COMMISSION RESUMES WEDNESDAY 18 JANUARY 2012 AT 9.31 AM

MR ZARIFEH CALLS:

WILLIAM HOLMES (SWORN)

Q. Mr Holmes you've given evidence to the Commission before in relation to the Pyne Gould Guinness building, and as I covered in opening I think you have some 45 years or more of experience in all aspects of structural design, particularly design for protection from earthquakes?

A. Yes.

Q. And you've got a Bachelor of Civil Engineering from Stanford University and a Masters of Structural Engineering from the same university?

A. Yes.

Q. You have been asked by the Royal Commission to peer review the various consultants' reports that were completed for the Department of Building and Housing and the expert panel's report, peer reviewed those consultants' reports?

A. Yes.

Q. And you've done that for the consultant's report from Adam Thornton into the Hotel Grand Chancellor collapse and the expert panel's report of which Associate Professor Pampanin was a member that reviewed that report of Adam Thornton?

A. I did.

Q. And I think you've got a power point presentation?

A. Yes.

Q. To present your peer review or a summary of it?

A. Yes.

Q. Thank you. Can I ask you to now present that to the Commission.

A. Okay.

POWER POINT PRESENTATION

MR HOLMES:

A. First I want to congratulate Mr Thornton on his remarkable graphics that he used both in the report and in the presentation yesterday to help

people understand the incredibly complicated building. I suspect that those graphics are going to appear in many PhD theses and power point presentations many probably without attribution for the next decade because I think many people will be looking at this building.

My comments today are largely the same as my review report that was dated November 2nd, in which I basically agreed with the primary failure mode as everyone does but had quite a few questions regarding the backup analysis and Mr Thornton subsequently has kindly submitted some written answers to some of my questions but some of the answers created more questions so hopefully the panel discussion will give us a good opportunity to resolve some of these issues.

So again my overall comments I'm in general agreement that the failure was caused by a heavily loaded and very lightly reinforced wall. It seems to be everyone in agreement, it's pretty obvious. The content of the investigative report results. The content of the investigative report results in some questions with the answers either not available in the report or at least not in a record and there was a lot of discussion about some of these questions yesterday some of which may have been resolved, some of which perhaps still have not been resolved. The report relied on fairly simplified analysis techniques apparently due to the complexity of the building and based upon testimony yesterday with the concurrence of the expert panel. One of the most difficult complexities, irregularities in the building is a very strong vertical discontinuity, unusual one because we usually think a vertical continuities with the softest portion of the structure at the bottom and in this case we have a stiff structure on the bottom. This is often the case in high rise buildings where there is a podium but you're typically talking about one or two stories versus 20 stories. You're not talking about a significant, a podium with a significant height, in this case effectively seven stories, 14 stories by number because of the parking consideration. I think this particular irregularity is, was touched upon yesterday by Professor Pampanin and I think this is a very significant discontinuity which causes analytical issues.

The derivation of drifts that was talked about yesterday a lot that was estimated from the displacement spectra how that was done was not clear in the report and again there was discussion about that yesterday. Section 5.2 of the report talks, has some, some tables and a graph that was shown yesterday the derivation of which is, remains unclear in my mind.

And similarly there is a section, an appendix section F.1 which derives the axial loading on the wall D5-6. Again they, those loads were discussed yesterday but the exact derivation of how some of them were derived and the assumptions that were required again is not documented well in the report and in some cases I say that was answered yesterday and some cases maybe not.

Lastly, many people have talked about the very high vertical accelerations that were noted in the February event and not in the September event but again their relative contribution to the failure has not been estimated and many people have stated in different testimony that really is no technical way to do this but the fact of the matter is when, when reports you know suggest that the vertical accelerations had something to do with the performance that is an open ended statement. Now it's interesting to me to note that there, there didn't seem to be a commensurate amount of damage in, in September and there was a lot of discussion yesterday trying to figure out why that might have been but it is also a fact that the vertical accelerations in September were not nearly as high. So one, one implication could be that the vertical accelerations in February were very important to what happened.

Another thing that was discussed yesterday that has not been explained. I say here the explanation is not satisfying. It was not discussed much in the report at all but this, that is that the shaking intensity by some measures and this is a measure I'm using is the response spectra which Professor Pampanin has discussed yesterday but still at the, at the range of periods that affects this building, the shaking would appear to be more intense in September than in I say

January, I'm sorry that should be February, the explanation of the lack of damage has not really been given, lack of damage in September.

The report states, again this was discussed yesterday, that the maximum possible displacements which were estimated on, based upon the peak of the average of the displacement spectra which is somewhat questionable that that, that relates well to this building but nevertheless they were estimated at 700 millimetres in September and over a thousand in February using these averages, but it was also noted that in September two of the four recordings were very high, they would have yielded over a thousand if they were more appropriate than the average and one of the records in February only yielded 850 so the use of the average is somewhat questionable in my mind. It's just a number to compare the average of one in September versus February, I think is, is questionable.

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There was a reference to a paper by Professor Pampanin, maybe when we have our panel we can ask him specifically. He talked about it yesterday a little bit, the reference to the paper in the report suggested that this paper explains why from an academic standpoint I think the terminology was why there was not that much damage in September. Now I have read that paper, maybe I misinterpreted it but the way I read it was that the spectra from September had very little energy in a period range where most older concrete buildings reside, so from maybe a half a second to two seconds there was not very much energy in September but the fact of the matter is there was a huge burst of energy between two and three seconds which is right where this building is so the, what was in the paper that explains there was no damage in September is unclear to me and maybe we can find out later.

There was also a comparison I think at the request of Commissioner Fenwick that was a comparison of inelastic displacement spectra with the estimated displacement in September and there is a huge disagreement that was submitted by Mr Thornton without, as far as I could find, any explanation of why this would be so these plots are of

inelastic displacement response spectra in September so these are all of the different plots with different ductilities and there is a red circle the deflection predicted from calculation from accelerationary spectra and then there is a blue circle which says 'probable deformation observed at site' which is night and day difference and there is four of these submitted all of which show the same tendency and yet there really is no explanation of why the ground motion from a standpoint of dynamics that most of us engineers believe in can't explain this difference so maybe that can be a topic of our panel as well. I have come up with some possible explanations myself and one has to do with the direction of motion –

Q. Just pause a moment Mr Holmes. We do not have this in our material, this sheet, so if that can be, we can go off the screen at the moment.

A. I have a copy of the handout yesterday that also was missing a different slide.

Q. Yes, that has enabled me to make another point Mr Holmes, you just go on, we can follow on the screen.

A. Okay. The direction of the strongest motion September was in fact north-south which is the strongest direction of the building and it minimises interaction with the global moments from the cantilever on the east face, this ratcheting issue, whereas in February the strongest motion was in east-west direction so it is somewhat dangerous to draw displacement spectra without consideration of what direction they you know are pertinent to, so the comparison of those two may not be appropriate. If you took the actual strongest direction by considering both components then you could compare apples and apples but I haven't seen any rotation of the motions to figure that out yet. That would also help us understand the interaction of the two directions which I think was very important in this building. The other possible explanation is that the damage in September in the frame superstructure was actually greater than reported. It is unclear, and maybe we will find out later today, how many finishes were taken off to inspect the frame, the concrete frames. There could be cracking there

that was not observed because other clues that engineers use about how much drift occurred may not have been there.

And lastly, and again Professor Pampanin mentioned this potential yesterday, that the inelastic spectra at the base of the upper moment frame it's filtered by the walled base structure. This is really indication that a structure that has a significant base that is seven storeys high and has a lot of mass upon which a moment frame is sitting is not well modelled by any single degree of freedom system so to use any kind of spectra displacement spectra, acceleration spectra all of which are based upon single degree of freedom systems may simply not work very well in this structure so that the using those rules of thumb or simplified methods to estimate displacements may simply not work very well. Which leads back to the use of the simplified analysis techniques in the report that appropriately describe what happened in the building but maybe we lost a lot of learning opportunities by not doing some more detailed analysis.

So what lessons should engineers learn from this building? It has been talked about a lot irregular structures if allowed at all must be carefully designed. Perhaps there is a peer review required. In the United States we define a series of irregularities and we have some measures of how extreme the irregularities are and we have different rules if it is a minor tortional irregularity for example there is one thing that is required. If it's a major tortional irregularity something else is required, typically a dynamic analysis. So that is an important issue here. Late changes in design which were described yesterday where the wall was moved from the exterior line of the building to the, to an interior and then we had all these cantilevers must be carefully considered. Another bad example of bad things happening with late changes I reminded was something happened in Kansas City, United States. There was a walkway in a hotel that was suspended by rods and during the preparation of the steel shop drawings for fabrication an engineer made a change in the detail. It went to the structural engineer of record and some you know person that was checking shop drawings said oh this looks okay but it

turns out it was doubling the loads on this rods and they had a party in the hotel lobby where people were dancing and everything and the walkways collapsed and killed a lot of people. It's sort of a famous example of what appears to be a relatively benign change in detail that was not benign at all. If the building had been built the way the original engineer had shown it there probably would not have been a collapse, so it would have been very difficult to build however that was the reason they changed it because the contractor said that is very hard to do, I don't want to do it that way so.

Structures that incorporate major elements affected by shaking in two directions must be carefully considered. Mr Thornton suggested yesterday that in New Zealand he feels this is well understood and well taken care of and I really don't know the practice here well enough to know that although it is changing gradually in the United States. The basis of all of our codes are basically that we design structures one direction at a time. With computers we are able to more easily incorporate what happens with two directions at once but except for fairly major structures, eight, nine, 10 storeys or more I think most structures are still designed one direction at a time and the code suggests that if there are corner columns or L-shaped shear walls that are affected by both directions then that has somehow be taken into account.

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One rule of thumb is that you take 100 percent of the lateral load in one direction and 33 percent of the lateral load in the other direction which is simply a rule of thumb. It has no basis in science. It's basically saying that it's unlikely that the maximum load on both directions will occur at the same time in the earthquake but that's not really necessarily true because if you have a pulse of some sort it's likely to occur in both directions at the same time, so it's very important, these elements are – can be very important particularly this one in this building was incredibly important as we saw because of the cantilevers, it was supporting a huge percentage of the total load of the building.

And lastly there is a ratcheting issue, I prefer to characterise this phenomenon differently than just say ratcheting. In my mind ratcheting is the result of a configuration that gives you interaction between the gravity framing and the lateral load system and it perhaps becoming a more common example of this because of our friends the architects who like to make buildings look interesting, is when you have leaning columns, the column that is on a slope because that kind of building you have gravity load and the gravity load actually produces inner shears, inner storey shears that will interact with the seismic response of the building and I indicated to several people that coincidentally I'm aware that the Canadian code committees are as we speak considering some provisions for buildings with leaning columns so they perceive the leaning column problem to be common enough to suggest that there should be something in their code. Now yesterday Professor Pampanin suggested this is a one-off building and I think a building with this many cantilevers probably is, but I'm not so sure that a building with leaning columns, and I think that will become more and more common so that is something that perhaps the code people should be aware of, because it completely changes our normal design. It would completely change our normal design practices and I think that's the extent of my comments.

JUSTICE COOPER:

Thank you. We will proceed straight to the panel now, so if Mr Thornton and Professor Pampanin can return.

ADAM THORNTON (AFFIRMED)

STEFANO PAMPANIN (SWORN)

JUSTICE COOPER:

Good morning gentlemen, I think the most convenient thing from our point of view would be if you were to lead the discussion at least initially raising the

various issues about which you still have questions and inviting Messrs Thornton and Pampanin to respond. Will that be all right?

MR HOLMES:

Sure. I would like to have a little discussion about this issue of the apparently unexplained response in September versus February and why there was apparently no, or very little damage documented in September and obviously a lot of damage in February.

MR THORNTON:

One point I make is that what was experienced in this building was not unique, that, I mean in other buildings of similar periods I mean, and in fact of different periods throughout the city in September perhaps didn't respond as the spectra would have suggested, so I guess my thought is that it's not an item, this is not an issue just related just to the interpretation of the response and the damage within the Grand Chancellor alone.

PROFESSOR PAMPANIN:

Yes, we were trying to discuss and I was in a way provocatively and self critically demystify the use of response spectra that unfortunately the two that we had to use, because that's what's in the code everywhere in the world is a standard practice, but we do know very much the limitation of them so the paper that we wrote and is referred to after September, the type of being complicated subject to the form of reinforced concrete building after September was that a big one, (inaudible 09:58:10) was prompted by they say an over-reaction in the way of under-reaction of not only the public but the technical community thinking that the New Zealand earthquake, the title could have been rephrased, that was only a success story, while we were trying to say that it was a success story, but also a wake-up call. The wake-up call coming from the fact that the emphasis that we were able to have were based on using the real signal of September records, so the real shaking motion record in the city centre, and running a no limit mystery analogies of building which for example some time was one of the example that we used to try to

match and compare the type of damage and we were quite well matching that the damage that's for example some (inaudible 09:59:03) had in September which was significant in the new structure elements, so the partitions are made of clay bricks that were sheared off, but that's what you're expecting under a very low level of drift, but there was not anything more major than that. We kept on – so we calibrated basically on some buildings in town which were quite high and so quite long period, but then we also used a shaking table test on a building which was low but very flexible, almost in the range of two seconds, and that two seconds after a little bit of damage could easily lean to a 2.5, three seconds, and again that building on the shaking table test which is a real record using the strongest direction of the September earthquake was not showing cracks, basically was almost in the elastic range. Then we used other evidences on the field based on what Mr Holmes was referring to are the clues that we typically use, and the very simple clues that we are able to use is based on the no structure or damage, specifically very brittle partitions like clay bricks, or very little, sorry very brittle glazing welded type of windows. We do know very well that they can fail at a very low level of drift and in many buildings at different height they didn't, they didn't show that type of drift being exceeded. So what we wrote in the paper was a series of evidences coming from numerical computer modelling, calibrated on some building, experimental, shaking table, as well as observation on the field which was really a range all the way through and the answer was that as soon as we try to use a different type of record which was not September, was a modified record from overseas, we use a Roma paper for example record and it was not strong enough and we use the Alpine fault simulated event so we took a sheer earthquake scaled down to show that you do need a peak ground acceleration of point 6 point 8 g like in some cases September had, the answer very shortly was that certainly under a different type of earthquake like the Alpine fault it would have collapsed.

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The earthquake, the model in the table got significant amount of damage under different type of record which did not have under September so we had all the evidences from the field and from experimental to say that the energy

in September in a way spread around the spectra was probably not as strong as the spectra would say and then I do strongly agree but in the way we discussed the directionality of the earthquake was very important and yesterday was trying to compare in a way probably more explicitly than what was in the, in their report. North/south versus east/west, and north/south versus east/west of the two records and clearly for the Grand Chancellor the north/south direction in September which is the strongest for September was not the most critical. So there are a series of facts that are telling us again nothing less than what we knew the response spectra which is termed as the response of an elastic single degree (inaudible 10:02:18) system a lollipop, has strong limitation. Going to the discussion about why in the report the expert panel accepted that so there was no need to go for more complex behaviour it was felt that to be very honest we were not interested because of the one-off characteristic of the Grand Chancellor to know the distribution of the drift all the way up the building. The type of big failure was very brittle and when we have a very brittle failure typical is governed mainly by force at the low level of displacement so we could have called analysis, people could argue that's the calculation by hand that Professor Fenwick was having yesterday plus minus 30% could have gone to the same ball park figure and be satisfactory enough to justify that at the end of the day we don't know enough about wall behaviour in three dimensional so that's the big lessons of the Grand Chancellor. Continue the theme yes it will open a very important research topic if we generalise the fact that in New Zealand as well as everywhere in the world set backs are used consistently and we don't have rules for that. Yesterday I was trying to prompt you to say what you do when you have a big problem in the United States and we do know that you are running normally in a very (inaudible 10:03:30) analysis.

MR HOLMES:

Yes. Well may not in our linear, we're running some sort of a dynamic analysis not, not simplified spectral analysis.

PROFESSOR PAMPANIN:

But that's in 2011 not in 1980.

MR HOLMES:

No, no.

PROFESSOR PAMPANIN:

So that's I mean going back to what would have been done in 1980 was really hard to try to do anything like that. Today to assess it the discussion would be is, are we aware that an elastic response spectra is not sufficient nor rigorous enough to assess a building of that complexity, the answer is yes but was it required to go for a very complicated model to know that basically that wall you look at it was just not capable of doing it and the agreement was no we prefer as a panel in the DBH to focus on more critical buildings which we did require more complexity type of analysis and from there on obviously from an academic point of view and I'm wearing my hat as an academic yes I do have a strong interest in knowing more about the Grand Chancellor type of building but that's something else.

MR HOLMES:

Let me clarify your, again I read your paper and maybe I've misinterpreted but are you suggesting that the results that you're concluding that given the limitations of an elastic response spectra I understand that but there still suggests that there was a fairly large blob of energy two to three seconds or in that range in September in at least in a north/south direction.

PROFESSOR PAMPANIN:

Correct.

MR HOLMES:

And are you suggesting that a building in that period range for some magic reason does not respond to that shaking, as dynamics would tell us it would?

PROFESSOR PAMPANIN:

The magic reason would be in a way more simple than that. We knew quite clearly that the, a tall building suffer more than what people were expecting so we did write that the 1980s type of buildings modern buildings suffer more than what people would expect when compared to pre 70 and the justification being clearly that's (inaudible 10:05:35) that we observe but also we wrote, or we tried to explain that the short duration of the earthquake is not sufficient to build up to bring the energy and activate the motion of the building it takes time for such a massive long period of building to receive the energy and start shaking for a long period. February had a completely different behaviour because you don't need duration when you have a velocity pulse. When you get just a punch you go for this way without needing to accumulate the energy so the justification of this shorter duration in September and the type of sort of the energy content being a little bit less than what the response spectra was suggesting is not saying that tall building were not affected by a big motion. It's saying that they are not affected by what we see in a response spectra and then the fact that the Grand Chancellor is not a single degree but it's at least a two degree of freedom system is another (inaudible 10:06:38).

MR HOLMES:

The other associated question I have with the response and something I don't think we know at this point is when is it suspected that this wall failed? Did it fail very early on? Did it, was it, was there enough even cycles of response so that the ratcheting effect could have ever happened? I mean I, there is no speculation it seems to me a fairly simple model could have been devised and had the actual, one of the time histories or all four of the time histories to go through to try to understand. I mean if this happened very early if you're saying one pulse, the first pulse came through, vertical acceleration, big velocity pulse, the wall fractures and of course all, all response bets are off at that time, this structure is not going to respond in any way the way we think it would at that point but if it was towards the end of the record or middle of the record then there's something going on in the building some response that is perhaps more important.

PROFESSOR PAMPANIN:

Fair point. I might leave to Adam for, to answer but may I say something the damage that would be probably more clear later on at least I managed to see the damage of the, of the beams and I did think myself that the L-shape, the location of plastic hinge was actually recorded in both directions. Anyway I saw a quite significant amount of damage in those beams after September. I saw those picture in a, a few months ago in October and I decided not to enter the building because it was not the case, I thought it was enough, I enter enough buildings and my family was not happy for me to do that all the time but just to say that, that type of damage is showing that the walls clearly at least a full cycle if no more in both direction but if I remember properly there is a clue of a, I wouldn't make an extreme, but if we see the evidences there is more damage in one direction and that can signify there's some ratcheting was occurring so clearly the time history could have helped and I'm not discounting we're not preparing a research proposal for next few years so a few months time we're going to have something on the table. Yesterday because it was prompted by the Commissioner I, we managed to prepare some velocity spectra just to come up with answers it is confirming the velocity in February was in the range of peak ground velocity of 75 centimetre per second versus 40 so we're talking about almost double. 75 is not dramatically high but there is a lot of energy distributed around many a period range which was absolutely not there in September.

MR HOLMES:

Did you do a time history of velocity? I mean you can see how the velocity can –

PROFESSOR PAMPANIN:

Yeah we have a velocity time history and you see that there is a pulse so it would be interesting definitely to look at some of what you called, it would be interesting to, to probably look at the leaning cantilever as I know that you are doing some work in the States with some colleagues of say the irregular building because of the set back in the future but the problem sort of the, the

difficulty would be to come out with a code recommendation because every single building would have a quite different substantial behaviour. At least we can tell to someone what limitation that we have found and the Commissioner the Professor Fenwick was showing it. The start it's an implication the starting from time zero should be accounted for in this counting it's like a P-Delta effect starting from zero. So we should be telling to someone that the procedure to account for such a symmetry, a symmetric behaviour is going to be from the beginning to account for such and such and also design beams and frames to think that these are basically is a (inaudible 10:10:39) building from day one, that would be guidelines but it's hard to put in a code.

MR HOLMES:

Mr Thornton, do you have any opinion about when wall may have failed?

MR THORNTON:

Look I think it's difficult I mean as Commissioner Fenwick said yesterday that the actual the duration of strong motion was very short, something like 10 seconds. The evidence from the damage in the frames is of cycling perhaps what we'd, typical typing if the wall hadn't collapsed was that there weren't many cycles that occurred but we can tell that from the amount of damage in the beam hinges, in the frames now, but as Professor Pampanin suggested it maybe suggest one or two cycles from that but I mean there were only three or four cycles within that 10 second duration. So the answer is I don't think we know precisely but it may well be after the first pulse. It might have had one shake, part of the pulse, and it collapsed but it is somewhat speculation as to precisely when it did occur.

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MR HOLMES:

The other thing I'd like to discuss or to point out and to clarify I should say I'm pretty sure that the final report suggests that confinement was, lack of confinement was very important and I can't remember the terminology but the most important issue and yesterday I understood you to maybe back off of

that a little bit or suggest that maybe full confinement may not have even prevented that perhaps out of plane shear failure or whatever we're characterising it. Have you changed your opinion and, if so, is the report gonna get changed?

MR THORNTON:

Well I don't think that was the inference. Certainly in my mind, and has been for some time, is that the slenderness effects, well the three main things – the slenderness, the unaccounted for really high axial loads and the lack of confinement. They all contributed. Perhaps I think we've firmed up a bit since the report finished that even if you had what we would call perhaps confinement in accordance with the code that there was no guarantee that the wall would not have failed anyway.

MR HOLMES:

Well that would have been my opinion. I suspect, I mean my opinion is that the wall may have failed in any case but I think the proximate cause was actually an out of plane drift. Incredibly high compression. It didn't take, just a little teeny side drift and you're gonna get that fracture.

MR THORNTON:

I mean it's easy to look at the drawings and say there's an obvious lack of confinement there and it's an obvious likelihood that that has contributed to perhaps the speed and the mode of the failures we talked about yesterday because maybe if there had been confinement you would have seen more of a sort of a crushing type failure than the shear failure that developed because once cracking had started without having not so much confinement but effectively what is shear reinforcement going transversely through the wall that may well have led to a slightly different type of failure.

PROFESSOR PAMPANIN:

Maybe at this stage I will say that probably we totally agree and when I say "we" it's really the larger engineering community on the fact that, let's say,

one confinement detailing is like taking a clause from the code. It's not going to save the world. It's the full package of design where you miss one detailing and the earthquake is going to just find it and so in this case specifically interesting enough if you think about the, I don't have the reference with me but is that possible to load up the presentation, my presentation of yesterday.

JUSTICE COOPER:

Yes it will be. What do you want to look at?

PROFESSOR PAMPANIN:

I would like to see again the plan view that was basically borrowed by, there are two slides Sir called "Global Behaviour" and "Local Behaviour" because this is all there. I can go there if you.... Thank you. So if we think it's interesting because Mr Holmes mentioned that Sir and it is coming more apparent nowadays that the issue of displacement compatibility of different elements within the structure. If we think with the eyes of 1980 there is a big spine stiff element over here holding on the building in the one direction so the expectation would be that this wall, the expectation at that time, would have been that this wall would just not be required to do too much in that direction in spite of what the belief was at the time we do know now that the torsion issue as well as the bi-directional component is asking this wall to work as it was designed in the north/south direction but as well as a little bit in the east/west. Now if you allow me to go to the end of the slides where I was trying to show what we know and what we know that we don't know which is really the point at least that we know something of what we don't, in the literature there it is. There we are. 1992 that's one of the major literature book from Professor Paulay Priestley in which he is talking about the failure mechanism of woods.

JUSTICE COOPER:

Just pause for a moment. This is our number BUICAS 1610048.55.

PROFESSOR PAMPANIN:

Now I did add 2D (two dimension) in brackets knowing that that's how we would see this mechanism. At that time, we are talking about 1992 so it's top state-of-the-art at that time people would recognise that the wall working in the direction that the wall has been designed to work thinking that's the out of plane so the theme, direction would not bring enough load to the wall and again I say load, not displacement, because it's not stiff enough. That's how people were thinking so everything is in plane. There was one mechanism where very recognised to be a very dangerous one which is typically happening. That's a sliding happening above the foundation and typically this is where the lap splices between reinforcement was occurring so we have seen in the past the many failure happening where the reinforcement from the foundation comes up here, stops, and then continues on. Let's remember that the Grand Chancellor in the core had that problem. Now if we imagine the 3D behaviour of this thing. there is a combination of something of, in a way, this nature and of that nature. Suddenly the Grand Chan..., the seventh storey wall on the top of which there how many other storeys, so a big mass, is cracking in the weak direction and now from there on you're simply sitting on a very tiny 400 millimetre hill if you wish as more push out of plane would cause the shear off happening and from there on so if we have to revisit what we typically do in terms of 3D response, let's be honest that the bi-directional understanding in the past was typically referred to contribution I totally agree. Every code in the world is saying that if the building is regular, which is not the case, you can take one direction and design it, the other direction design it and typically the only bi-directionality contribution happens on the column. What we do know that is not typically accounted for, for example is the beam to column connection, the failure of the joint in the corner is a massive problem. It has been observed in the past. Only quite recently were we in the laboratory able to reproduce it so the 3D behaviour is happening very recently, the last decade, to become better known.

MR HOLMES:

But we have not really seen out of plane failures of walls caused by out of plane motion and in this case I don't think without that very unusual high axial

load that the out of plane had to be a tiny motion, it was right at the bottom of the building in the shear wall that the drifts are going to be very small -

PROFESSOR PAMPANIN:

I totally agree.

MR HOLMES:

So it had to be a culmination of those two things.

MR THORNTON:

Except that a point to record there is that we did see similar looking failures in other walls. Now they certainly had gravity components on them but they didn't have the really high concentrated load that we know this one had. Referring back to that Paulay picture, and certainly those pictures that all structural designers are very familiar with over the last 20-30 years this is how we design shear walls and I think consideration, certainly for a plane wall, a blade wall, i.e. not an L-shaped wall, there's really, I don't think there's any suggestion in the code that you need to give any consideration to transverse actions. It is very much about the in-plane action and certainly for the confinement considerations for example are really only about the in-plane action you are working out the length of the in-block. That is what you do to determine how much transverse reinforcing is required.

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MR HOLMES:

If you had a structure which is legal that has shear walls in one direction and a moment frame in the other then the moment frame drift would be higher than usual.

MR THORNTON:

Yes.

MR HOLMES:

And you might be worried that take a look at that, what that drift is doing to your out-of-plane wall but that is an unusual...

MR THORNTON:

So (inaudible 10:21:37) what we saw here in Christchurch and in Chile just before that has, it is a wake-up call isn't it? I mean, both at academic level and for consultants, for designers, I think. We talked about this yesterday that often, the view often was, used to be, maybe 10, 20 years ago that shear wall buildings don't fall over in earthquakes so therefore you know they are a safe bet where Mr Holmes and ourselves were discussing that perhaps in the intervening period engineers and designers have relied on that fact too much and have allowed, you know, the size and the walls to be reduced and put under higher loads, higher stresses and so we have now, if you like the pendulum swung too far in a way of usefulness of shear walls and they need to be better understood so I think that's a real lesson.

JUSTICE COOPER:

It is possible though that this wall as dimensioned might have performed adequately were it constructed in its originally intended position?

MR THORNTON:

Well, it is not clear from the original calculations how far that concept was taken. As I explained yesterday that diagram which was a page from the calculations at the beginning of the calculations saying look here is the, this is the engineer's concept of probably what is going to be required and then and to get to that point the engineer may well have done some preliminary calculations, hand calculations. Then that structure is modelled and analysed and each individual member is designed for the forces and loads and actions that he has received back out from his computer analysis so on the basis of that the designer got to the end point, looked at the actual loads that he thought that he had derived for the wall and on the basis of that he was happy that a return was not required as we discussed yesterday an error had been

made and certainly in terms of the derivation of the axial load on the wall and so...

MR HOLMES:

I think that if the wall had been put in the original position even with its surprisingly little reinforcement I doubt that it would have failed because you had this huge amplification from a cantilever which doubles the load –

MR THORNTON:

Oh it is more than double, it is compared to the wall on the other side it is more like eight or 10 times the –

MR HOLMES:

It is a huge, it is a huge vertical load so if it had been in the original position it may not have failed. Now interestingly there is some comparison to the Pyne Gould that I was surprised on that building that there was some fairly large girders coming into an eight inch wall without any special pilaster thickening of wall, reinforcing, anything. There were just wall reinforcing this far apart and just sitting there and I think you may have mentioned this, you said you'd think that an engineer would look at this right here and see something fat on top going into something thin and that you would put a big blob of concrete there –

JUSTICE COOPER:

So what point is that in terms of the grid line?

MR HOLMES:

D5 and D6 but I suspect that the reason it wasn't is because it was mentioned it was in the lobby and the architect did not want a big element looking as you walked into the building. He wanted it thin and unfortunately we engineers work for architects and sometimes we do things probably we shouldn't do.

MR THORNTON:

There was an element of thickening, a blob if you might call it, at the point of connection between the frame and the wall and the transverse so in fact at the level between levels 12 and 14 there is actually, if you like, a blob so that those can transfer from the column into both the transverse beams and the wall below.

MR HOLMES:

But then if you –

MR THORNTON:

But that did not carry down to the ground floor.

MR HOLMES:

If you superimpose that plan onto the floor below it would look very funny that you have this very thin wall underneath that.

MR THORNTON:

Not sure, yeah, but it wasn't a knife blade like that, it was a wall coming together and the column sitting and there was a thickening, and that is I think visible on one of our drawings.

MR HOLMES:

One other issue I want to since you have this plan up here –

MR THORNTON:

This one here. I am looking at the level 11 and 12 plan that was in my presentation yesterday.

MR HOLMES:

You did a good job explaining that blob but I, it's below there that is my concern. You did a good job yesterday of going through all of the various eccentricities that this presents. It is pretty remarkable how you know one configuration can have so many eccentricities. One you didn't mention

actually is the podium sticking out with no lateral elements so I have to describe the podium. We know what that is right? It is sticking out towards Cashel Street. That is a very large blob of mass that would create a large torsion which led me to wonder, you did some sort of a spectral analysis in your basic analysis for your report, were all those eccentricities, I mean were the masses put in the –

MR THORNTON:

Yes, the masses –

MR HOLMES:

(inaudible 10:27:37) so all those torsions would have been taken into account in your analysis?

MR THORNTON:

Yes, I mean, the contribution of that mass at the lower levels I think was, would not be so great as perhaps some of the other issues but the point I did make is that when you look at the, we talked about where the centre of rigidity was in those lower floors and that is towards the north end because there is a wall at the north end of the building. In fact, what I didn't mention is that the lower levels the centre of mass has shifted to the south as Mr Holmes says because of the podium, the bit that comes out to Cashel Street. So that is giving you a bigger eccentricity which on those lower levels which can add to the amount of the transverse –

MR HOLMES:

But that was in your model is that correct?

MR THORNTON:

Yes, all the masses were modelled.

MR HOLMES:

But in their location, I mean, I'm just wondering in the east-west direction was that large mass of the podium structure included in the eccentric location?

MR THORNTON:

I am almost certain that that happened because the in the relatively simplified model but the masses are put in as single masses and as centre of mass each floor level would be –

JUSTICE COOPER:

I cannot hear you now.

MR THORNTON:

Oh sorry, yes, I mean the standard way of doing a, if you like, a modal spectral analysis is to input the floor masses as a single point of mass at the centre of mass of each floor so as you go down the building –

COMMISSIONER FENWICK:

Can I suggest that we have (inaudible 10:29:27) .003.43, sorry 0003.43, that shows the podium on the floor. I mean the, it is six or seven storeys of podium and I think that if that it will make it clear exactly what you are talking about there and also I am quite intrigued by the torsional action of that section so I certainly want to hear exactly what you did and I would also like to know what implications it had, where it is described in the report. That is the podium on the right as you see displayed little lateral resistance in the podium structure so as Mr Holmes pointed out –

MR HOLMES:

Line 1 to line 5 is basically sticking out without any significant, without any lateral element in the north-south direction, and that is not a frame, my understanding is that on line 1 there is no moment frame.

MR THORNTON:

No but even if it was it would be, I would suggest, insignificant stiffness compared to these walls. The mass of that, the contribution of this section in my view would not be great because it is relatively, it is at the lower point of the building. It is in the podium which is the stiffer part and it is relatively low density. It doesn't have these heavy walls which add to the mass of here so if we said well we suggested that the centre of rigidity might be somewhere between grids 8 and 9 because of the contribution of the main I-wall and this L-shape wall on grid 11, whereas the centre of mass for the upper structure of the tower would be centred between grids 5 and 11. You might expect that the contribution of the podium in the podium floors might offset the centre of mass, maybe somewhere a little bit beyond grid 7 I would suggest, so just from a proportionality point of view. So sure it would be increasing the eccentricity on those lower floors only and that would have an effect on the transfers displacement of the wall at (overtalking 10:32:05).

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MR HOLMES:

At the very wall that we're concerned about.

MR THORNTON:

Of course yeah, I made that, I did make that point yesterday because of the eccentricity was on to the – closer to the north end then that does increase the if you like the displacements at the other end of the building.

COMMISSIONER FENWICK:

Mr Thornton, that podium deflecting through there would have had its own natural torsional period wouldn't it, which would it be quite short, so it's hardly going to be – how is it going to contribute to the torsion higher up in the tower coming down which is going to have a different natural period and a different frequency.

MR THORNTON:

I doubt it would have much influence on the tower performance. Is –

COMMISSIONER FENWICK:

I think you are saying, I got the impression you were saying the tower had an eccentricity about that point and that would tend to counter-balance the torsional interaction from the podium. I'm just questioning whether that can be the case when they've both got different stiffnesses and periods and subject to different displacements. I would see the podium –

MR THORNTON:

I may have given you a mis – a wrong interpretation. What I was suggesting is that when you consider each of the podium floors, the L-shape floors that within each floor the contribution, the displacement of the centre of mass, well there obviously is a contribution to it, but it's probably not all that significant when you consider the whole building. It's not – you've got a much larger area. It was four times the area of the podium floor compared to the – so it's of the total podium compared to the front portion of the podium and it is if you like less dense because it's hasn't got the weight of the walls in it, so it might offset the centre of mass by 15 to 20 percent of that dimension there, which is about 12 metres, so in the order of three metres from the centre of mass within the total what you call a podium which is the lower portion.

COMMISSIONER FENWICK:

But do you think when this rotates like that in torsion do you think that that might have actually pushed the effective centre of mass or your centre of mass you've (inaudible 10:34:41) about, compared to the effect of dynamic centre of mass out further because of the torsional rotation, do you think that's likely. Normally we talk about the inertial force being proportional to the deflection, well in torsion of course that podium is going to be moving outside much more than in the middle isn't it, closer to where the podium joins onto the tower.

MR THORNTON:

Of course certainly I agree that it would have effect in increasing the displacements at shear wall D5.

COMMISSIONER FENWICK:

And your analysis, it's not – I don't think it's reported in the report but your analysis picked up, I mean often in these analyses you look at the first three or four modes and when you get to 90 percent of the mass contributing you're happy. Of course when you get torsion it's rather hard to know how it contributes so did you actually look at the modal effect which was predominantly a torsional rotation of the building at the bottom of the podium, to actually consider that in your analysis, or could it have been cut out because you didn't go down to the tenth mode or the eleventh mode which would have picked that up.

MR THORNTON:

In all cases analysis would be to get well over 90 percent of contributions so it depends I guess of when that particular mode cuts in.

COMMISSIONER FENWICK:

So that there's a complication there how you add in the effective mass and a torsional one too.

MR THORNTON:

Sure.

COMMISSIONER FENWICK:

But the 90 percent value that you have to achieve.

MR THORNTON:

I mean at – as we've discussed at reasonable length about the method of analysis which was used which was modal analysis, that – in a simplified way that the off – the centre of mass of the total lower floor, floor plate is offset and

that is how the if you like the eccentricity is accounted for and that's what would have been done in this case.

PROFESSOR PAMPANIN:

Something maybe that is worth noting is, again think about what we don't know and what is not in the code. I think a little bit elaborating on the Commissioner probably suggestion is likely, at least if I see these and I take it upside down, these podium could very well be a cantilever in the horizontal direction so is the same type of effect that yes, I was trying to describe of having the vertical cantilever working with a high, very high frequency, while on the vertical direction while the Grand Chancellor will be doing something else, so the two stiffnesses are very different and here we can have the same, a very slow torsional motion of the main core with a hammering effect of the horizontal cantilever from the podium. To be honest again academia's been suggesting the past of try to look at the torsional response spectra, the response spectra of a singular system trying to go in torsion. We are not there, let's be very honest there. We'd all like to know that in 50 years time people will be looking at this thinking, how come that those people did not know it, that's part of know how, but we are not there. Just knowing that and writing the code that a cantilever can also be a horizontal cantilever, and just saying that this means that you should just not go there, that's become probably an issue of how much in the code we want to penalise the irregularity. I'm not sure that penalising is the right approach, penalising even in (inaudible 10:38:25) safety is just going back to the fact that we try to hide ourself from not knowing what is going to happen to some mechanism, and it did not work in the past. That was called allowable stress mechanism, so the big discussion could be that we don't want to design bunkers, such engineers are not against architects and vice versa, but I think we agree that such a building more likely, or less unlikely would have had troubles if the wall had been in the right position. The podium would have had probably less significant or absolutely negligible contribution so a proper design conducted from the conceptual path until the end would have gone to the proper performance more likely, so the discussion is why and why not there are

modification that happens in the real life of engineers. You're getting to modify three or four times in a row and why and why not a peer review process cannot be in place with someone helping a designer to not go for such an issue and try to say, sorry, I'm back, I'm off. It would be quite nice to be able to say I step back, that building's not going to be designed. The type of – this is basically speculation if you wish, but it's written in the report, the design approach in having that the cantilever be hanging it was very smart, so there are detailing of the design showing a very good approach in design and then to try to account for everything. But that was not required at day one of the conceptual design. So there's a big effort of the engineer trying to do as much as possible to solve a problem which was not anticipated and that created more other problems that could not be anticipated, so –

MR HOLMES:

Could we put up a floor level lower, a lower floor level?

JUSTICE COOPER:

We will adjourn briefly to enable the arrangements to be made for the video link which is going to interrupt this interesting discussion and while that process is going on you can select a level to be displayed when the discussion resumes.

COMMISSION ADJOURNS: 10.41 AM

COMMISSION RESUMES: 11.29 AM

MS SMITH CALLS

GARY HAVERLAND (SWORN)

Q. Mr Haverland, your full name is Gary Haverland, and you are a director of Structex Metro Limited. You have a Bachelor degree in Civil Engineering and you are a chartered professional engineer and you have been practising as a qualified structural engineer for 24 years, is that correct?

A. That is correct.

Q. And you have prepared a brief of evidence for the Commission?

A. Yes I have.

Q. Do you have that before you?

A. Yes I have.

Q. If I can get you to read that Mr Haverland from paragraph 2?

A. Sure. On the evening of the 4th of September 2010 Mr Steve Martin contacted me by telephone in relation to the Hotel Grand Chancellor, the hotel. Mr Martin is the hotel's general manager. Mr Martin asked me to inspect the hotel as best as I can recall to determine whether there were any immediate safety concerns arising because of the earthquake on the 4th of September 2010. I inspected the hotel on the 5th of September 2010. The inspection commenced around 8.30 am and finished at around 12.30 pm. The hotel had a green placard with a level 1 rapid assessment having been carried out. Given the owner's instruction to identify initial structural and safety issues I carried out my inspection to level 2 Christchurch City Council rapid assessment. A level 2 rapid assessment is meant to identify immediate structural and safety hazards and includes an inspection of the building interior. It is a visual inspection only and not intended to provide detailed information on repairs that may be required. It is focused on immediate public safety as well as assessing the need for any temporary work such as shoring, temporary securing, making safe or barricading. According to the

New Zealand Society of Earthquake Engineering guidelines for building safety evaluation during a state of emergency (August 2009) level 2 rapid assessments are appropriate for the assessment of large multi-storey buildings. No plans were made available to me at the time of the inspection. The plans would have been of limited assistance in the context of a visual only inspection. Plans are useful when a detailed inspection is being carried out. The hotel is a ductile frame building designed and constructed in the mid to late 1980s with the expectation that these buildings have good performance characteristics in an earthquake. I inspected a representative sample of floors which included the level 28 stair observing only minor damage due to building movement, not of a structural nature. The level 14 kitchen: no damage observed and the level 15 bottom of stair where some damage to vinyl was observed. The exterior was not inspected. Mr Martin directed me to areas of damage that he had observed and which he wanted me to view and comment on. He accompanied me during the inspection. I observed some damage to the gib linings with cracks generally at sheet joints and corners. The extent of damage to the linings was not so extensive to suggest that the structure was compromised. As such and as it was a visual inspection only I did not inspect behind the gib linings. I observed that at the base of the level 15 stair an area of vinyl had torn. The hotel staff and I removed a section of bulkhead to the underside of the stair to allow a closer inspection of the stair support. The base of the stair is rebated and seats onto an opposite rebated landing to allow the stair to slide relative to the landing. This is consistent with standard design and construction practices of the time to allow seismic movement between floors to occur. The sealant in the sliding joint was still in place and undamaged and the stair support also appeared to be in sound condition. The areas that I viewed during my inspection indicated that the damage to the hotel was superficial only and not of a structural concern. All relevant observations I made are contained within the Structex seismic inspection report dated the 5th of September 2010.

Q. If I can just stop you there for a moment, if I can refer you to document WITHAV.0001.5 should appear on your screen shortly. Is that the document that you were referring to as the inspection report dated 5 September?

A. Yes it is.

Q. Thank you Mr Haverland, if you can continue from paragraph 9.

A. I provided my comments to Mr Martin on the 5th of September 2010 and later emailed him a copy of the report. I heard no more from Mr Martin or the hotel's owners until after the Boxing Day earthquake. I was asked to undertake another assessment of the hotel, however I was unavailable to do so. I understand that the building owners engaged another firm to carry out the inspection. To my knowledge information from GNS or other sources about the likelihood, location and extent of further aftershocks was not available at the time of my inspection. In my opinion the severity of the aftershocks that were being experienced were highly unlikely to cause subsequent damage to the hotel. The hotel was constructed out of reinforced concrete. These buildings are expected to sustain large earthquake loads with multiple cycles of loadings and maintain their structural integrity. Given the limited damage I observed as a result of the 7.1 magnitude earthquake on the 4th of September I considered it highly unlikely that further structural damage would occur as a result of the less severe aftershocks. This statement is true to the best of my knowledge and belief –

JUSTICE COOPER:

You have already dealt with that by making the oath that you made at the outset.

EXAMINATION CONTINUES: MS SMITH

Q. I just simply have one further question for Mr Haverland. You have seen reports that have been presented to the Commission which indicates that the damage to the building or the hotel after February's earthquake was due to the failure of the shear wall?

A. Mmm.

Q. Was there any evidence of damage to that particular wall during your inspection in September?

A. On entry into the building we walked past that shear wall. There was no evidence of damage that I saw to that wall and there was no damage that was pointed out to me by Mr Martin at the time.

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CROSS-EXAMINATION: MR ZARIFEH

Q. Mr Haverland, in relation to that shear wall you said that you didn't have the plans for the building. Would a level 2 assessment normally entail getting plans if they were available?

A. Not normally.

Q. But in terms of that shear wall did you understand, obviously you knew it was a shear wall in terms of the design of the building?

A. I did not know it was a shear wall in terms of the original design of the building, however we did walk past the wall on entry into the building.

Q. And did you consciously examine the wall or not?

A. No, the main purpose of my visit was to look at areas that Mr Martin had observed were damaged. The earthquake occurred on the morning of the 4th of September and the building had received a green placard during the day and at the time that I went into the building the following morning, Mr Martin had obviously had opportunities to go round and look at the building and observe areas of damage.

Q. Right.

A. And he pointed out these areas to me and asked me to comment on them to see if they were of a structural concern and that wall was not part of the damaged areas.

Q. The wall was not something that he asked you to look at or pointed to?

A. No.

Q. So, just so we're clear you walked past it when you were on the ground floor?

A. Yes.

Q. So you saw it but you took no particular notice of it other than it didn't – notice that it didn't have any visible damage or cracking?

A. Correct, yes.

Q. And the level 1 assessment, the green placard that would have been under the directions with any of the council?

A. Mmm.

Q. Did you have any documentation in relation to that or are you just aware of that from the green placard on the door?

A. I – as best as I can recall there was a green placard on the building and I do know that that inner city block was inspected on Saturday afternoon.

Q. All right, but you had no contact with the Council or anyone who'd done, who carried out that inspection?

A. No.

Q. And just tell us a bit more about a level 2 assessment or the level 2 assessment that you conducted on this building?

A. Mmm.

Q. You said that it's primarily for public safety and we haven't heard from Mr Martin yet, but we're going to, but he has said in a reply to a letter from the counsel for the Commission, that his instructions to Structex and to Powell Fenwick were that 'we needed to make sure that the building was structurally sound and safe for us to continue operating'. Would that be fair in terms of the brief you received?

A. Well it's difficult for me to recall given that he called me on my cellphone on Saturday night after I'd been in town for the whole day so I do know that he did contact me by cellphone. As far as I can recall he wanted me to have a look at areas in the building to make sure that there were no safety concerns.

Q. All right, so the gist of what he's saying sounds correct then?

A. Can you say that again what his words were?

Q. 'We needed to make sure that the building was structurally sound and safe for us to continue operating'.

A. Mmm, that would sound right, yes.

Q. He also said in that email that he had made plans available to both Structex and Powell Fenwick. Now you've said that you didn't have plans. Are you talking about any plans at all or structural plans?

A. Any plans at all. When I inspected the building I did not have any plans of the building.

Q. Now do you recall if there was any discussion about you obtaining – or he obtaining plans for you?

A. He may well have said that he would be able to get plans for me if I wanted them.

Q. And did you want them?

A. I didn't believe it was necessary given that we were doing a visual inspection only.

Q. Right. Would structural plans have helped you understand the design of the building and the shear walls and the seismic frames, or could you understand that without those?

A. They would have helped me get a more detailed understanding of the building. However I did have a general understanding of what the structure was.

Q. Right, so you knew that there was a shear wall, podium and on top of that seismic frame?

A. Yes. I was aware that the building was constructed as a shear wall lower portion of the building with a frame structure over the top of that.

Q. Right and how were you aware of that. Was that from your viewing of the building?

A. I guess there's a little bit of history associated with that. We had a talk that was given to us at the University by the building designers when we were in our final year and he outlined the building to us.

Q. Right.

A. There was also a – I had previously done work on the building for the Hotel Grand Chancellor so there was some familiarity that I'd built up as a result of that and we observed the building being constructed in the late 1980s.

Q. So who was that who gave you the lecture on the design, can you remember?

A. Pete Tilson.

Q. From –

A. From Holmes – well Holmes were Poore and Johnson at the time.

Q. And can you recall – you recall the general layout of the building from that lecture do you?

A. General understanding of the building yes.

Q. Do you recall whether that lecture included any discussion about the need to change the plan once construction had started?

A. No I can't recall that.

Q. And you said you also had some knowledge from work you'd done. What was that work?

A. There was some spalling of the reinforced concrete topping up at level 28 at the top flight of the stairs and the hotel were concerned about that and while I was working at Holmes Consulting Group they asked me to come and have a look at it and we gave them some repair details associated with that.

Q. When was that roughly?

A. It was probably about seven years ago I think.

Q. You said that Mr Martin took you round and pointed to damage that he had seen.

A. Mmm.

Q. Did you – you said you spent some four hours there?

A. Yeah.

Q. Is that the extent of the damage that you looked at or looked for or did you have any time on your own when you looked at what you thought might be relevant to look at?

A. Well Mr Martin took me around the areas that he had observed which were the worst damaged areas. He asked me to comment on those. That included going from – we went in through the ground floor entry lobby up to the lift, into the lifts, right up to the top of the building. We looked at the level 28 stair at the top. We looked at a selection of floors

on the way down and then we looked at level 15 and 14. Then we went out through into the conference room area and then we also looked at the junction between the hotel building and the carpark building where there was a seismic separation.

Q. And as I understand it, you didn't remove any linings?

A. No we didn't remove any linings.

Q. Did you think there was a need to in terms of what you were doing?

A. No, no I didn't.

Q. Why was that?

A. Because the damage to the gib board wall linings was quite small and it indicated that the building had not gone through a substantial amount of movement that might have caused the building structure to be compromised.

Q. So in other words there was no – nothing to indicate structural damage behind the linings?

A. That's correct. There was only one area where there, where I suspect there might have been some damage and that was at the base of the level 15 stair where some of the vinyl had torn and it was at that location that we did remove the linings, we cut holes in the wall and in the bulkhead that concealed the structure and when we saw the structure we saw that it was still in sound condition. There was no evidence of damage to the structure itself, so to me that was evidence to say that if we've looked at this what I saw as being the worst affected area, then the other areas were also in a sound state.

Q. So removing the lining in that area was as a result of the level of damage you observed in the vinyl?

A. Yes.

Q. Did the vinyl indicate to you that there had been some movement in those stairs?

A. Yes there had.

Q. But once you looked behind it you were satisfied it was minimal, is that –

A. The movement was very small, yes.

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Q. So a level two, certainly on this occasion could involve removal of linings and looking behind walls if necessary?

A. Ah, yes. I think if the inspecting engineer is concerned about the level of damage that he sees then it would be appropriate to continue on with the investigation and remove linings to determine the extent, well to determine if there is any damage in behind the linings.

Q. And the other shear walls, did you look at those?

A. No.

Q. Not at all?

A. No.

Q. Right, were you aware there were other shear walls?

A. Ah, yes we were aware that there were other shear walls lower down the building.

Q. Right, and as you say you were aware of the general design of the structure, the shear walls at the bottom and the frame at the top?

A. Yes, yes.

Q. Did you give those any thought then in terms of your inspection?

A. Sorry I have to go back a little bit. We did look around some of the concrete walls at the junction between the hotel and the carpark.

Q. Right.

A. And there had been a very small amount of movement occur there where some of the, where some of the asphalt ramp areas had been knocked out of place associated with the relative movement between the two buildings, but it indicated that it had moved probably about 20 millimetres as a relative movement between the two buildings which was minimal. In that location there was a shear wall that was, was quite visible and I don't recall seeing any damage in that wall.

Q. Thank you. I guess what I was getting at was given that you knew that there was the shear wall structure at the bottom of the hotel building did you specifically look at shear walls or not?

A. No I didn't.

Q. No. Was there any reason for that from the structural point of view?

A. We were mainly being guided by Mr Martin in terms of the damage that he had observed.

Q. Right.

A. Throughout the building.

Q. But Mr Martin is presumably not an engineer?

A. Mhm.

Q. I'm just trying to understand when you go into a building like that which is a reasonably complex building we've heard in terms of structure, whether or not you would look at features that you thought could be stressed by an earthquake, structural features?

A. Mhm.

Q. Did you not give that thought? I'm talking about shear walls and the frame above. Did you not specifically look for those kind of areas?

A. Well on the basis that the upper portions of the structure which were the more flexible portions of the building had undergone minimal movement and the damage to the linings was also low I did not see a need to carry the inspection any further.

Q. Okay, were you aware of the cantilever nature of the building over the right-of-way on the eastern boundary?

A. Yes. Yes.

Q. Did you give that any thought in terms of stresses or added stresses as a result of the earthquake?

A. Well the evidence of damage in the linings themselves indicated that the building had performed very well.

Q. All right, and you said that you didn't have any information from GNS but you understood that there was a likelihood of aftershocks as we knew?

A. Mhm.

Q. But not the severity of what eventuated in February, is that fair?

A. Mhm. Well –

Q. So when you did your examination your inspection were you, did you have it in mind that there could be reasonable aftershocks?

A. Ah, yes the aftershocks that we were typically experiencing were of much shorter duration and lower magnitude than the September 4

earthquake and I certainly do not recall information coming out of GNS and it would have been difficult for me to have time to look at that in the 24 hour period between when the earthquake came and when I inspected the building.

Q. Right and was that your, you didn't have anything else to do with the building after that in terms of inspection?

A. No I didn't.

Q. What about columns, did you look at columns for damage?

A. We did not look at columns for damage. I do know that the principle behind these buildings allows for weak beams, strong column system, so if there was going to be any damage it would have been to the beams first with the columns remaining very stable.

Q. Right and in terms of the beams you were relying on there not being any damage to the gib board linings that might indicate stress?

A. Yes it was on, it was on the basis that minimal movement had occurred in the building which was reflected in the, in the extent of damage to the wall linings.

Q. Right. Can you not get situations where you have minimal cracks to linings but more severe cracks underneath or not?

A. I think that's very unlikely in a building of this nature.

Q. So when you left after your inspection and reported to Mr Martin and sent this email report did you envisage that any further inspection would be required, any further detailed inspection from a safety point of view or not?

A. No, no.

Q. You didn't think that it was needed?

A. No.

Q. All right so we, we know that Mr Martin got someone else to look at it but that wasn't on your recommendation or advice?

A. No I think he must have done that from his own initiative.

CROSS-EXAMINATION: MS SMITH – NIL

COMMISSIONER FENWICK:

Q. You said there was damage to the stairs at level 15 and you said that was a small amount of movement but can you cast your mind back and say how much movement how far was the vinyl push you said it was a small amount but are we talking about 10 millimetres, 20 millimetres?

A. As far as I can recall it was about 10 to 15 millimetres.

Q. Right. And would it, was it in such a position that that would have been the full movement or was there some slack before that vinyl, the stair would have got into the vinyl?

A. The vinyl was rigidly connected to the both the landing and the bottom stair itself and the movement that had occurred had occurred right over where the sliding joint was between the stair and the landing and so it would indicate that that was the, that was the total movement that had occurred.

Q. The vinyl was torn was it?

A. The vinyl was broken yes.

Q. So it could have been a bit more if there had been some stretch apart from the tear, I mean I'm trying to get a feel?

A. Yeah, certainly we –

Q. Fifteen?

A. Certainly we, mhm, when we pulled off the linings it was very brittle in nature and indicated that if it had tried to stretch it would have snapped.

Q. Right. Now that was at stairs which went from level 14 to level 15?

A. It was at the, it was at the base of level 15.

Q. Base of 15 okay well that's very helpful and that would have been in an east/west movement then would have moved that?

A. That is correct.

Q. To produce that tear?

A. Yes.

Q. Yes. You didn't manage to see any of the beams in their potential plastic hinge zone which I understand were displaced from the columns. You wouldn't have seen that at all?

A. Ah, not after the September earthquake, only after the February earthquake.

Q. Okay well we're interested of course of what the movement was in the September, you saw it after February as well then?

A. Yes.

Q. Okay. And so you know where the plastic hinges are. You weren't able to see them in September?

A. No.

Q. Right. Where there any broken windows in September?

A. Not that were pointed out to me no.

Q. So the, the basis of the small displacement was purely lack of damage to the, to the linings?

A. That is correct yes, the, the –

Q. Both directions, north, the ones which lined up with the north/south direction and the ones which lined up to the east and west?

A. As far as I can recall it was primarily in the east/west direction.

Q. Okay. You can't remember at what level that was can you?

A. No I can't I'm sorry.

Q. That's all right, look I realise it's impossible we're going back so far aren't we over a year. And you've got no idea how closely the framing would have been tied into these linings at any rate, I mean were they, you wouldn't have known whether they were between columns or whether the columns could have moved a little bit on the inside of the linings? That would have been hidden wouldn't it?

A. Yeah, it's pretty much strapped and lined directly on the columns and then there's a very small ceiling space between the gib board ceiling and the underside of the structure.

Q. Right so there would have been room for some potential movement without necessarily crushing linings presumably then if they, if the linings were outside the line of the columns?

A. Well generally what occurs is if the columns move then they will shift the linings almost the exact amount of the column displaces by and if

anything else tries to remain where it was then it would break immediately at that location.

1159

Q. Wouldn't that depend on how it was tied in to the column?

A. Yes it would but it most cases it's strap and line directly onto the columns.

Q. Yes, they were detached. They were not just independent walls not lining up the columns. Thank you very much. That is useful information. Oh no, there is one, sorry, you said between the shear walls at level, well you didn't say what level but you said there was about a 20 millimetre movement which doesn't sound here nor there with displaced asphalt?

A. Yes.

Q. At what level was that?

A. That was right up at the top of the car park level which would have been level –

Q. 12 or 13 or, at the top anyway?

A. Probably level 12 I think.

Q. Depends which way you are counting it –

A. It was level 12, yes.

Q. Yes, okay, and that would have been again displaced so that would have been a definite 20 millimetre, well around about 20 millimetres, I can't imagine you would have been measuring exactly.

A. No. It is not noted in, yes, it is noted in our report dated the 5th of September saying that the amount of dislodgement that had occurred was about 20 millimetres but that would include the combined movement of both the adjacent car park building and the hotel building itself.

Q. That is right.

A. If they move similar amounts then they might have been moved 10 millimetres each.

Q. Yes, yes, now you say you saw the building again in February?

A. Some time after February, yes.

Q. How far up?

A. We are involved with the deconstruction of the bldg with Fletchers so I have a good understanding of the building in its current state.

JUSTICE COOPER:

Q. By that you mean to say all the way up, do you?

A. Yes, yes, I have been right up to the top of the building.

COMMISSIONER FENWICK:

Q. You would have seen then the frame in its exposed position and the looking north-south so you are looking at the east-west beams they have displaced plastic hinges from the columns –

A. Mmm.

Q. – is that correct? And they predominantly have diagonal cracks in one direction but there was diagonal cracks in both directions, can you recall that from February? At the potential plastic hinge sites.

A. Yes, after the building was stripped out we had a close look at those cracks. The worst of the cracks was on the south side frame which is grid 5, that is the south wall, and there is less cracking on its opposite frame which is the grid 11 frame and only concentrated in the middle two bays.

Q. Yes.

A. The north-south frame on grid A and the one on grid D are both in relatively good condition still, apart from the location between grids 6 and 7 where the shear wall had dropped down and the beam had gone through some significant curvature because of the amount of movement the building had dropped down by but in terms of the south side frame on grid 5 the cracks through there are predominantly a single vertical crack that propagates through most of the depth of the beam before returning out at 45 degrees. It is not a fan arrangement of cracks at 45 degrees in each direction. I understand it is quite different than what the original research would normally have predicted.

Q. There was one crack and the cracks are not spread but from memory, I mean, my memory and maybe that is a bit vague was going up on the outside of level 11, of line 11. Even there there were predominant diagonal cracks in one direction and lesser cracks in the other, but that is on the north side?

A. Yes, I think that is the case on grid line 11 if you –

Q. Yes, that distance is away from where the collapse, presumably when that wall collapsed it would have tipped the south end down as you say, I mean, there is significant diagonal cracking there but –

A. Yes.

Q. – on the north end presumably you wouldn't have had quite as much effect?

A. Well the building, when the shear wall collapsed it has taken the building, shifted the building across and it seems to have had an effect right down at the far end of the building as well.

Q. Yes.

A. Given that it is all tied together with a rigid concrete floor diaphragm so there has been an effect at the north end as well.

Q. But not as much as at the south end?

A. The south end is significantly worse, yes.

Q. That is very helpful, but we might possibly come back to you if you got pictures and other things which could just help sort out some of the problems?

A. Yes I do have extensive photographs of those cracks, yes.

Q. And you would be happy to let us look?

A. Yes.

Q. Very useful, thank you very much.

QUESTIONS ARISING - NIL

WITNESS EXCUSED

JUSTICE COOPER ADDRESSES PANEL

MR HOLMES:

When we stopped I had asked for a plan to be put up of a lower level and it is being shown now and it is just a visual demonstration of the fairly significant torsion that would be generated in the base structure in the east-west direction because of the fact that we have this major shear wall and only one other wall in that direction and you have not. There is an eccentricity even without the podium but with the podium sticking out there it is a fairly significant torsion. I mean, we were just talking about the torsion so I am making no point about that other than there is a significant torsion. The building would tend to rotate round this huge wall –

JUSTICE COOPER:

That is the wall on grid 8?

MR HOLMES:

Yes, the wall on grid 8 which would tend to exaggerate the motion out of plane of the famous wall on D5-6 which that movement is being more and more targeted as perhaps the real ultimate cause in addition to the high axial load so that is the only point of that plan.

1209

MR THORNTON:

If I might make a comment speaking as, if you like, a design practitioner, I think that most of us would feel that we have the tools that are required to design for plan eccentricity. Now that belief may not be well founded, but, and certainly we believe we have the tools through standards, codes and practice to adequately deal with plan eccentricity resulting in torsion and many buildings, really because of architectural or planning requirements or the site requirements, it's quite – it's not untypical for a building to have some level of plan eccentricity. When we consider though the vertical eccentricity I think it's probably acknowledgement amongst practitioners that we don't have the

same level of confidence of dealing when we have a change of stiffness in a vertical sense that we can adequately deal with it. Again within New Zealand and in my experiences Wellington city, there there are a lot of podium structures and it's not unusual to have some element of change of vertical stiffness as you go through from a podium to a tower, it's really quite common. I think that particularly when you have a situation when you have – it's well recognised a stiff structure on top of a flexible one, I mean the obvious example of this is a water tower type structure, which we have a stiff structure on top of a flexible one, it's well known that they can perform poorly, whereas when you have a structure like this which is a flexible on top of a stiff structure, the podium is if you like an extension of the rigid foundation and I guess practitioners would feel more confident of dealing with that. Certainly this – we've seen in the Christchurch earthquake a number of failures or structural failures which have undoubtedly resulted from eccentricity and this is I guess put into question the tools that we have and the knowledge and the ability we have to deal with it, so it is certainly an area that needs research and further guidance.

COMMISSIONER FENWICK:

Mr Thornton, you have the tools there to assess this, can you tell us what those tools indicated the lateral deflection would be on that beam, or alternatively what the lateral – the lateral bending moment would have been there, out of plane bending moment would have been, in the out of plane displacement on that wall, based on those, or that analysis? I don't think there's anything recorded in your report on what the displacement would be on the wall and the (overtalking 12:11:48). The large component causing that displacement would have been those torsional – well may have been this torsional interaction.

MR THORNTON:

Yes, we did some – we did do some calculations to determine what the lateral deflection of that would expect and I think that was shown on one of the diagrams. I'm afraid I don't whether that was at the centre of mass or at that

grid line 5, but it certainly as I say, the tools are available to determine that. For the exercise that we undertook we thought it was clearly identified what the problems with the wall were and why it failed so working out whether the deflection at that was a little bit more at grid 5 compared to the centre of mass would not have had any effect on the conclusions for why, for the failure.

COMMISSIONER FENWICK:

Are you saying it was it was not necessary to work out the lateral, predicted lateral displacement of this wall to account for its failure? Is that what you're saying? Have I put it to you correctly?

MR THORNTON:

Well you recall that, for the purposes of our analysis, the answer is yes. You recall that the deflections within the podium structure were extremely small. At the top of the podium I think it was only a maximum of about 50 millimetres and so where we, even at centre of mass down at the first floor it was an order of 10 millimetres.

COMMISSIONER FENWICK:

That 50 millimetres, whereabouts was it, I understood that was sort of the centre of the tower, you know the vertical axis of the tower objected down is where you were predicting 50 millimetres. Now the displacement of course away from that could have been higher or lower due to the torsional action couldn't it?

MR THORNTON:

Yes. As I just said I think my belief is that the information I give you is probably at the centre of rigidity rather than at the extremity.

COMMISSIONER FENWICK:

So the torsion would have produced unknown displacement on that wall? (overtalking 12:13:54)

MR THORNTON:

Yes it could be calculated.

COMMISSIONER FENWICK:

So you could assess it from your analysis?

MR THORNTON:

Yes we could.

COMMISSIONER FENWICK:

If you had done it. Thank you.

PROFESSOR PAMANIN:

You've taken out of the discussion, I think that's it's a – I agree that we is going back to the global behaviour and local behaviour. It is true that we do have tools to understand that the distribution of forces and displacement in the elements that are coming from global behaviour so we do have a better understanding nowadays than in the past. The problem is that as soon as we do that then the current practice and current code is driving us back to going from a 3D, a response to 2D, so basically the allocation people be physically engineers, would be doing a good job of understanding what are effect of torsion on each element and then going back in their brain, because that's what is allowed, to think that this wall is going to work in one direction, is going to take care of the north/south behaviour with amplification due to the torsion, why the east/west would be carried out by the other walls in the other directions, so in a way we are amplifying those actions but if we are to ask again to ourself, are we aware and I'm talking about international community, of what would be the behaviour of this wall for a combined compression shear in the two directions, the answer is we don't. That because we don't or we never thought it would have been important there are not investigation in place that can prompt a clause in the code that would reduce the capacity, in-plane capacity of the wall to account for that, so we do need more information in the future about experimental testing, numerical investigation to understand

the element behaviour when subjected to more than one component, which will be then changing completely the way of designing or sort of assigning the loads and displacement to each element and there will never be any more, all the assigning loads and displacement in one direction and that's the major change that is going to happen. It is happening already, beam column joints.

COMMISSIONER FENWICK:

Professor Pampanin, I will just stop you there, if we can just restrict our comments to the Grand Chancellor. We know that we need to do research on bi-axial actions of things and curvature and the rest, so if we can just restrict it to the Grand Chancellor at this stage. There will be an opportunity later on to look more at general walls and what we need to do.

MR THORNTON:

If I just might add something to what I said before and that is I did explain yesterday that when we looked at the, you know, when that wall was in extremis, when it was – had the really high axial loads on it, its moment curvature performance was so poor that almost any displaced – lateral displacement would of course possibly no displacement, it still would have failed, so I guess that's why from the work that we did it wasn't so important to establish precisely what the displacement of that wall was.

COMMISSIONER FENWICK:

It was so I could apply your moment curvature relationships to see whether it would take that displacement and also I point out the moment curvature relationships you derived, I think were for uni-axial conditions only and as Stefano and others have pointed out actually the reversing action and actions tend to change. So that was really why I was asking, you know, whether we had idea of the lateral displacement, but thank you, you have answered the question.

MR HOLMES:

I have a couple more points, that okay. If you could, you have up there 0003.41, if you could put up 0003.45 please. There is just one other eccentricity that I just wanted to point out. I think you may have pointed out yourself in your original testimony, but this is the – this is – called a typical upper tower plan and there is an exterior frame on line E that is a – what we could call a gravity frame, but for whatever reason probably having to do with the exterior cladding, these little gravity columns are actually elongated so they are longer in the north/south direction than a typical gravity column which you can see on the inside of the building say at C10 or some other interior grid line. I just want to point this out that elongated columns would give that gravity frame additional stiffness more so than the other frame.

1219

MR THORNTON:

We did point that out in the report and it did, in our understanding, create a ratcheting effect on that frame because if you can imagine really because of displacement compatibility that frame which was intended to be a gravity frame effectively had shears induced in it through the displacement and that would have pushed, resulted in axial actions at the column on grid 5 and grid 11. Now when you add the vertical shears, well the shears deriving from the beams into those columns in the gravity sense so when the column was going to compression then you get additional axial load on the cantilever beams at grid 5 and, perhaps to a lesser extent, on grid 6 and then the reverse cycle at the other end of the building. We did notice in our inspections that those end columns had dropped so that did suggest it was a form of ratcheting where you have a mix between, you have effectively elastic actions occurring on a structure which should be totally elastic, that is, the support of the cantilever.

MR HOLMES:

Because these are in columns on 11 and 5 are actually supported on cantilevers at every level.

MR THORNTON:

Yes, yes.

MR HOLMES:

So as the compression went down there was really no equal amount to pull them back up.

MR THORNTON:

Yeah and the extent of that load would be unanticipated by the original designer so that beams are likely to have yielded because normally you would try for a cantilever beam you would make sure that it remains elastic.

COMMISSIONER FENWICK:

Mr Thornton, if someone had done capacity design which they should have done, that should have been immediately clear. That would have come out in the capacity design. You pushed it sideways but you get the higher axial loads at the end which had to be transferred back.

MR THORNTON:

Yes I agree with you. If they had modelled that frame on grid E.

MR HOLMES:

You wouldn't do a capacity design of a gravity frame probably.

COMMISSIONER FENWICK:

Oh yes. You would have to take that into account, wouldn't you?

MR THORNTON:

The code does not require that in a total frame sense. It does require that you consider the inelastic actions on a gravity frame and make sure it's appropriately detailed.

COMMISSIONER FENWICK:

Yes you'd have to consider the imposed displacements on it.

MR THORNTON:

Yes. I don't think the current code would anticipate that you would add up all the over-strength or the shears in bay beams and add up the effect on that column.

MR HOLMES:

Probably in the 80s we would not be doing that in the US. All we have to do is rationalise that they can take the drift.

COMMISSIONER FENWICK:

You said current code. Do you mean the current code when this was designed or do you mean our current code now?

MR THORNTON:

No. The current code now. I guess we've all learnt a lot in the last 18 months and maybe that's something we'd certainly consider going on but looking back, say even the current code required you to look after any compatibility displacements on a gravity frame but not to, if you like, design it as a full seismic frame.

MR HOLMES:

I think the practice in the US is weak in this area. We can sort of artificially decide and say this is a gravity frame, it's not part of the lateral force resisting frame and there's the requirement that you rationalise the displacements but not very specific so obviously as someone said yesterday the earthquake doesn't understand the code so it doesn't know whether there's a sign on the column that says this is not part of the lateral frame or not so we have the same weakness. What I want to point out now if you could go to 0003.44. As was pointed out yesterday those exterior columns that we just were looking at at the upper floors were stopped right above the transfer beams on purpose to force the cantilever loads in the moment frame towers to go into each level rather than being supported on the large cantilevers which support the floors

in the walled portion of the building. So the fact that this frame that has some significant stiffness because of the shape of the column stops at one level. This is yet another torsion that would be set up in the tower portion and you pointed it out so you were well aware of it. I'm just wondering whether that torsion was somehow in your model.

MR THORNTON:

No it wasn't and it wasn't in the original designer's model either.

MR HOLMES:

Probably because people don't model the gravity frames.

MR THORNTON:

And the same, I mean the effect of the transverse gravity frames was not modelled either.

MR HOLMES:

Okay, well we were just curious. My last point is that yesterday Professor was suggesting that we need to consider redundancy in a better way and I wanted to point out that the US feels that way and has put in a redundancy factor in the code way back in I believe 1997 and we had a lot of problems with it because it was a penalty factor which might not be the way to do it but basically there were ways to numerically measure the redundancy of your structure regardless of whether it was a framed structure, shear wall structure or whatever that you would measure numerically how many elements you had and figure out a rating of the redundancy and if the rating was not good enough you would have to increase the forces on the whole structure, apparently reducing the ductility demand and reducing the need for redundancy. That's the way the whole thing worked but the interpretation of the redundancy that you obtained from these rules was impossible. There were apparent penalties against some types of structure that were way worse than other types of structures and it has been gradually eaten away after the rules have been softened and softened and softened. So my only point is that

if New Zealand would like to somehow consider redundancy formally I highly recommend that you look at the history that we have with trying to do that and try to avoid the mistakes that we made.

PROFESSOR PAMPANIN:

If I can comment on it. In general terms of the redundancy it's got quite good precedent from the States but also we are aware by sort of talking to colleagues of the consequence of that in the sense that a redundancy to the extreme in this case would be to consider that Park Terrace as we saw it before, a main wall in one direction would be allowed, it would not be unallowed, it would be allowed with a penalty factor enforcing that wall to become stiffer and stronger and designed for load ductility which doesn't give enough safety against unknown events like this so is basically going back to the danger of taking a safety factor from the unforeseen but the unforeseen is going to be all the time bigger than what we are estimating so what we are trying to discuss in the Department of Building and Housing and that was part of the expert panel is not to try to penalise one element and still allow one element to be there. You can have a big tower, pre-stress tower, made of one element because that's part of a design but a Sky Tower in Auckland still will be able to be designed but if you have opportunity to add what we are discussing is showing an alternative load path to the main one that has been designed by the designer and showing what if, making the question what if, things are going wrong and my main element is not behaving as was intended to or what if the earthquake is stronger than what was intended to, do I have a backup plan. So we really use this sort of internal jargon – what if, and backup plan to allow for something else to happen. It's basically nothing else than what has been used in the blasting engineering. So try to prevent terroristic attack and a progressive collapse from the point of view of taking away one element which is going to cause progressive collapse. In an active sense a terroristic attack will try to create probably the weakest element and the collapse will occur. From a design point of view we will be trying to avoid the weakest link to cause a progressive collapse, so redundant system would be

the one that if a main element goes there would be some other ways of, is not only a penalty factor there is more really trying to give a back up mechanism. 1229

COMMISSIONER FENWICK:

Yes I've got just one more point, you were asked to say would the wall have failed with our current 2006, sorry 2004 building standard, a more interesting question for me would be would that current, would that failure have likely to have occurred if it had been designed to the 2006 loading standard and the concrete standard of 2006, sorry the loading standard of 2004 and the concrete standard of 2006? My apologies for my fumbling over that. Would the walls have satisfied, would have been adequately, adequate then if you'd supplied those new provisions in our current standard?

MR THORNTON:

To the existing structure?

COMMISSIONER FENWICK:

Yes to the structure.

MR THORNTON:

Well if it had, I think if you design it fully to the code and they fully understood the actions that could occur on that wall the only question in my mind would be on the slenderness because the code still allows quite a slender wall so.

COMMISSIONER FENWICK:

I agree that's why I'm asking the question.

MR THORNTON:

I mean because it's an interesting point, in fact if the, if the wall was designed, had been designed correctly, to the correct code in '86 in fact it would have a better chance of survival than if it had been designed to the code today because of course the demand from back then is bigger than it is, is now.

That's not – and as Professor Pampanin says that's not what's in the code doesn't bear any relation to what nature throws at us so in that respect at that longer period the spectra that we saw is considerably higher than the current spectra was for Christchurch.

COMMISSIONER FENWICK:

Yes but the, as you have said before the design of this wall should have been based on capacity conditions?

MR THORNTON:

Yes.

COMMISSIONER FENWICK:

And our capacity conditions now are actually more severe in 2006 than they were in 1984 in terms of calculating the over-strength moments and so on but you think there's some doubt in terms of whether it would, the current standard would satisfy, would have prevented a failure of that wall?

MR THORNTON:

Yes well I think as I said the, the question in the back of my mind and Professor Pampanin will have perhaps a view but would be about the slenderness. I think we are confident that you, if you took into account all the actions that would come on the wall you would, the code should adequately size and reinforce and confine the concrete to take the loads but the slenderness is perhaps an issue to be considered.

PROFESSOR PAMPANIN:

I agree and I think this what the Commission was prompted as an answer. In the revision of the new concrete code we're almost, we should be anticipating that there will be require modification on the wall section for how much New Zealand has always have been in the last few years. Apologies for that one the best code in the world in engineering and I'm saying that based on what I refer to the very real recent modification that happen in Italy after the

Italian earthquakes and confirmed by the Chilean earthquake. This wall is suff- typical walls in the late, last 20 years has suffered for not only the slenderness ratio but everything which is ratio so which means –

COMMISSIONER FENWICK:

Stefano, sorry Professor Pampanin thank you, if we can just restrict this to Grand Chancellor.

PROFESSOR PAMPANIN:

For the Grand Chancellor.

COMMISSIONER FENWICK:

I think we've got our answer from –

PROFESSOR PAMPANIN:

Yeah and I would agree on that.

COMMISSIONER FENWICK:

I think there's a chance to go into some of the issues you're raising later on, better when we can consider those altogether rather than –

PROFESSOR PAMPANIN:

Simply supporting the fact that yes me too I don't believe this would have been better.

MR HOLMES:

If, if the wall had been designed to the minimum level the code allows, if an engineer had looked at that and said I think I want a fatter column underneath all those big loads coming from the cantilever, then you know looking at a wall that's five metres long and thin as a column as a single element with huge loads coming at the end is maybe you know questionable, you may want to just put a fat column at each end but the architect may not have allowed that.

Different thing about what an engineer would do and what the code is a minimum.

COMMISSIONER CARTER:

Gentleman I note that at least two of you are practising design engineers and we note, have heard considerable information about the way this building structure evolved and including the comment that I think you picked up Mr Holmes in regard to late changes. I suspect that in any office that is designing a number of structures there are lots of things going on at the same time and whilst we are just concentrating on one particular building with its particular problems at the time this building was being processed and particularly with the late change this would have had to be accommodated within the operating system of the office. I'm just wondering whether you've got any observations you want to make about the importance of systems in considering design, design development and design choices that might be of help to the future in thinking through issues particularly ones in which late changes are introduced.

MR THORNTON:

If I might comment, look I would endorse and reinforce the aspect of potential late changes coming at the end of a design process. Maybe that can cause problem and we've seen lots of examples around that of that through the, certainly through my experience. There might be a change suggested by a building contractor to make it a bit easier or a late, late change by the client. I mean a design process is a long process as you say require systems and you start with a conceptual design, you went through to final design. That period might take six months and then sometimes perhaps in the tender period the engineer is put under a great deal of pressure to make quite a significant change and he doesn't have the time and the client's not paying him to repeat the whole process to consider adequately the effects of that change. However, when we come and look at this building here and when we look through the calculations that were done I don't believe that that was the case. I think it was, the calculations indicated that you know the whole, the final

structure that you see there was modelled and analysed and calculated in a reasonably appropriate way, obviously a mistake was made but I'm not sure that that is directly as you know a late change sort of systemic problem.

COMMISSIONER CARTER:

Okay thank you.

MR HOLMES:

Well the, the, what you're talking about is office practices. It's very individualistic it depends upon how the office is organised, whether it's a big, small, how much involved are the principals versus the people that are actually producing the design and there are no standards frankly. I mean every office, the only standards are the people have to be licensed and how you run your office or how you check your calculations or all those things are pretty individualistic. That's the good part about a, either a review at time of consent or peer reviews in general or in California we have a very, very vigorous checking procedure for hospitals in California due to a state law. It's almost like a nuclear industry check and what those checks do actually is make individual engineers more aware of possible mistakes or in fact they become more aware of what another office might do. If you get peer reviewed you will be asked a lot of questions that might be different than your principal in your office might ask so it, it actually is a very good process in addition to perhaps uncovering errors in an individual building. It's a very good way to broaden any engineer's experience and design talents.

MR THORNTON:

I just want to add, I agree totally with what Mr Holmes said. I think you know we have over the last 20 years had a change in culture in our design offices really partly through technology so where there is a much, the computer modelling tools and things that we have now enable us to design a structure much more finely but there is also, there is the risk in that that you don't, you're not perhaps understanding what you're modelling or you're not modelling correctly, you're not representing what the, what the structure is.

So at the end of the day Mr Holmes is actually right it does come down to the culture within firms and I have to say that within New Zealand when you can look through there is a great variety in that culture so getting some general improvement across the design culture I think is important, a very important area to consider.

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COMMISSIONER CARTER:

Just one other matter. Obviously as this enquiry concludes with a report will be studied by those that seek to improve the economic performance of our building stock and one issue in that is the extent to which secondary damage can be minimised. The codes introduce limitations to drift and are you comfortable as designers in the New Zealand scene with the levels that are set in the codes at the moment for the amount of secondary damage and perhaps you could comment on the need to do more design of the secondary elements to avoid there being damage, them being damaged and I cite as an example the art gallery close to here which has an extensive glazed wall and suffered through all of these earthquake events without damage, presumably because of the way that glazed structure has been provided with the ability to allow the structure to be deformed without causing damage to the, I think some guidance on secondary elements might be a valuable addition to our work.

MR THORNTON:

I guess part of the answer to that in my view is one of economics, building life, the period of, in a return period for earthquakes and how you deal with them and part of that also is the level of ductility that you assume for your principal structure. As design engineers we all know of course that it is not normally economic to design for a building to remain totally elastic which I guess is the ultimate form of damage avoidance and so if the code has given us, gives us guidance and I guess that guidance came from engineers and perhaps from policy makers and maybe from insurers as to you know looking at the repetition or the periodic nature of these events, you hope it happens only

once 500 years and it is not in your lifetime. Of course what we have seen in Christchurch is we have an unlucky generation with the event has occurred within their lifetime and we are putting pressure on the insurers to respond to appropriately. Now I guess society may well sit back and say well is that, do we have the appropriate appetite or recipe for risk? Are we, is our level of ductility that we assume is that appropriate compared to the economic consequences of when a big event does happen? So because I see that as part of the same questions that you have asked because whereas you can, it is actually quite difficult in a practical terms to protect secondary elements when there is a large ductility demand on the building. You are going to see get some quite large displacements in any case. Even without ductility the earthquake will demand that the building responds in a certain manner and when you look at the cladding systems and internal partition systems it has become very expensive if you are to detail every joint to withstand damage so I am not sure it quite answers your question but I guess acknowledging that it is a good question but the answer is not easy.

PROFESSOR PAMPANIN:

At least what I would like to stress is the second part of the question where the problem is there and the cost of the non-structure damage has been shown for the last decade to be huge for a modern country. Raising the bar in asking people to limit, to put a brake, a limited drift is one way but the other way would be as you said knowing there are solution out there, they are definitely are going to be a little bit more expensive but in the long run it is going to be the new technology so there is new technology for partitions, for ceilings, for facades, that allows them to go through all disaster shock without being damaged and if people knew that with a little bit of a premium as more percentage they could avoid millions of dollars of losses for direct damage and for business interruption then basically it is going to become the new technology of the future so in the future Japan is very advanced for example they have seismic doors which can be opened by hand in case that after the ratcheting a big earthquake you get the problem of being trapped in the building so they developed a frame so that you basically open by hand

whatever has been happening to your building. We are not there because obviously a seismic door costs more than a normal door but the point is how much does it cost more if you see the consequences and there are solutions which are very simple. Gib board we are working with the industry, for partition which are just minor separation they can go quite a leg ahead in reducing the cost.

MR HOLMES:

I want to make a distinction between drift and non-structural damage. There are many elements secondary systems in a building which are susceptible to drift damage but there is almost an equal amount dollar-wise or maybe even an additional amount that are sensitive to acceleration and it turns out that drift and acceleration do not work together, they work against one another so if you reduce the drift in a building you are increasing the stiffness and you increase the acceleration on the floors so things like desks and book shelves and ceilings which are affected not by drift but by acceleration will get larger accelerations and the disruption in the building is likely to be larger so you have to be careful recognising that drift is not the only major of non-structural damage but in fact most countries I believe, including New Zealand, has fairly universal requirements to protect the non-structural systems in their buildings, either by anchoring things down which protects them from acceleration generally or by providing some allowance for differential movement between floors. The real problem is getting that done having it enforced and I think this is a universal, is a world-wide problem. Frankly I think the US maybe doing it a little better than most although in Japan does probably a pretty good job but we noticed in Chile, for example, they have a code which says you do all this stuff and they did nothing. I mean, almost every elevator in Chile was knocked out, not in the whole country but in the shaken area, was knocked out because they would order elevators that did not have any of the seismic protection that everyone knows about, even though it was in their code, so enforcing what we already know would go a long ways and it is a very difficult problem because these are orphans, you know, the structural engineer's very concerned about the structure and from a seismic standpoint but there is no

one that is really concerned about the seismic performance of all the other components. A mechanical engineer is worried about whether the building is hot or cold. The architect is worried generally about what it looks like and how it functions and so these things nobody really takes responsibility for, so that is the enforcement of the things we know about without getting very innovative actually is you know it would be a big jump in performance to begin with.

JUSTICE COOPER:

Mr Thornton, in your report at paragraph 9, the conclusions section, you state that the structure contained a critical structural vulnerability resulting from the fact that the capacity of the D5-6 shear wall could be exceeded by the demand actions that could be expected during code level shaking to the extent that a brittle and abrupt failure could occur. Can you help me to reconcile that statement with a statement that you made more recently in this hearing today that you thought that the role of the wall had been analysed by the designer in an acceptable way?

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MR THORNTON:

Yes, I should clarify that. There are different levels of analysis that are undertaken and the analysis that is - that I referred to this morning, at this hearing, relates to the way you determine the, primarily the actions on every element resulting from the horizontal movement from the horizontal shaking. Now – and that – so that determines in structural sense the bending moments and the shears and the displacement within that wall and that's – it's a semantics, but we refer to that as modelling then once you – when the modelling is completed you actually design that element and the actual summing up of the axial loads doesn't come directly from that modelling. A component of it does but other parts of it come from if you like a more mechanical calculation of summing the vertical loads from various different aspects, from the gravity loads from the over-strength shears which is something you've done after you've put – you've worked out what the reinforcing is in the upper tower frames and the other aspects that contribute

to that vertical load so it's that portion that we concluded the designers had got wrong, not the computer modelling. It's certainly in terms of the – the modelling that was done was relatively unsophisticated to what is done today but for its day I think we feel that it was done adequately.

JUSTICE COOPER:

Well the modelling was done adequately but another step of the consideration of the overall structure that has been designed was not done adequately?

MR THORNTON:

Correct.

JUSTICE COOPER:

Now Mr Holmes, would you like to just discuss briefly what was said yesterday about the relative importance of velocity as opposed to acceleration.

MR HOLMES:

You want me to discuss that?

JUSTICE COOPER:

That's right.

MR HOLMES:

Well I – displacement and velocity and acceleration are all directly related in dynamics so once you know one of them in a given series of motions over time, you really know the others as well. So it's really a matter of understanding what conditions are more affected, or how can you visually understand things that are important by which one you look at, because if you look at one if your mind is very sharp you can actually kind of figure out what the other ones are so I suspect that Professor Pampanin is basically saying that for pulses at these – for near field events you can be – you have to be very sophisticated to look at an acceleration response factor and understand

what the velocities are doing, so you would – it's more obvious if you look at velocities instead of the acceleration response spectra.

JUSTICE COOPER:

So, I mean, this is – what you seem to be describing is a different method or emphasis of analysis rather than a different phenomenon.

MR HOLMES:

It is definitely not a different phenomena.

JUSTICE COOPER:

Yes, well gentlemen, thank you very much. We are very grateful to you for your evidence and the time and care that you've put into your presentations to the Commission.

COMMISSION ADVISED MR LIND FROM POWELL FENWICK MAY NOT BE AVAILABLE BY VIDEO LINK THIS AFTERNOON

COMMISSION ADJOURNS: 12.57 PM

COMMISSION RESUMES: 1.32 PM

MR ZARIFEH ADDRESSES JUSTICE COOPER

MR HANNAN CALLS:

HENRY JOHN HARE (AFFIRMED)

Q. Yes now is your name Henry John Hare?

A. It is.

Q. And you're a director of Holmes Consulting Group based here in Christchurch?

A. I am.

Q. If you read your brief of evidence please from the second sentence in paragraph 2.

JUSTICE COOPER ADDRESSES COUNSEL – FIRST FIVE PARAGRAPHS TAKEN AS READ

Q. If you read your brief of evidence please from paragraph 6 and I will pause you at one point a couple of paragraphs in just for one supplementary question.

A. Yep. "I on behalf of Holmes Consulting Group provide this brief of evidence pursuant to the Canterbury Earthquakes Royal Commission's letter dated 17th November 2011 incorrectly dated 17th December 2011 in relation to the Hotel Grand Chancellor building. I am asked to outline my position with HCG and the basis of my knowledge of HCG's involvement in the Hotel Grand Chancellor. My current position is that of director of HCG based in its Christchurch office. The Hotel Grand Chancellor building was originally designed by Holmes Wood Poole and Johnstone Limited a predecessor company of Holmes Consulting Group. Holmes Wood Poole and Johnstone became involved in or about late 1984 or early 1985."

Q. Now I'll just pause you there and ask you one question to clarify the name of the company that designed this building if we could look please at document BUI.CAS161.0049.

WITNESS REFERRED TO DOCUMENT

Q. Now just have a look at that if you would please?

A. Yes.

Q. That is, is it not, the certificate of incorporation for Holmes Consulting Group Limited?

A. It is.

Q. And that's your present, that's the business in which you're presently involved?

A. Yes.

Q. And if you look down through there you'll see that under a previous name this company was first incorporated on 6 September 1989?

A. Yes.

Q. So this is not the company that designed the, designed the building?

A. Ah, no that was a predecessor company.

Q. Thank you please continue reading at paragraph 10.

A. Yep. "At the time of completion of the building's design and its construction I was a graduate engineer in the Christchurch office. I loosely recall the Hotel Grand Chancellor project being discussed in the office but I had no direct involvement in it.

HCG review. Following the February 2011 earthquake HCG has untaken a review of the original design documentation for Hotel Grand Chancellor building. This review was performed by Graeme (inaudible 13:36:12) a technical director in HCG's Auckland office.

Structural design of the building. I am asked to provide a brief outline of the role HCG had as structural engineers in the structural design of the Hotel Grand Chancellor. As I have previously confirmed the Hotel Grand Chancellor building was initially designed by Holmes Wood Poole and Johnstone a predecessor company of HCG. As far as I can recall and from what I can see of such, of Holmes' files as are available, Holmes Wood Poole and Johnstone's role was a conventional design role. As such Holmes Wood Poole and Johnstone was responsible for the structural design and documentation and the construction

monitoring. I am not aware that Holmes Wood Poole and Johnstone and/or HCG had any special role beyond that remit.

The original design of the building and subsequent change to the design. I am asked to provide brief details of the original design of the building and to provide details of the subsequent changes to that design and the reason for the changes. As far as I can tell following a review of the files the Hotel Grand Chancellor was designed over an extended period from 1985 through to 1987 during which time it underwent several design changes relating to land and site usage. The building is 21 stories comprising six levels of car parking at the podium level and 15 stories of hotel above, originally intended as office floors. During the early construction of the building the original design had to be amended to remove structure from Tattersalls Lane. The developer had attempted to secure title or rights over the use of Tattersalls Lane but was prevent by subsequent legal action after the original design was complete and after construction was underway. Consequently I believe Holmes Wood Poole and Johnstone was required to re-design aspects of the podium structure in order to relocate the shear wall between grid 5 and 6 to line D on the west Tattersalls Lane. This required the addition of transfer beams to cantilever the tower over Tattersalls Lane. As part of HCG's review of the design works in order to provide this brief of evidence HCG has studied the original calculations and performed additional analysis of some aspects of the building.

The original building design. The building was designed by Holmes Wood Poole and Johnstone to the prevailing standards at the time being primarily NZS4203 1984 for loading and NZS3101 1982 for design of concrete structures. In respect of the shear wall in question on grid line D 5 to 6, HCG has reviewed the loads used in the design of the wall. The original calculation sheets that HCG has been able to recover were out of order and were not numbered but were dated. A copy of the calculation sheets has been copied to disk and has been supplied to the Royal Commission. It appears the calculations for the wall on D5 to 6 were carried out on 22nd of July 1986 under the heading "Design of

Walls on Line D". A copy of the calculation sheet bearing these calculations is attached. The design actions were stated as follows: axial compression PD dead load 14 765 kilonewtons, PL life load 2437 kilonewtons, scale bending moment NU equals 79 60 kilonewton metres, scale shear force BU equals 796 kilonewtons. The word scaled refers to the scaling of the seismic analysis results to the correct ductility and building period used for the design of the walls. The design actions do not show any seismic axial load. It is likely that in the wall's original location on the east side of Tattersalls Lane the seismic axial load would have been zero in which case it seems likely that the designer at the time made reference to the original calculations when the wall was moved and did not consider the implications of the transfer structure. There is a narration in the calculations dated 22nd July 1986 referring to the Court decision to not allow use of Tattersalls Lane which required relocation of the wall. It appears the confinement calculations were carried out on 6th of August 1986. A copy of the calculation sheet bearing these calculations is attached. In broad terms confinement refers to the stirrups or hoops placed around the main vertical steel in the wall to provide a confined concrete core to resist concentrated loads and to prevent buckling of the main steel typically located at the compression ends of the walls. The neutral axis depth was calculated and compared to the critical neutral axis depth, that is the point in the wall about which it might rotate under bending actions was compared to a theoretical limit set by the code. In this case as the calculated depth was less than the code limit no special confinement reinforcement was required. The calculations considered slenderness, noting "checked width for stability after preliminary design". HCG has not been able to locate a specific calculation but I note that under the 1982 code for walls of sufficiently low axial load it was acceptable to allow a wall thickness of less than L upon 10 with no minimum given. It appears that the axial loads used in the 1980s design were approximately at this limit. From HCG's review of the calculations it appears that the seismic component of the axial load was omitted probably as a consequence of the wall

being relocated away from the boundary. This was compounded in that confinement and slenderness were considered using the same load without the seismic component. If the seismic component of the axial load had been included, it appears that both confinement and slenderness provisions would have been triggered.

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Impact of Changes to the Building Design:

I am asked to provide details of how the changes impacted on the structural capacity of the Hotel Grand Chancellor. Having read the Dunning Thornton report dated 26 September 2011, I am generally in agreement with its conclusions. As noted above, HGC has conducted an independent review of the design and has reached a similar conclusion as to the capacity of the building.

Christchurch City Council:

I am asked to provide details of any involvement anyone from HGC had with the Christchurch City Council in relation to the design changes and the Council's consent to those changes. I am not personally aware of Holmes, Wood, Poole and Johnstone's involvement with the Council in relation to the design of the Hotel Grand Chancellor building. At the time, it is most likely that Brian Wood, the director in charge of the project, would have been primarily responsible for the building and conducted or co-ordinated any discussions with Christchurch City Council in relation to the design of the building.

HCG's further involvement:

I am asked to provide details of any further involvement by anyone at HCG with the project relevant to the structural integrity of the building. To the best of my knowledge the project director was Brian Wood and the project engineer was Peter Tilson. Neither is currently employed by HCG nor have they been employed by HCG for over 10 years. I also understand neither is currently resident in New Zealand.

Dunning Thornton Report:

I am asked to provide a comment on the issues raised by the Dunning Thornton Report dated 26 September 2011 and in particular in relation

to the slenderness of the shear wall at D5-6 and the nature of the confinement of the reinforcing in that shear wall (Please refer to paragraphs numbered 17–27 above).

I am also asked to comment on the Dunning Thornton Report's conclusions regarding the stair support details. The stair support details were typical of those at that time with a structural steel RHS hanger supported in a pocket in the supporting beam. A gap was detailed between the end of the stair and the beam face. This may have been a calculated inter-storey drift at the time but is less than would be calculated to the current Building Code. I am of the view that it is possible the stairs could have lost end support as a result of the intense shaking that occurred on 22 February 2011.

I am asked if I wish to make any comment on the conclusions reached by Adam Thornton in relation to the Hotel Grand Chancellor building in terms of its structural design. I considered the Dunning Thornton Report dated 26 September 2011 and I am generally in agreement with its conclusions in respect of the structural design of the building. I have read the letter dated 28th October 2011 from Adam Thornton of Dunning Thornton to the Royal Commission. I have also read the letter from the Royal Commission dated 20th October 2011 which Dunning Thornton's letter responds to. In his letter Mr Thornton responds to the questions put to him by the Royal Commission. In response to the Royal Commission's question regarding the identification of critical vulnerabilities of the building he notes that although some vulnerabilities of a building may be visually apparent or able to be anticipated from a review of the drawings, others require more detailed evaluation. HCG generally concurs with his comment noting that in case such as the consideration of the shear wall at D5-6 detailed analysis and calculations would have to be performed to ascertain the extent of any deficiencies. I note further that although such deficiencies may have been detected through that level of detailed assessment there would need to be a triggering event to require that level of assessment. Prior to any earthquake there would have been no obligation for an owner to

review such a building in the current legislative environment where only the earthquake-prone building policy applies to existing buildings and such a building apparently complies easily and in fact has performed well in excess of that threshold. Following 4 September 2010 and prior to 22 February 2011 if there was no significant structural damage there would still be nothing to the level of review that would have detected these deficiencies. The nature of the deficiencies described is such that the margin between the onset of damage and the failure of the element is low. The consequence of this is that the earlier events were unlikely to have caused any detectable damage which may have acted as a trigger for specific intensive analysis and review of a design to the level required that would have led to the discovery of these issues. Moreover, even if that level of review had been undertaken, it is not clear under existing legislation whether retrofit would have been required in any case.

Mr B J Wood:

I am asked whether Mr B J Wood is still with HCG and, if not, whether anyone has had contact with him. Mr Brian Wood is a former director of Holmes, Wood, Poole and Johnstone and HCG, now resident in Sydney since his retirement from HCG in 2000. He has been in brief contact with HCG but HCG has had no formal discussion with him in relation to the Hotel Grand Chancellor.

JUSTICE COOPER:

Q. Mr Hare, the two sheets of calculations that you've provided state that they are calculations by PGT. Is that likely to be Mr Tilson?

A. That is definitely Mr Tilson.

MR ZARIFEH:

Q. Mr Hare, obviously from your evidence you had no direct involvement with the design of this building and your evidence is given it seems to be on the basis of the Holmes' Consulting Group's perusal of the plans and calculations et cetera?

A. Correct, yes.

Q. You mention though that there was some contact with Mr Brian Wood who was the director in charge of the project. Do you know whether he has any disagreement with the Holmes' Consulting Group's conclusions in relation to the building?

A. Ah, no I don't.

Q. So there haven't been any enquiries along those lines?

A. There's been no discussion, no.

Q. Do you know or are you aware of a drawing that showed the shear wall in its original position with a return? Have you seen that? I'll get it brought up on the screen so you can have a look at it. It's 0003.38.

A. Right, yes.

Q. So you can see this is taken from the materials supplied to the Department of Building and Housing. You can see the structure is originally conceived at the bottom?

A. Yep.

Q. And then the structure is modified to suit the right-of-way?

A. Yep.

Q. Then you see that small return on the wall of D5-6?

A. Yes.

Q. Do you know why that wasn't or didn't find its way into the final plans?

A. Ah, no.

Q. You don't know?

A. Sorry, no.

Q. Now we're going to hear from Mr McCarthy from the Council about the permitting process back in the '80s but it would appear that there was no requirement for an independent peer review of the plans for this building when it was permitted. You talked about, at paragraph 43 of your brief, about the deficiencies in the shear wall at 5-6 would only be really ascertainable with a detailed analysis and calculations, correct?

A. Correct.

Q. Is that the kind of thing that might have become apparent in an independent peer review?

A. It may have. It would depend on the way they went about doing it.

Q. Peer review?

A. Yeah.

Q. Was there any form of peer review within Holmes' Consulting or its previous company at that time so for a project such as this where presumably Brian Wood designed it with Mr Tilson's help presumably. Was there any peer review by other people?

A. It was a long time ago now and I was a junior engineer but my recollection would be that projects would be internally reviewed probably by the director in charge. I couldn't say according to who was doing what exactly what they would have done.

Q. And has that changed?

A. Um, yes to the extent that I know a little more about what happens. Certainly all projects are reviewed before they go out the door.

Q. And if a project such as this, this height and this complexity was being designed today by your company would, presumably that internal peer review would occur?

A. Yes, we would run a sort of a multi-stage review project as the building was being designed at various whole points with a final detailed review before it gets issued for construction.

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Q. Would there be any independent peer review by another firm or not? Not talking about as a requirement by council but just in the general course.

A. It would be unusual for that to happen as a matter of course, the projects, if there are certain projects with certain demands that might happen, really depends on the relationship with the client, the way that it's been permitted, all those sorts of issues.

CROSS-EXAMINATION: MR LAING – NIL

COMMISSIONERS FENWICK AND CARTER – NO QUESTIONS

RE-EXAMINATION: MR HANNAN – NIL

WITNESS EXCUSED

MR LAING CALLS

STEVEN JAMES MCCARTHY (AFFIRMED)

Q. Is your full name Steven James McCarthy?

A. Yes it is.

Q. Have you prepared a statement of evidence?

A. Yes I have.

Q. Do you have it with you?

A. Yes I have.

Q. Could you start reading at paragraph 4 Mr McCarthy please?

A. The documents related to this building that had been provided to the Royal Commission are the building permit, building consent file for the Hotel Grand Chancellor building and the post earthquake files. My evidence will address the following matters, the building permit processes followed by the Council at the time the building permits were issued for the construction of the Hotel Grand Chancellor building, whether the Council's current processes relating to the review of structural plans for building applications for buildings of the nature and height of the Hotel Grand Chancellor are different to those at the time the building permits were issued, compliance with the relevant building by-laws and standards at the time of construction, the Civil Defence Emergency management response in relation to the building after the 4th of September 2010 earthquake, Council involvement with building subsequent to the lifting of the state of emergency on 16 September 2010 but before 22 February 2011. Information about any Council response in relation to the building following the Boxing Day aftershock.

Council's building permit processes.

The Hotel Grand Chancellor building was constructed between 1985 and 1988. The main applications for building permits related to the building were: application 2412, 10th of the 9th 1985, piles for the carpark building; application 3043, 29th of the 10th 1985, pile caps; application 3483, 20th of the 1st 86, substation; application 511, 21st of the 5th 86, erect retail shops; application 1765, 25th of the 7th 86, piles for a multi-storey building; application 3690, 20th of the 8th 86, erect a

retail and carparking development; application 2284, 28th of the 8th 86, carpark building foundation; application 3689, 21st of the 1st 1987, extend the carpark over the right-of-way; application 1323, 20th of the 7th 1987, stage 8 additions including structural cantilever; application 1727, 23rd of the 12th 1987, erect office tower; application 3164, 25th of the 1st 1988, alterations to former shop; application 3328, 24th of the 8th 88, construction stage 2 architect finish and structural details; application A092873, 6th of the 12th 89, partitions.

From a review of the Council's building permit file it appears that the Council's building engineer at the time was Mr Brian Bluck. Mr Bluck had an extensive career in the building industry and local government. He is now deceased and so the specific details concerning the extent of his examination of the plans submitted with the building permit applications cannot be determined. The plans were not reviewed by an independent structural engineer. I can provide some general comments on the Council's building permit processes at the time the permits were issued and as I was not employed by the Christchurch City Council in the 1980's, these comments have been based on a review of the information on the building permit files.

Building by-law 105 1985 which was current at the time of the building permit applications for the Hotel Grand Chancellor building set out the requirements for obtaining a building permit including the requirements for certification. Clause 8.2.5 attachment A required the following for design certification for concrete structures. The designer of any concrete element shall provide calculations which establish the concrete element has been designed in accordance with the requirements of this by-law, or alternatively certify in an approved manner that the design method conforms with a recognised code of practice. Design certificates in the Association of Consulting Engineers' format were accepted by the Council as an approved manner for certification. These certificates were required to be signed by qualified engineers. The Council also received design features reports which outlined the structural aspects of the buildings. In relation to the Hotel Grand

Chancellor building the Council received design certificates from the owners' engineer for the main structural elements. The main tower structure application, application 1727, has a design features report and a design certificate BUICAS1610023.1 from Holmes, Wood, Poole and Johnson Limited and design certificates from its successor company Holmes Consulting Group Limited. A further design certificate dated 10 July 1987 covered the 14 level carpark building beneath the tower structure. The wall D5-6 and the stairs were included and the drawings S1 to S88. As design certificates and a design features report were received, there was no requirement under the by-law for the design calculations to be submitted to the Council. I believe that it was reasonable for the Council to rely on the design certificates as indicating compliance with the building by-law. The certification was from experienced engineers on behalf of a consulting engineer practice experienced in the design of multi-storey buildings. The engineers involved were directors of the company concerned. A letter from Dunning Thornton Consultants to the Canterbury Earthquake's Royal Commission dated 28th of October 2011 BUICAS1610017.1 states, "Therefore in answer to part B of your question the vulnerabilities we have identified could have been identified from the drawings prior to 22 February 2011 but that was very rigorous, an in-depth analysis would most likely have been required to do so." As noted above the Council relied on design certificates provided by the engineers. The Council would expect any vigorous and in-depth analysis required would be carried out by the engineers before giving any design certificates. The current requirements for obtaining a building consent for a building structure are set out in the Building Act 2004 and the Building Code. The Christchurch City Council operates as building consent authority. This means that the Council has been accredited by International Accreditation New Zealand, IANZ, against the standards and criteria in the Building Accreditation of Building Consent Authorities regulations 2006 and has been registered by the Department of Building and

Housing against the standards and criteria and the Building Registration of Building Consent Authorities Regulations 2007.

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The accreditation process involves IANZ assessing the technical competencies, resources, equipment, procedures, systems and processes of a local authority to ensure they are adequate, are being followed and that identified outcomes are being achieved. No accreditation process existed at the time the building permits were issued for the Hotel Grand Chancellor building. The building the procedure currently followed by the Council for the processing of building consent applications for commercial buildings is very similar to the procedure which existed at the time the building permits were issued for the Hotel Grand Chancellor building. This includes certification by way of issue of a producer statement PS1 design by suitably experienced chartered professional engineer. The Council may also require a producer statement PS2 design review certificate from an independent CPENG engineer for buildings of an unusual nature such as a building using new materials or design philosophy. The role of the structural engineers employed by the Council includes considering the plans submitted with building consent applications in reviewing the associated producer statements, to determine whether the signatory is suitably experienced and qualified, and that all aspects of the design are appropriately covered by the producer statement. The engineers do not carry out a detailed assessment or calculations submitted with the applications but rather rely on the producer statements provided. In 2009 the Department of Building and Housing carried out a review of the Building Act 2004. The department records on its website that one finding of the review was that the system is out of balance with an unduly heavy reliance on building consent authorities to identify and correct inadequacies in building design and construction. The website records that the amendments are proposed to the Building Act to make it clear that designers are accountable for ensuring that their plans, specifications and advice will meet the requirements of the

Building Code. Builders are accountable for building to the approved plans and specifications or if there is no approved plans or specifications then they are accountable for meeting the requirements of the Building Code. Owners of building work are accountable for getting any necessary approvals. If they change the plans or specifications or do the building work themselves then they are accountable for meeting the requirements of the Building Code. Building consent authorities are accountable for checking that others are doing their part including checking plans and specifications for building code compliance, checking at any prescribed inspection points that work is done in accordance with plans and specifications, approving any critical variations and certifying that the work has been completed in accordance with the consent.

Design compliance.

The structural performance of Christchurch CBD buildings in the 22nd February 2011 aftershock, stage 1, expert panel report prepared by the expert panel appointed by the Department of Building and Housing BUIBAR0017 expert report based in relation to the Hotel Grand Chancellor building that the investigation found that for the most part the structural design appeared to be compliant with the codes and standards that were applicable when the structure was designed, however with the failed wall D5-6 it does appear that there was some design assumptions that may have contributed to the failure. The design appears to have underestimated the magnitude of possible axial loads in the wall lack the confining reinforcing needed to provide the ductility required to withstand the extreme actions that resulted from the 22nd of February 2011 aftershock. The assessed response of this building to the shaking exceeded the actions stipulated by both the current and contemporary loading codes for a building of this type, structural period of the vibration and importance. The expert report continues in relation to the stair flight collapse, analyses carried out under this investigation indicate that the stairs were unlikely to have collapsed under the earthquake actions on 22nd of February 2011 had the wall D5-6 not

failed. The displacement of the building due to the failure of the wall D5–6 was sufficient to cause collapse of the stairs above level 14. Displacements between adjacent floors under design loadings were estimated to be an average of 16 millimetres per floor over the height of the frame. Taking account of tolerances and variability of inter-floor displacement this dimension could vary by up to 20 millimetres for any one floor. The stair detail provided for 70–80 millimetres of horizontal spreading movement of the supports but there was minimal provision for closing movement. Under the 22nd February 2011 ground shaking the average displacements were estimated to be 65 millimetres per floor. There was no apparent damage to the stair flights although there was evidence of damage due to the compression at the supports but it is considered that the stairs did not significantly affect the structural response. Surveys of the building following the collapse showed that the permanent displacement of the tower in line with the stair was 1000 millimetres. It is likely that a further elastic displacement estimated at 250 millimetres occurred at the time of the failure. This is total displacement of the tower at the time of the aftershock was likely to have been about 1250 millimetres which is 90 millimetres per floor. For any one floor this displacement could be between 70 and 110 millimetres. When compared with the 70 to 80 millimetres of seating available this points to a very high likelihood of stair collapse. As well as the expert report I have read the related report on the structural performance of the Hotel Grand Chancellor in the earthquake of 22nd February 2011 from Dunning Thornton Consultants, the Dunning Thornton report and a peer review of both reports by William Holmes on behalf of the Royal Commission. The reports have been prepared by well qualified experts in the area and reach similar conclusions. As stated above the Council relied upon design certificates from the building owners' engineers which stated that the building complied with and was constructed in accordance with the building bylaws and standards current at the time.

Events after 4th September 2010 earthquake.

A level 1 rapid assessment of the building was undertaken on 5 September 2010 during the state of emergency building evaluation process. This resulted in the building receiving a green placard. A level 2 rapid assessment of the building was undertaken on 9 September 2010 during the state of emergency building evaluation process. The level 2 rapid assessment confirmed the green placard. The Council has no record of the building being assessed after the Boxing Day earthquake. I refer to s 7 of the Council's report into the building safety evaluation processes in the central business district following the 4 September 2010 earthquake which outlines the response to the Boxing Day aftershocks. Not all CBD buildings were assessed after Boxing Day. The building owners were advised to arrange their own assessments. I understand from the Dunning Thornton report that engineering assessments were also commissioned by the building owners including an assessment after the Boxing Day aftershock. The Council has no record of these assessments. As the building was green placarded during the September state of emergency the building owners were not required to provide the results of the assessments to the Council. There was no indication from the owners or the owners' engineers to the Council following the September or Boxing Day earthquakes that the wall D5-6 had been damaged.

CROSS-EXAMINATION: MR ZARIFEH

Q. Mr McCarthy, I just want to ask you about two issues.

A. Yes.

Q. The permitting process at the time that consent was given and currently?

A. Yes.

Q. And the inspection after September undertaken by the Council on behalf of the Council.

A. Yes.

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Q. In relation to the permitting process am I correct in understanding that it hasn't essentially changed from the Council's point of view?

A. That's correct.

Q. And you mentioned PS1 and PS2 forms?

A. Yes.

Q. Were they in existence back then?

A. No they weren't. They were introduced in the 1991 Building Act they were recognised and designed and agreed with the associated, Association of Certified Engineers at the time.

Q. Right, I think its IPENZ isn't it?

A. And IPENZ as well yes.

Q. Was there any predecessor of those forms in existence back then?

A. Only the design certificate form that was part of the bylaw.

Q. Right, what about the PS2 though which is the independent review form? Was there anything like that then?

A. Not to my knowledge.

Q. So dealing with back in the late 80s when this building was designed?

A. Yes.

Q. And permitted, essentially the Council placed full reliance on the designer certificate and the other documentation that was completed by the principal of the firm –

A. Yes. Yes they did.

Q. – that signed that form. Or those forms?

A. Yes they did.

Q. And you said that I think talking about currently but you said engineers do not carry out a detailed assessment of calculations submitted with the applications but rather rely on producer statements provided?

A. Yes.

Q. And that was the same back then?

A. Yes.

Q. And in this case you told us that because a design certificate and design features report were filed there was no requirement under the then bylaw to file calculations?

A. That's correct.

Q. So no calculations were filed with the Council?

A. That's correct.

Q. So even though Mr Bluck is deceased and we don't know what, exactly what he did, he wouldn't have been able to check any calculations from the material supplied to the Council?

A. That's correct.

Q. So again would've, as you've said, relied on the certificate by Holmes, Holmes Consulting or Holmes Wood Poole and Johnstone Limited?

A. Yes, that's correct.

Q. Do you know what the position would have been dealing with the late 80s with a building that was thought to require some form of peer review?

A. I can only imagine that the Council would have agreed with the owner at that time that prior to issuing a permit that there was a, that a peer review would be carried out. I'm aware though that the Council was aware of the local engineering firms and would only accept certification from those companies that they had confidence in. Holmes or their predecessor would have been one of those companies.

Q. Right so was there some form of system that graded them?

A. They, the engineers at the time have always, I believe, held a list of engineers that they would accept that certification from.

Q. Right and was that a formal system that was in place or informal?

A. I think it was at this time it would have been relatively informal but clearly based on the knowledge that Mr Bluck had of the engineering companies in Christchurch at that time.

Q. Well you said that dealing with the current position that a PS2 would be required or might be required due to the unusual nature of the building you said such as using new materials or design philosophy?

A. Yes.

Q. What about a building such as this one if it was being designed and built today. Can you tell us whether a PS2 would be required?

A. Certainly I think for a building of this height, magnitude, structure, there would be a PS2 required. Certainly the industry is going that way and the local authorities and the DBH are encouraging that approach.

Q. For an independent peer review?

A. Yes.

Q. So that's something that perhaps has changed since the late 80s?

A. Yes and it's also been if I can just add to that a little bit, it's been incorporated I believe into the Building Amendment Act number 3 which is currently before Parliament.

Q. Right, so you wouldn't have any argument with the evidence of Associate Professor Pampanin and Mr Holmes to the effect that a structure such as this which they refer to as complex and obviously irregular –

A. Mhm.

Q. – in a number of ways that that in their view should require an independent peer review?

A. That would be the current practice.

Q. Right. In this case we know that the original design was altered at the 11th hour so to speak when the legal action forced effectively meant that they couldn't build over on the right-of-way?

A. Yes.

Q. Is there any procedure in place where changes occur to a building or design such as this at any stage or, or certainly late in the day in terms of checking, peer reviewing?

A. It appears from my review of the file, the property file for this, that it was multi-staged consent and each successive stage compiled the, the, moved up the building so essentially there was a, a large range of, large number of consents actually issued. The, if this – and these changes as a result of the, the lane not being able to built over were incorporated into the, into the plans. My understanding is that that occurred in, the Court hearing occurred in mid, in mid 1986 and subsequent plans came in but that wasn't until early 1987.

Q. Right so as far as the Council was concerned it wasn't an amendment because they didn't get it until the final plan was prepared?

A. That's right.

Q. Okay, if the change had been made after the original plans presumably the same procedure would apply though from the Council's point of view if they'd required a peer review that any amendments would be peer reviewed?

A. Yes they would.

Q. And talking about current policy today then, when you say that a building such as this would, the Council would require a peer, independent peer review, would that depend on who at the Council was receiving it and assessing it or is there a formal policy in place to cover buildings such as this?

A. Our buildings services engineer would assess the building in terms of its use and importance and the structure of the building in effect a risk, create a risk profile of the building and make a decision about whether a peer review was, was required. Often that would be done at concept stage so there's a pre-application process goes on and we go through with the owners and the owners' engineers and we say "but this building has a risk" or "it's a large building, it has a risk profile so we would like a peer review to be undertaken" and that's done from time to time in, with various buildings. I took some examples, the airport, the hospital, buildings like that are given added attention because of their, the fact that the public, there's lots of the public involved, very large complex structures, so that's the process we do.

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Q. Right, but complexity and the design of the structure itself, would that be enough?

A. It could be, yes.

Q. So –

A. Sorry, can I just add that geotech issues are playing a part now as well for obvious reasons in Christchurch, and where – so we're asking for

PS2's around foundations in particular so you know we – that the risk, assessing the risk profile of the building is quite important.

Q. So it's an assessment by the engineer or the person in the engineering or building section?

A. Yes.

Q. But is there an actual policy that sets out what kind of criteria should be considered in terms of complexity or importance?

A. Not yet, but the Department of Building and Housing is incorporating that into the legislation (inaudible 14:23:09).

Q. So that may come about then?

A. Well it's going to be – it's proposed to be part of the regulations and they will specify how that's done in the regulations, so at this stage there's not a – it's not fully formalised in our world as yet.

Q. And is there a PS4 form as well, an IPENZ form for an independent review on completion?

A. Not to the best of my knowledge.

Q. I think I saw one – oh it's on the back of the PS2 form. Have you got one in front –

A. I do.

Q. It's 0044.1. There's a reference to it on the back. Can we look at the back of it, or the next page.

JUSTICE COOPER ADDRESSES MR ZARIFEH – ADVISES 44.2

A. So I'm sorry, there is a PS4 form which is in widespread use.

Q. Which is or isn't?

A. Is in widespread use and engineers submit that at the completion of the building consent. Your question though I think was is there a peer review of that, of the PS4, do we require a peer review of that PS4 completion certificate.

Q. No, I was – the PS4 construction review says it's intended for use by suitably qualified independent design professionals, so is that – does

that refer to the actual firm that's designing the building, as opposed to someone independent?

A. Yes, it's the former – it's the engineer who has designed –

Q. The original engineer, it's not –

A. Yes.

Q. – it's not intended to be an independent peer review then?

A. No it's not. It could be carried out by another engineer at completion during the course of the construction, another engineer takes up those duties and issues the PS4, but often that's not the case. In most cases it's the original engineer follows the project right through to completion.

Q. Right. So I must have misunderstood that so it's not an independent review at that stage?

A. No.

Q. So that never happens?

A. Not to my knowledge, it's certainly not – it's not common. Once the design is agreed and it gets constructed to that design and checks are made through the process, PS4 validates those checks have been made.

Q. So just leaving, to leave that issue then the only real change that's occurred since, from the council's point of view since the 80s and today in relation to buildings such as this is specific forms in one, looked at PS2 for an independent review, and the possibility that there might be an independent review required by the council depending on the assessment made?

A. Yes.

Q. Just now turning to post September assessments. You said that a level 1 rapid assessment was undertaken on the 5th of September and resulted in a green placard. Have you got a document that records that?

A. I have in front of me a rapid assessment form level 1 inspected Grand, 5th of the 9th 2010.

Q. Has it got a number, the Royal Commission number on the top right?

A. No it doesn't.

Q. So that's from your file is it?

A. Yes.

Q. Right, because I don't think we've got that. So you could provide that to the Commission?

A. Yes we can.

Q. Thank you. But that records as you've said the level 1 inspection on the 5th of September?

A. Yes it does.

Q. And just ask you, as I haven't seen the form but it records minor or no damage presumably?

A. Inspected green, 0 to 1 percent, estimated overall building damage.

Q. That would have been an external review as we've heard?

A. Yes.

Q. And for a building such as this, 21 storey building with these complexities, would anything further than a level 1 be undertaken by the council as a matter of course after a large earthquake?

A. The process followed was generally that multi level buildings of this size, there was a level 2 assessment.

Q. And so the level 1, did that indicate there should be a level 2 conducted?

A. No it doesn't.

Q. Doesn't but then as you've said there was one carried out on the 9th?

A. Yes.

Q. And is that the – there's a form we've got on the file looks like it, event details form from the council that records that, but you've actually got the form in front of you have you?

A. Yes I have.

Q. And what does that record in terms of damage?

A. 0 to 1 percent.

Q. So similar to the level 1?

A. Yes.

Q. And was that an internal inspection?

A. There's nothing to indicate that it is an internal inspection but equally it doesn't.

Q. Generally they were weren't they, the level 2s?

A. Yes they were internal, external and internal.

Q. And does it indicate whether it was a building inspector or an engineer or not?

A. No it doesn't. It does indicate that there's the stairs, the elevators, interior wall partitions are all ticked.

Q. What about structural elements, any –

A. Everything's ticked.

Q. Everything's ticked, right.

A. And the – it's signed by an M Stewart. That is not a council person to my knowledge.

Q. And as you've said from the council's point of view after that level 2 assessment, and the green placarding being maintained, the council would've unless advised by the owner or someone else, wouldn't have had any reason to require any further inspection?

A. That's correct.

Q. And the inspections, we heard about one this morning and there was another one we've yet to hear about, the council wasn't aware of those?

A. No they weren't.

Q. And again that would be the normal course in events after September?

A. Yes.

Q. After Boxing Day you said that there wasn't any council initiated inspection?

A. Yes.

Q. I just wanted to ask you why was that, was that, do you know if that was a conscious decision not to or I'm just thinking given the nature of the building, that the height and the structure of it whether that would have been a building that would have been earmarked for an inspection?

A. I believe the focus was on those buildings that are clearly failed in the Boxing Day event, and those were the ones that were inspected. It

doesn't appear to me that there were a large number of buildings actually inspected at that time.

Q. Right, so when you say failed you mean that it had clearly failed?

A. Yes.

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Q. And collapsed or partially collapsed.

A. Visually failed. There was a period at Christmas time, a lot of office buildings were closed obviously so it was, but there were news broadcasts from the council encouraging building owners to check their buildings.

Q. Thank you.

WITNESS EXCUSED

COURT ADJOURNS: 2.34 PM

COMMISSION RESUMES: 2.54 PM

VIDEO CONFERENCE WITH STEPHEN MARTIN

JUSTICE COOPER:

Q. Mr Martin, I am Justice Cooper. I am Chair of the Royal Commission on the Canterbury earthquakes. On my left is Commissioner Fenwick. On my right is Commissioner Carter. If I may begin by just asking you to make a declaration that you will tell the truth. Do you solemnly, sincerely declare and affirm that the evidence that you will give to the Royal Commission will be the truth, the whole truth and nothing but the truth.

A. Yes I do.

EXAMINATION: MR ZARIFEH

Q. Mr Martin could you give the Commission your full name please?

A. Stephen James Martin.

Q. And you reside in Wellington. Were you the manager of the Hotel Grand Chancellor here in Christchurch in 2010–2011?

A. Yes I was.

Q. And how long had you had that position?

A. I had been in that position for approximately two and a half years but I had worked at the hotel for about 10 years.

Q. And I understand from a Title search that the owner is Grand Central (NZ) Limited?

A. That's correct.

Q. So were you employed by that company?

A. Yes I was.

Q. And do you know how long that company had owned the hotel?

A. I believe that that company had opened the hotel and the hotel opened in '96 I believe.

Q. Now do you have any personal knowledge of the design or construction of the Hotel Grand Chancellor?

A. No, no I don't.

Q. Now I want to ask you about events after the September earthquake in 2010.

A. Okay.

Q. And really to ask you what you did as a result of the earthquake in terms of getting inspections of the building. We've heard from Mr Haverland from Structex.

A. Yes.

Q. Was he the first person you contacted in relation to an inspection?

A. Yes he was, yes and he came in and inspected damage on the Sunday after that quake.

Q. Right now he said that he received a phone call from you on the evening of the 4th, that's the Saturday of the earthquake?

A. Yes.

Q. And, as you say, inspected it the next day. Can you recall what your instructions to him were in terms of what you were after from him?

A. We really just wanted to ensure that the building was safe to continue to occupy and to operate as a hotel.

Q. When he came on the Sunday was there any further discussion about what you wanted?

A. We certainly had a good look around the hotel and I had pointed out some of the areas that I was a little bit concerned about in terms of some of the damage that I could see and that I wanted him to take a further look at.

Q. Was there any discussion about plans for the building?

A. As in structural drawings?

Q. Or any sort of plans.

A. I'm not really a hundred percent sure to be honest. No I don't recall, sorry.

Q. Well Mr Haverland didn't recall any discussions that he did not see any plans. Does that accord with your memory or you can't remember?

A. Sorry I really can't remember.

Q. And as you've said his evidence was that you pointed out damage that you had observed. Presumably you'd seen that on the Saturday?

A. Yes that's correct.

Q. And did you point out to him all the damage that you had observed?

A. Yes I believe I did yep.

Q. And then you received advice from him – what orally initially as you went round or not?

A. Yes that's right. I stayed with him the whole time that he was at the building and we discussed the various aspects.

Q. And then he sent you an email dated the 5th of September outlining his conclusions?

A. That unfortunately I can't recall and I haven't been able to get access to my emails from that time.

Q. He's produced a copy of that email to you but you recall receiving something from him?

A. Yeah I believe I did, yeah.

Q. Now after that inspection on the 5th of September did you do anything further in relation to having the building inspected?

A. We started a process then with our insurance advisors on how best to repair the building and so we had various meetings with repair people which ended up we appointed Fletchers to commence the repair so they brought in some of their guys and had in fact started repairing the building but we also after the Boxing Day quake I think it was we engaged Andy Lind from Powell Fenwick to do some further reports for us.

Q. He hasn't given evidence yet but we've got some letters that he sent to you. One is dated the 28th of September 2010 and it relates to an inspection by him on the 23rd of September. Does that ring a bell?

A. Right, yes it does, yep it does.

Q. And then another letter dated 18 October 2010 relating to a further inspection on the 1st of October 2010?

A. Right, yes, yes that's correct.

Q. So was your request to him as a result of wanting to get the repairs required quantified or assessed?

A. Ah yeah we wanted some advice on the best way to progress the repairs for the building.

Q. Right so was that the purpose of getting him involved?

A. Um, yes, primarily and I guess it was just to seek some assurance that the building was safe.

Q. Right so what another check on the inspection by Mr Haverland, a second opinion?

A. Yeah I guess so. I have to admit I don't recall the exact reasons why we did that. I guess what I can say is we did want to make sure the building was safe and we also wanted some advice on the best way to repair it.

Q. Right and did you accompany Mr Lind when he inspected on the 23rd of September?

A. Yes I did.

Q. And, what, point out damage again to him?

A. Yes that's correct, that's correct, yeah.

Q. What about when he returned on the 1st of October?

A. Yes I was with him then during that inspection as well.

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Q. And you would have received those two letters that I referred you to even though you haven't got copies now?

A. I do actually have copies of those two. I just don't have the one from, yes I don't have the one from Gary Haverland. Andy Lind also came in on the 27th of December after the Boxing Day quake and further inspected the building then.

Q. Tell us about –

A. But I don't have a report from that time.

Q. Tell us about that. Did you contact him and ask him to do that?

A. Yes I did, yes I did, yep.

Q. And what were your instructions? What were you after from him?

A. After that event there had been some movement in-between the, in the seismic joint which was particularly noticeable on level 14 of the

building, which is the conference area and there had been some more damage there that we could see through the gib board and cracks in the gib board et cetera and I really wanted Andy to check that out to you know to make sure that that was okay.

Q. So is this damage that wasn't there on the 1st of October when he last, had last inspected it?

A. No, the damage was there it was just, it was more pronounced.

Q. And when you say the seismic joint, do you mean between the hotel building and the car park adjacent?

A. Yes that's correct, yes.

Q. And so he came on the 27th of December and carried out another inspection?

A. Yes that's right he did.

Q. And were you with him then?

A. Yes, I was.

Q. Can you recall roughly how long that inspection took?

A. Not exactly, I would have said probably 40 minutes.

Q. And did it involve just that seismic joint or other areas of the building?

A. I don't recall exactly although I think, I think we did walk down from that, from the level 14 area, I think we walked down through the car park and had a look at some of the other joins in-between the car park and the hotel building, although I am not entirely sure. Yes I think we did walk down the car park.

Q. Apart from the seismic joint and the increase in damage there, had you noticed any new damage after the Boxing Day aftershock?

A. Not, not structural, but there had been some movement in the air conditioning, air conditioning vents up on level 14, on the conference area and also the sprinkler pipes had moved and in fact there had been a flood. One of the sprinkler pipes had burst open and there had been a flood of water so there was certainly some movement there but that, I hadn't noticed any further structural damage.

Q. And when you say structural, what are you talking about a cracking and damage like that?

A. Yes, yes, that's correct, yeah.

Q. What about broken windows? Did you notice any broken windows after any, either the September or the Boxing Day earthquakes?

A. Yeah there were broken windows after, after the, after the September quake.

Q. Where were they?

A. I don't, sorry?

Q. Whereabouts were they? The broken windows?

A. They were primarily in guests' rooms on the 15th and 16th floor and I think there may have been some on the 17th floor, but primarily on the lower, lower floors of the accommodation area was where the broken windows were.

Q. In which side of the building?

A. That would have been on the west side.

Q. So after Boxing Day did you receive anything in writing from Mr Lind as a result of that inspection?

A. I don't recall. Yeah, I don't recall, sorry.

Q. We have a document that is dated 26 January 2011 on Powell Fenwick paper which seems to list damage description and suggested repair. Did you receive anything like that from Powell Fenwick?

A. On the 20- in January did you say?

Q. It's dated 26 January, yes.

A. I don't recall, sorry.

Q. But do you recall receiving anything in writing then from Powell Fenwick in relation to damage?

A. Oh yes, absolutely, yes, yeah, absolutely and certainly they, they sent through some documentation on recommended repair.

Q. And would that have been after the Boxing Day aftershock?

A. I believe so, yes.

Q. We have also got a document from a firm called Goldman Exterior Building Care, post-earthquake report on the Hotel Grand Chancellor talking about damage to and repair works to the exterior?

A. Right.

Q. Dated 1 February 2011. Do you recall that firm being involved?

A. Yes I do.

Q. So as at the 21st of February if you like last year, what was your understanding as to the inspections that you had had of the building and the safety or otherwise of it?

A. We, my understanding was that the building was structurally sound, that the damage that was there was cosmetic, albeit you know reasonably serious cosmetic damage, but structurally that the building was sound.

Q. And on the night of the 21st February was it in full use, the hotel?

A. Yes it was.

Q. Was it fully occupied or not?

A. We were full on the night of the 21st. When the earthquake struck on the 22nd we had 55 rooms that were in-house so we'd had a number of rooms that had checked out that morning. We were due to be full that night but guests hadn't yet arrived so at the time that the earthquake struck there were 55 rooms that were occupied.

Q. So do you know how many people were in the hotel when the earthquake struck in total including staff?

A. No, no, I don't. We had, because of course whilst there were 55 rooms occupied we don't know who is actually in-house at the time. We do know though we had approximately 50 staff that were working that day.

Q. And was anyone seriously physically injured as a result of the earthquake or not?

A. No, not that I am aware of, no.

Q. We know that the stairs, some of the stairs collapsed. How were people evacuated from the building?

A. We had, we had a couple of our maintenance guys that were up on the 26th floor so right in the very top rooms and they were repairing, doing a repair to a bathroom up there when the earthquake struck, so we were quite fortunate in the fact that we had some of our own maintenance team there that had had tools with them. After the earthquake struck they went to evacuate via the stairway and of course noticed that the stairway had collapsed. The building was such that there were two

internal stairways that overlapped each other if you like so whilst one of the stairways had collapsed, the other one was still intact but having said that because the building was on such a lean some of the doors had jammed so our maintenance team as they went down the building knocked on all the doors on each floor and gathered up any guests and any staff that were around and as they went down the building the number of people increased and fortunately because it was the maintenance team and they had tools with them they were able to prise doors open, take out the pins and hinges et cetera so eventually there were approximately 30 of them that got down to level 15 of the building and from there they climbed out on to the, through the window on to the conference roof and were craned down from there.

JUSTICE COOPER:

Q. From which floor?

A. From 15.

EXAMINATION CONTINUES: MR ZARIFEH

Q. After the February earthquake did you obtain any reports on, any engineering reports on the structural integrity of the building?

A. After the February earthquake?

Q. Yes, yes after February?

A. Yes we did.

Q. From which –

A. Yes we did.

1514

Q. – from which firm?

A. Powell Fenwick, provided a report. Beca also provided a report which was peer reviewed. I'm sorry I can't remember who peer reviewed that, and I believe our insurers also had, had a report commissioned.

QUESTIONS FROM COMMISSIONER FENWICK - NIL

QUESTIONS FROM COMMISSIONER CARTER – NIL

JUSTICE COOPER:

Yes Mr Martin thank you very much for your evidence to us and for its clarity and for making time available. Thank you.

WITNESS EXCUSED

JUSTICE COOPER ADDRESSES MR ZARIFEH – WITNESS AND TIMETABLING

COMMISSION ADJOURNS: 3.16 PM