asked anything other than what was shown on the plan at the time of construction.

Q. And at 1986 your perception was that the connection was sufficient?

A. After the retrospective work had been done I had no, I didn't know whether the retrospective work had been done. I didn't find out until reading evidence that it, that it actually had been done.

Q. Yes I think you missed the date in my question Mr Harding. I said as at 1986 –

A. Yes.

Q. – your perception was that the connection was sufficient.

A. At the time it was put in for a building consent I had no reason to think otherwise.

Q. And designing a connection of that kind was within your skills and expertise?

A. Yes.

Q. And, and in that sense not an unusual or abnormal requirement?

A. No.

Q. Now turning to the beams would you accept that they met the code for gravity in seismic loads?

A. Well the beams had no seismic loads on them. The beams were designed for gravity loads only.

Q. You referred to the situation with Landsborough House. Landsborough House was not a Hibond floor system was it?

A. After reading John's evidence I, it appears not, no, but I, I don't recall that. I don't, as I say I'm not sure if I saw the drawings for that.

Q. "Concrete rib with infill."

A. Okay. That's more normal for pre-cast floor. That's what we would normally have done in a pre-cast concrete beam system.

Q. And that's where you're able to drop the concrete infill in using a crane?

A. Well no you have the pre-cast beams, the bottom half of the beam, and then you put a series of planks across between the beams and then you use timber infill between those planks. Generally the planks are about 200 mm wide and there's about a 700 mm gap between the planks that you put the timber infill in and then you pour a topping over the top of the whole thing and that generally forms a lighter floor than what the Hibond. The Hibond ended up being a very thick, very heavy floor.

Q. And with, with extra strength if I understand your evidence.

A. I don't think extra strength. I think that's one of the things that I've thought about a number of times regarding this vertical acceleration. I think that, well I could go on about it but I mean I think that over time the load factors have reduced. I think when we first design things we had 1.5 dead and 1.8 live and we've reduced it to 1.4 dead and 1.7 live and it's now down to 1.2 dead and 1.5 live. So I think we actually had better strength in our floors then than we do now, but I have no reason to think that the, either the rib and infill or the Hibond was stronger. I, I prefer the rib and infill because it's lighter and it's less susceptible to, well, to vertical acceleration or – I mean how the Hibond goes in a 200 mm floor with doubling the weight in a gravity situation and whether the bond is adequate for that I, I've wondered about that a few times. I've read the evidence as to how the Hibond has performed, looking at some of the photos and the fact that a lot of the Hibond has been separated from the concrete and I, I wonder whether the Hibond is actually, well I don't believe it's the best produce in that situation I think is all I'm saying.

Q. Yes and in fact Dr Reay's evidence would be that it was a requirement of the Design Build Construction Company, not his requirement.

A. Okay well I, I can't comment on that. That wasn't anything that I, I was only given the instruction to use Hibond. I, I'm not privy to how that decision came about.

Q. Now we've discussed the beam column joints but you consider that that element of the design was within your skills and expertise at the time?

A. Well as I say that was a standard detail. There was no, there was no ductile action of that. It was a standard detail using standard procedures. So all I needed to do was calculate the reinforcement.

Q. You also designed the roof steel work for the plant room and the crane platform.

A. Yes.

Q. And all of those were within your skills and expertise?

A. I believe so. Could you just repeat, the crane platform, the roof steel work, the plant room.

Q. The roof steel work, the plant room and the crane platform.

A. Yes.

Q. Yes and so in summary if we take the elements of the structural design they were in fact all matters within your skills and expertise?

A. There was nothing new. It was really just the fact that it, I hadn't done it before and there were, there's always some item of a design like that which an experienced engineer when casting his eye over it will say, well have you thought about this or, or why have you done it like that and when you haven't done something before there's always, you don't know what you don't know. You may think you know it all but if you haven't done it all, if you haven't done it before you can't afford to be confident that you can do it. So that's really part of this business of, it's a, it's a ethical thing. As an engineer you've got to feel in your own mind that you are confident to do it. You've done it before. You know what the traps are. If you feel that you don't have that confidence you seek someone to review it.

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. I would not have done it if it had been me by myself. If I'd been asked, as I say, as an independent consultant to do that job, to take on that commission at that time I would not have done it.

Q. Now you've referred earlier in your evidence to Mr Scott of the Design Build Company. You recall him?

A. Yes certainly.

Q. Have you read the brief of evidence that he has filed for the Commission?

A. I don't think I have.

Q. No. The reference is WIT.SCOTT.0002.2. First we'll look at paragraph 4 if we may please. If we could have that enlarged. Could you just read that through please Mr Harding.

A. Yep.

Q. Do you accept that?

A. No I don't think I've ever visited Williams' office. I think he may be, may be confused. I wouldn't even know where Williams' office is.

Q. Or more accurately was.

A. Okay.

Q. Well leaving aside the question about whose office you met in do you recall meeting Mr Scott in the way he describes?

A. No the only, I met, first time I met Tony was after the building was starting to be built and we were having site meetings.

Q. If you have a look at paragraph 5 next please. Do you recall at any stage referring Mr Scott to Dr Reay on any matter related to the project?

A. Do I refer –

Q. Do you recall at any stage referring Mr Scott to Dr Reay at any stage in the project?

A. I had no reason to during the construction. At the time of construction when Tony was involved the design was, was decided and we had a building permit and we were just building it toward the drawings. There was no reason to refer Tony to Alan for anything.

Q. Given the matters we've just been through in paragraph 37 of your brief which I took you to, do you maintain the position you state in paragraph 37 as to the compliance of your design?

A. Sorry which, what am I referring to? Everything in 37?

Q. Yes you can look through that.

A. Yes I, I'd no reason to change anything I've said there.

Q. Thank you. Now if we go to BUI.MAD249.0141.1. You've seen this document before.

A. Yes.

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Q. Do you recall this, the document transfer form. This is your transfer on two sets of drawings containing amendments.

A. Would appear so, yes.

Q. Now you'll recall that prior to that there was Mr Tapper's letter which is, apparently we're going to come to it at the permitting stage, so I won't be asking you about that today, but in relation to the design matters which are raised in that document transfer form, do you recall now what the amendments were which you had to make?

A. No. No I think a lot of the things on that letter are more drawing than design. They're just details which hadn't been drawn yet at the time, as I say I think the drawings were prematurely sent to the Council and there was still work for Wayne to do on them.

Q. And do you recall whether the drawings would have been sent by your firm or by the design build company?

A. I doubt that it would have been the design build company. I think all contact with the firm in most of these situations is by the engineer. There's no real reason for the design build company to be involved in that process so far as I'm aware.

Q. Mr Tapper's letter opens by saying, "It is re an application," and it gives the application number. Would the application for building consent have been made by the design build company, the architect or the Reay firm?

A. I have no idea. I was just sitting in the back room so what happened once it went onto Alan's desk, who took it from there I have no idea.

Q. And you were asked by your counsel about the matter of the design certificate. Do you recall that?

A. Sorry say it again.

Q. You were asked by your counsel about the matter of a design certificate.

A. Yes.

Q. And if I understand it correctly you have never sighted a design certificate?

A. Well I'm going from the documents that have been presented in evidence.

Q. Yes.

A. From 30 years ago so I have no recollection of anything directly. I'm just looking at what's been put in front of me now.

Q. Given that you originated the document transfer form would it have been normal for you to originate the design certificate?

A. No.

Q. Why not?

A. Because that was really the final sign off that Alan would do, and especially if it was one of the first jobs I'd done going back, Alan would definitely take that unto himself.

Q. Would you have expected a design certificate to accompany those plans under that transfer form?

A. Well as I say when the job was initially put in with half completed, well partly completely drawings, I definitely would not expect a design certificate to go in at that stage. It would be folly to issue a design certificate for drawings that you knew weren't complete. You would never do that. So at the time when the drawings had been completed, it appears that once Wayne had been through and completed the drawings we copied them off and I shot them off to Mr Tapper and he obviously asked for some calculations in that letter regarding bondek which I must have done for him. So I was really just giving him updated drawings. I had no input to whether a design certificate had been in or not. I would expect that Mr Tapper would have asked for one once he had received all of the satisfactory drawings. There may well be other

requests for information from Mr Tapper apart from that one, but I have no recollection of any of that.

Q. The point of my question was much briefer, which was simply whether you would expect the plans sent in that form normally to be accompanied by a design certificate?

A. Not if they were incomplete. If they had been complete I would have expected one to have gone.

Q. I take it you have since drawing your brief of evidence considered Dr Reay's briefs of evidence?

A. Yes.

Q. And do you accept that there was a difference of view between him and you as to the level of involvement he took with draftsmen and work supervision?

A. Well he's the one who can ultimately say how much time he spent. I wasn't sitting there with a clock deciding how many hours he was spending on each job. I was just getting on with mine. What I'm really saying is that when I saw him going around the draftsmen, looking at what they were doing, coming to me asking me questions, to me that was confirmation that he was doing reviews of the job. Now as to the extent of that review, the number of hours he deemed necessary in order for that review to go, that's his call not mine. I was just reassured that he was reviewing it and that I wasn't doing it by myself. If I had thought I was doing it by myself I would have bailed out right then.

Q. So is it your contention that all the work that you did at the draftsmen stage was invariably reviewed by Dr Reay?

A. No, I can't say invariably. I think it was a fairly intermittent process, I –

Q. And Dr Reay may in fact have equally been discussing his own jobs rather than yours with the draftsmen.

A. No, well at times he was, but as I say, anything that was said in that office could be heard. Alan had a very loud voice, so did Terry and if anyone was having Alan talk to them everybody in the office could hear that conversation so you would know if he was talking to the draftsmen

working on your job. You tended to listen to what was going on and when a question was being asked, why did you do things this way.

JUSTICE COOPER:

Q. The way you're describing it, you're relying on overheard conversations for your assurance that Dr Reay was looking over your work. Is that the impression you want to leave with us?

A. Well I have no way of knowing what he considers appropriate in terms of the number of hours needed for review. If he had not been looking at the work at all I would have been concerned that he wasn't reviewing the work.

Q. Yes.

A. When I knew that he was looking over their shoulder I was reassured that he was reviewing the work.

Q. But you're not giving any specific evidence of him coming to you and asking you about details of these plans of the CTV building are you?

A. That's too long ago for me to recollect specific situations.

Q. You can't recall. And is it the case that you can't recall either going to him with particular difficulties or questions that had arisen in your mind as to the job progressed?

A. No, I specifically remember going to speak to him about the southern shear wall. I remember sitting in the front office and having that exact discussion.

Q. This is after you had taken the project a certain distance and discovered that it wasn't going to work as it had been designed up to that point?

A. Yes.

Q. Any other instances where you can recall going to Dr Reay to raise issues or concerns?

A. Not specifically but as I say after 30 years I doubt that I would remember anyway.

Q. You keep saying 30 years, but it's 26 in fact isn't it?

A. Twenty-six yes.

Q. So if you did have issues as the design progressed which you raised with Dr Reay, apart from the southern wall, you can't tell us what they might have been?

A. No, I think what happened, as I say there'd be from time to time he'd be looking over the shoulders of the draftsmen and there'd be a particular detail of precast beams or connections or what have you and he'd come and say, you know, we do it like this or we do it like that. That would happen pretty regularly, there'd be times when I was designing panels and I'd be designing them with reinforcing bars. He would say no, we use mesh so he'd redo it with mesh, but it wasn't the sort of thing that I would write down in my diary as to, as you know it's not like you're having a discussion with a client and you write yourself a file note as to what the decision was and how you made it. This is just the normal day to day conversations you have in a design office, so there's no reason why you would take particular note of them.

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Q. And what you've just said related to the CTV building did it or is it just some sort of generalised memory that you have?

A. That was one of the earlier examples. Whether it applied to CTV I can't answer that. I suspect probably that particular message probably wasn't the CTV that was probably another building but, yeah, there would be regular review of what the draughtsmen were doing because Alan was very particular how the drawings were done and in what amount of detail. Sometimes Wayne got his hand smacked for doing too many details trying to iron out every single problem and he was told that that wasn't necessary and I remember similar discussions with me that I was trying to go to too bigger, too closer degree on it and this is our standard detail, just do it like that, don't try and reinvent the wheel.

Q. Just, I'm really just wanting to know whether in relation to the key structural elements of the building – you've told us about the south wall – but you've also said to Mr Rennie that those structural elements were all matters within your expertise. You made the point that you felt comfortable with designing them but reassured by the fact that there

was somebody available to check your work. Apart from the south wall you can't remember whether there was any particular concern you had, which you raised with Dr Reay, as you went about this process of design.

A. No I can't.

CROSS-EXAMINATION CONTINUES: MR RENNIE

Q. Mr Harding is it your proposition that Dr Reay would go to a draughtsman, look at their work, direct a change in the work but not communicate that by discussion with you?

A. No absolutely he would come direct to me after he'd spoken to the draughtsman.

Q. And explain why the change should be made.

A. Yes.

Q. And obtain your agreement.

A. Ah, there wasn't really much of that, no. It was, you could have a big long argument with him if you wanted to but ultimately there'd only be one winner for those arguments so it was a case of just doing it.

Q. Whatever level of empowerment you felt you had he would discuss it with you and the two of you would agree to the change.

A. No, as I say, occasionally but, as I say, I can't remember any situation where if I had a different opinion then my opinion would have been taken. I think the south wall was something where he accepted it but I think in hindsight, reading John Henry's evidence, I think he half expected me to come up with that anyway because he probably –

Q. Well I don't think, Mr Harding, it's helpful for you to speculate of what you think Mr Henry's evidence may mean. Just concentrate on what actually happened between 1985 and 1988 in this firm. Is it your evidence that on each occasion that Dr Reay saw something in one of your projects where he considered that a drafting change or a design change should be made he would come and tell you that and only after that would the change be implemented?

A. Yes.

Q. And do you recall that ever happening on the CTV project?

A. Well, like I say, it's not something that I made specific note of. It was something that happened on a day-to-day, week-to-week basis.

Q. But if we analyse what we're looking at it would either be an error by the draughtsman or an error by you wouldn't it?

A. No it doesn't have to be an error. It can just be the way of doing things. It can be a way of connecting things. It can be whether a standard detail is something which has been used before which we haven't used rather than trying to reinvent the wheel and do something a different way.

Q. So it could be a matter of an improvement or enhancement not just an error.

A. Well it most likely was an improvement or an enhancement or some way of simplifying it or making it more economical to build by making more elements precast than in situ and being a bit, I wouldn't say revolutionary but inventive, you know, thinking outside the square as to a simpler way of building something.

Q. Isn't that just the type of knowledge extension and skill enhancement you were expecting to get when you went to the firm?

A. Yes it was, absolutely.

Q. And to what extent do you say the frequency of these discussions occurred?

A. Well they were more regular at the beginning and less regular towards the end. I think once we had an understanding as to what his feeling was and what his preference was and what the standard details were those kinds of discussions would be less often. I mean once you know that he wants mesh used in panels instead of reinforcing bars you design all the panels with mesh and that it's not a big deal.

Q. Is that really just a case of designing to the house style rather than to something that you personally might have wanted to try?

A. Yes I think that's true.

Q. The key issues in relation to the CTV building appear to have related to a small number of design elements which we went through before. Is it

my understanding that you do not recall any discussion with Dr Reay on any of those?

A. No I'm not, well there will have been discussion on a lot of them but I can't recall those discussions. Certainly in terms of the spandrel panels we would have had discussions on how we do it; in terms of this beam column joints, but, as I say, it's not something that I kept a file note of at the time.

Q. Just pausing on the spandrel panels, when you say "how we do it" are you referring to the specification of the panel or how it is fixed, what –

A. How they're connected to the building; how they integrate with; how much of it's precast; how much of it's in situ; how you connect them; what the simplest way of connecting them is; whether you build them before you pour the floor or after; how big the elements are as to whether you can lift them; whether you use a mobile crane or a tower crane.

Q. And your assessment of the outcome of all of that is that the spandrel panels were compliant and had sufficient clearance.

A. I believe so, yes.

Q. Now the next item that you instanced was the beam column joints. I think you are assuming that there must have been discussion on those rather than particularly remembering such discussion.

A. Well they, as I say, are a standard detail. They had been built like that in a lot of buildings and the only variation was the shape of the column and the width of the beam. The actual mode of constructing it, oh and the fact that it was a HiBond floor rather than a concrete floor, but once you've decided which part of it is to be precast and which part of it is to be in situ it's just a case of working out the geometry of how the bars intersect and don't clash and making sure there's enough anchorage for all the bars and in a lot of cases that's done by the draughtsman.

JUSTICE COOPER:

Q. Are you saying it's a standard detail used by engineers generally, or was at the time?

A. No.

Q. Or that it was a standard detail in terms of buildings designed in Dr Reay's firm?

A. It was a detail which Dr Reay had developed in order to make the beam precast in the bottom part of it so that you didn't have to box the beams and prop them and so on. You could actually build the precast beam and drop it into place between the columns without having to do boxing and in situ pouring of the beam.

Q. So it was a standard methodology employed by Dr Reay.

A. It was a development that Dr Reay, yes he developed it and he tended to use it and vary it in different ways on different buildings.

CROSS-EXAMINATION CONTINUES: MR RENNIE

Q. In fact the beams at Landsborough House had square ends as contrasted to the u-shaped beams at CTV. That's correct isn't it?

A. Yes because the, apparently the Landsborough House had rectangular columns, the CTV had circular columns.

Q. And Broadway, similarly, had square end beams not u-ended beams?

A. I can't recall what Broadway, that's only a two storey building and there had been a lot of other issues on that. I can't, I couldn't tell you what that would have had.

Q. So if a selection of a u-shaped beam for CTV was your design response to round columns, not a standard design.

A. No there's two different types of precast beam on the CTV. The internal columns have got one kind of column, one kind of beam, and the external ones have another shape. The internal beams were very much a standard precast beam design modelled to fit the round column.

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The external ones needed to be a certain shape because of the architectural requirements for the shape of the building and the draftsmen would have modelled that in one of the discussions that no doubt they would have had with Alan and presumably myself, was to whether if they – because they were much bigger than required for

architectural reasons, whether we just precast the bottom or the bottom in both sides or made a U shape out of it or what have you and that's one of the – that'll be one of the things that probably went to and fro a few times between us all to decide what was practical and how we would make it.

Q. So it's now your contention that it was the draftsmen who originated the type of beams to be used?

A. No, the draftsmen would have been given that instruction by Alan before he started doing his carcase drawings.

Q. Or by you?

A. Well as I say the decision as to whether it was precast or not wasn't made by me. It was initially made by Alan and I just basically put the numbers in it.

Q. But Mr Harding we're moving away from whether to have pre-cast beams to talk about the issue of the design of the ends of the pre-cast beams which is quite a separate issue isn't it?

A. No, it's all part of the same question, that the whole, the way you decide whether the pre-cast beam is feasible is by working out the joint detail first. It all hinges on a satisfactory joint detail.

Q. And I understood you to say that the first cut of that would be done by the draftsman?

A. Well the concept as to how it would be done would be discussed between Alan and the draftsman and in some cases with me, and we'd make sure that it would work. I would often – the draftsman would basically do what they call carcase drawings which show the overall shape of the beam and from that I can work out its weight and its dimensions and work out the reinforcing that will go in it.

Q. And in fact the design process which operated was between you and the draftsman with Dr Reay not involved. That's the case isn't it?

A. No that's not the case. I've said to you the whole idea as to whether it will be pre-cast or not and how it would be fitted together is something that Alan took a lot of time with the draftsman discussing.

Q. You regarded the draftsman as competent to do that work?

A. At the time I certainly did yes.

Q. Are now suggesting that one of them was competent and one of them was not,

A. No I'm not saying that. I'm just reading their evidence and it would appear that Terry had a lot more experience in multi-storey buildings than what Wayne did, that's all I'm saying, from reading their evidence.

Q. So you're not actually drawing a conclusion as to their skill or competence?

A. No I'm not.

Q. And what proportion of the design time for this project would you expect to be taken up with the draftsmen working through the beam column joint details?

A. I've no idea. If it's a standard detail half of the thing is sorted, you just have to go through – it – I can't tell you how many hours it takes. It's one of the trickiest parts of the job is not having reinforcement clash when you've got it coming from three or four directions at the same time.

Q. And here you had beams going into square columns, you had beams going into round columns?

A. Yeah.

Q. You had a north shear wall and a south shear wall where the beam ends also had to be determined as to their positioning and placement.

A. That's correct.

Q. And all of that would be a major part of the draftsmen's work on this project?

A. That is true.

Q. So a reasonable inference could be drawn that the draftsman who has most time recorded against the project is likely to be the draftsman who did the work?

A. Well I don't know who had the most time recorded. My recollection is that Wayne did most of the work. I can't comment beyond that. In the drawings that I have looked at, looking at the style of numbering and writing, it appears to be Wayne's.

Q. But the numbering and writing is a post plan tracing process isn't it?

A. Yes, some cases it is, but ...

Q. So the question of who finally lettered the drawings may not tell you very much about who did the primary drafting work?

A. Yeah, I'm not in a position to comment on the number of hours that each of them spent, and you are right, if there was a tracer involved then it is impossible to tell.

HEARING ADJOURNS: 5.01 PM

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