COMMISSION RESUMES ON WEDNESDAY 14 MARCH 2012 AT 9.32 AM

JUSTICE COOPER ADDRESSES COURT TAKER RE LIGHTING

MR MILLS:

Just before I call the first witness for the day, just to get a quick outline of the issues we'll be covering today. We're starting with what we've termed the architectural perspective. We'll be hearing from two witnesses on that issue although, as the Commissioners are about to find out the first of those witnesses is really a structural engineer who's got himself into the Victoria University Architectural Department. Then after that, as I mentioned yesterday, Professor Quennville from Auckland will come and talk again about timber issues. Then we have a panel discussion scheduled for the balance of the morning and after lunch we turn to the regulatory issues. So with that brief overview I will call Associate Professor Andrew Charleson.

MR MILLS CALLS:
ANDREW WILLIAM CHARLESON (AFFIRMED)

Q. Morning Professor. I'll just run you through some of the background details before I leave you to run through your own presentation. Your full name is Andrew William Charleson.
A. Correct.
Q. You are an Associate Professor at the School of Architecture at Victoria University of Wellington.
A. Yes.
Q. And among whatever other duties you have you teach building structures to Years 3, 4 and 5.
A. Correct.
Q. You are an engineer by profession with a Bachelor of Engineering degree, Civil, with Honours and a Masters of Engineering degree, Civil, with Distinction both from the University of Canterbury.
A. Yeah.

Q. You are a Fellow of the New Zealand Society of Earthquake Engineers, a Member of the New Zealand Timber Design Society, a Member of – you just need to say yes I think so it can be picked up.
A. Yes.
Q. A Member of the New Zealand Concrete Society.
A. Yes.
Q. And a Member of the New Zealand Structural Engineering Society.
A. Yes.
Q. With that background I'll leave you to run through your presentation.

ASSOCIATE PROFESSOR CHARLESON:

Thank you very much. Good morning Commissioners. Perhaps I could just explain that I am, indeed, a structural engineer by profession but having spent over 20 years teaching at the School of Architecture I'm somewhat unsure of my current sort of status, whether it be engineering or architecture.

My presentation today is entitled Architectural Implications of New Technologies and I need to note it's really entirely about seismic resistant design because yesterday we heard about a number of new technologies that weren't particularly related to earthquake issues but in this presentation I'm more or less focusing on the seismic side of the new technologies.

So, in my presentation there are really three sections. First of all I just make some general, I think three or four general observations about the new technologies that we heard about yesterday. Then I'm going to identify a number of issues that are really important to architects and, of course, their clients. And then, in the final section, I'm going to look at the implications of each of those architectural issues on the broad range of new technologies that we were introduced to yesterday.

So my first observation is that the technologies that we have been introduced to this week are pretty much only applicable to engineered buildings. If you reflect on the technologies that we've seen over the last few days they really are applicable to larger scale buildings. For example if they're single storey buildings these new technologies would probably only be applicable to structures of this sort of scale, halls or gymnasia, long span quite large structures. Also these new technologies are particularly appropriate for multi-storey construction which can house any occupancy type and including apartments. So it's not to say that other dwellings are not affected by these new technologies because multi-unit dwellings are but individual houses are not going to be touched too much by what we've heard about over the last couple of days. The other type of building that these new technologies are particularly suited to are buildings where after an earthquake we are hoping for little or no damage or the ability to very swiftly reinhabit the building and in those types of buildings these new technologies offer some tremendous advantages, both sort of architecturally but particularly to the clients.

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Given that these new technologies are not applicable to domestic construction I think it's fortunate really that we've seen as Professor Buchanan briefly outlined yesterday by and large domestic construction fared very, very well in the Canterbury earthquakes and if we rule out the effects of liquefaction and the damage to masonry components in those houses really the rest of the structure performed exceedingly well, just with minor cracking and so, in a sense, with perhaps a little bit of modification to current practice the construction and design of domestic construction may change very little as we move on into the future and so that is why these new technologies aren't particularly relevant.

The second observation I'd like to make is that the forms, the shapes, the appearance of these new technologies are very similar to those of conventional structural systems. In this slide I've got, shown three different types of structural systems. At the top we've got shear walls or structural walls. Then we've got braced frames and then the lowest diagram shows moment frames. And these three structural systems essentially sum up that the design palette that a structural engineer works with when she or he is designing a building, that is, an engineered building. And so it's a very limited range of structural options, but even though there are only three options there's an almost infinite number of ways in which a particular design can be realised using only those three options. For example, you'll see here that in this direction, if this building gets shaken in this direction there are two walls that can resist that shaking. In another design one might use a single wall or three or four walls and so there's so much opportunity for manipulating these three basic systems to achieve a structure that works and also one that integrates with the architecture. So ideally every building that is designed should have one of these systems in each of the main orthogonal directions of the building plan and so quite often we may have shear walls working in one direction of a building, like we might have two shear walls like that but yet in the orthogonal direction, in this direction, we might be relying upon some moment frames. That is entirely normal and in a few buildings, particularly very high rise buildings, engineers will mix the systems and in say a building over 20 storeys it might be economically viable to use a mixed system consisting of say shear walls working in parallel with moment frames.

And so as we look at these little schematic structures I think, and as we reflect on the images we saw yesterday, we'll see that there's great similarity between, you know, these structural systems and those of the new technologies and here I want to take us through the sort of similarity between conventional practice and what is being offered up as new options for structural engineers and architects. So on the left here we've got the three typical conventional systems and then we look at case studies and so here, for example, are two shear walls at the Nelson Marlborough Institute of Technology that we were taken through yesterday and so, you know, these walls are very similar to conventional timber walls. Although having said this these walls are not only unique in the fact that they adopt a new technology, a rocking system whereby the walls are post-tensioned to the foundations but also these walls are using an entirely new material, a laminated veneer lumber whereas conventionally these walls would be constructed out of plywood and perhaps timber studs. Also there is some visual difference as well whereas in the typical scenario, the conventional practice scenario, the shear wall would be one solid wall. In the new technology approach we've actually got two walls, each of which rocks about its toe, each of which is post-tensioned to the foundations and these two walls as we saw yesterday are separated by a modest gap in which energy dissipaters are inserted to absorb the earthquake energy but, you know, as you can see there's a great similarity. Then we come to the Te Puni building at Victoria University with its braced steel frame designed as a rocking system and you can see that this steel brace frame, you know, has got great similarities with the braced frames of conventional practice. This particular braced frame is certainly a lot more sophisticated because as we saw it's got these special springs at the base of each column and it's also got special energy absorbing links joining the two elements of the frames together. But, you know, essentially it consists of columns and diagonal braces like conventional practice. If we move to a building under construction in California we can see the use here of buckling constrained braces, another type of new technology that we've been introduced to and the configuration of these braces is pretty much identical to what we would get in a conventional braced frame that we would expect to see in New Zealand. It's just that the new technology component is all encompassed in the brace, its design and its construction, so that it can absorb a tremendous amount of earthquake energy and yet not buckle, nor, nor rupture nor fail.

In this image we see an example of a braced frame incorporating dampers. Yesterday we heard about the possibility of putting dampers in the line of bracing members and although it's not particularly clear you can see at the bottom of each of these braces you can see a damper and this damper is in line with the brace which is part of a braced frame, in fact a partial moment frame in this case. And so once again this, this configuration, you know, is very similar to that of a normal braced frame. And then we finally come to the third structural system, moment frames, and this is the moment frame, one of the frames we saw yesterday on the Massey University Campus in Wellington using LVL material and post-tension steel cables attaching all the members together and making sure that during an earthquake the building would always self centre and spring back to its vertical position. The form or shape of these frames is, is really identical to a conventional moment frame.

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The difference is all about the connectivity of the members and the way that energy is dissipated and the way that this design will avoid structural damage. And then finally back to California an early example of a PRESSS moment resisting frame, also using that technology of post-tension tendons passing along the length of the entire frame, tensioning everything together and then enabling this excellent self-centring and energy dissipating capacity. And so you know these case studies are pretty typical of the new technologies we're using and you know it's fairly evident that we've got this overriding similarity between conventional form and the new form of the new technologies.

And I think we can be quite thankful that that is the case actually because imagine if our structural engineering researchers were coming to us and saying, "Look, the only way we can have really adequate earthquake resistance in the 21st century is to design our buildings as like semi-circular dome structures", or buildings that are fragmented and have shard like properties that you know give particularly good protection against seismic motion. Or we are fortunate the engineers are not coming to us at this Commission and saying, "Look by far the best solution to seismic design is to make sure all our buildings are elevated on very slender columns". So we can be in fact very thankful that the engineers are very mindful of what is conventional practice and that they are trying not to rock the boat too much but to just enhance the properties of these conventional systems so that there's not going to be a huge change of culture in the building industry.

JUSTICE COOPER:

Q. Just before you leave that, curiosity has the better of me I'm afraid. Where are these structures to be found?

A. Yes well I was hoping to whet your interest.

Q. Yes well congratulations.

A. This structure is a building built in Italy. It is actually a Civil Defence headquarters in southern Italy and actually the red dots indicate base isolators. And so in some way the architect was trying to communicate the earthquake resilience of this building by its shape as well as the detailing of the base isolation units. The building on the top right is called "The Crystal" and it is a new addition to the Royal Ontario Museum in Toronto designed by Daniel Libeskind one of the leading contemporary architects and also in Toronto we find the Sharp Centre which is a school of fine art designed by a British architect who enjoys and has a real predisposition towards elevating his buildings wherever they are located in the globe.

ASSOCIATE PROFESSOR CHARLESON CONTINUES:

And so now to the third general observation about these new technologies and that is that the amount of structure that they need is very similar to that of conventional structure. Now since I prepared this slide and after discussions with my colleagues yesterday particularly Dr Pampanin, I need to really modify this observation because it's been pointed out to me that in one or two of these new technologies we need considerably less structure and I'm going to talk a bit about, a bit more about that in the rest of my presentation but essentially for the rocking wall structures we are going to be able to have considerably shorter walls that will be received very, very positively within the architectural profession and also by the clients of architects. This observation however might be slightly disappointing for some architects because architects often talk about their aspiration of floating buildings. Architects generally love transparency, they love a lightness in the quality of their architecture and so I'm sure some architects might be hoping that from the developments of new technologies the engineers would be able to provide them with almost ethereal structures which are very, very light and very, very slender but that is not the case unfortunately. However, the good news is that it seems in every case of these new technologies there's never going to be more chunkier structure required. It seems to me that in almost every case the size of the structural members will be similar or smaller than what is conventional practice and that is actually in my opinion you know very good news for architects and for buildings in general.

I mentioned that some architects will be disappointed because it's always a struggle in the interaction between engineers and architects to, to work together to achieve a good structural layout that meets the needs of both professions and it's particularly challenging in the area of seismic design because the structure we need to resist earthquake forces is so much larger in its plan area than the structure needed to resist just the self weight of a building. Here we've got three building plans, these are typical floor plans of three different buildings, each of which is eight storeys high and could be built in Wellington. If we just look at the structure, if we just look at the columns required to resist the gravity weight of the building they are approximately 500 millimetres square and they would typically be placed something like that. If we now look at the structure required to resist earthquake forces and we're going to use structural walls in both directions so two walls in this direction for shaking, two walls in this direction, you can see that we need some quite large structural walls and in fact each one of those walls takes up the area of about 14 columns and not only do those walls take up a lot of area but they have huge architectural implications. Not always are they welcome on the perimeter of buildings as we know because they're just so disruptive to light and views and so wherever they are placed in plan these walls represent you know a real architectural difficulty in terms of spatial planning. Now when it comes to the new technologies there's not going to be a tremendous amount of relief except for rocking shear walls where it might be possible to reduce these wall lengths by possibly up to 50% which you know will actually create a very positive change for some buildings. Here's another example where we're using moment frames, I've just drawn it in this direction, but you can see that these moment frames that are required to resist the earthquake forces they have columns that are also so much larger than the columns required just for the building's self weight.

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And, once again, these large columns and the deep beams that are also necessary they have very significant architectural implications that I'll talk about later. But even with new technologies the dimensions of these moment frames are not going to change significantly and so architects and engineers are still going to have to negotiate over where these frames are located and planned, how many of them are going to be used and just generally how the architectural function of the building is going to be integrated around them. The other aspect about the layout of structure that is not going to change very much is in terms of the need for the structure to be separated in plan. Engineers always prefer that structural walls in this case, or these could be moment frames, are separated by what we call a long lever arm. And so even if these walls are not lined up as it were as long as there's a significant horizontal separation between them it means that the building is far more stable for horizontal twisting forces and these twisting forces which cause a building to rotate horizontally like this, these can be very serious during an earthquake, and so engineers try and avoid the situation where, for example, these two walls are closely placed together with a very short level arm. Now even with the new technologies these considerations won't change. Engineers will still be trying to negotiate with the architects these long lever arms to improve the torsional stability of each of the new buildings.

A final general observation is that even though the seismic structure is very significant compared to the entire structure of a building what we find is that there's no need for this structure to reduce the quality of architecture. Several years ago I had one of my senior classes in the school undertake a research project. I chose 10 cities throughout the world in very high seismic regions and 10 cities where there was no seismicity and the students had to, through the literature, find out the most exciting works of architecture in each of those cities and then they evaluated the quality of all those works of architecture without knowing what city the building was in and whether the building was in a seismic zone or non-seismic zone. When we analysed all the results it came out that, if anything, the buildings that were in the seismic zones had more architectural appeal than the buildings in non-seismic zones and this was incredibly encouraging actually because intuitively you would think that because of the constraints imposed upon architects by the need for large shear walls, large frames, large braced frames, you'd expect that the architecture would be somewhat blander and less interesting. But that actually is proving not to be the case. Just to explain, this was a very attractive School of Forestry in British Colombia. This is the headquarters of a Japanese brewing company in Tokyo and here is one of Frank Gehry's designs in Seattle.

The key attention that must be paid to this relationship between structure and architecture, and particularly seismic-resisting structure and architecture, is to make sure that the structure is integrated with the architecture. Here I'm showing you two examples where this actually is not the case. On the left we have a retrofitted building on the University of California campus at Berkley, and here we can see the ground floor of this building is retrofitted by buckling restrained braces. So applied to the façade of really quite an elegantly designed building we have, in my view, you know, a crude nuts and bolts appendage. You know the structure is just not well integrated and even worse this is a new school of music on the same campus and as you walk into the building through the main entrance you almost strike your head on this partial leg of another buckling restrained brace. Here's new technology very poorly integrated with architecture. So my hope is in New Zealand as architects embrace this new technology there's going to be a far better and more satisfactory integration of these two systems.

Now I move onto the next phase of my presentation and just present here in outline the different architectural issues I'm going to work through one by one and as I approach each architectural issue I'm going to look at the implications of these new technologies and so we begin by looking at the siting of a building.

This upper diagram shows the way a building sways too and fro during earthquake shaking. It bends like that. Every building will bend somewhat like that and the all important note is that we must make sure that our building doesn't sway across the boundary and hit the neighbouring building and so in New Zealand every building has to be set back from the boundaries. Well, to be precise, it doesn't have to be set back along the street frontage. Local authorities don't mind if our buildings sway into the street but we always have to have a separation gap between the side of our building and site boundaries. What we are trying to avoid, what we have to avoid is this scenario where one building pounds another and, in this case in Mexico City I think in 1985, you can see that this building on the right has come off second best and pounding is a type of earthquake damage that we are very very concerned about and unfortunately will be endemic in some situations because the old codes of practice required very little separation between building and boundary.

What size of separation gaps do we need? Well if an engineer designs the most flexible building that the Code of Practice allows that means that a separation gap of 2% of the building height has to be provided. That means an 80mm gap for a single storey building that is 4m high.

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If we have a 10 storey building with four metre storey heights that means we require an 800 millimetre gap between the sides of the building and the boundaries. That gap represents a huge loss in floor area. It represents a huge economic penalty for the building owner and in a situation like that the architect after consultation with the client would almost certainly go back to the structural engineer and say, look, I know you've designed a building within the code limits but please, please can you design your building to be stiffer so it deflects less and the separation gap can be reduced and so the structural engineer has to go back to the computer and come up with a significantly stiffer structural system so that that separation gap can be, well, acceptable to client and architect. This is current practice.

JUSTICE COOPER:

Q. I was going to ask you, the 2% building height. Is that a rule in the current standard?

A. Yes it is. The current New Zealand loading standard doesn't allow us to design buildings more flexible than that. If a building is more flexible than that it's just not complying with the code, you know, and it won't get building consent.

ASSOCIATE PROFESSOR CHARLESON CONTINUES:

Now the implication for new technology is really just focussing on base isolation because even for a single storey base isolated structure depending on the importance of the structure and the soil conditions we need at least a gap between 400 and 600 millimetres wide and so the siting is a particular issue for base isolated buildings. If I can just explain using an analogy of a building that is isolated on ball bearings. When the ground moves to the left a conventional building also moves to the left but an isolated building remains almost stationary because it will roll on its isolators. When the building moves to the right the conventional building with move with the ground. The base isolated building will almost remain stationary and so you get, you know, the gap closing here and opening up when the ground moves in the other direction. And so in every base isolated building we need to provide these, these gaps and here is a fairly conventional detail around the base of a base isolated building where this is like the ground floor slab, this is the, perhaps a lead rubber bearing, the actual isolating unit, this might be a foundation slab, here is a little retaining wall, we call this a moat and this, this is the seismic gap here which might need to be repeated here to create a drainage system. The gap almost always needs to be covered to stop people stepping into it or rubbish accumulating and so this is the way we conventionally accommodate these fairly large seismic movements in base isolated structures. And so the implications of this technology are very significant for the siting and a consideration of requiring these large gaps might, might suggest the need for perhaps narrow lanes between base isolated buildings, you know, which would have some very interesting urban design implications and so this is one of the, the very serious implications regarding base isolation.

The next really important issue for architects is this whole question of spatial planning and the functionality of a building. Obviously a building has to have the quality of internal spaces that suit the function of the building and the functioning of a building can't be compromised by poorly placed structure and as a corollary of that it’s worth noting that, you know, a building has to be functional every day of its life which might be in excess of 50 years but, you know, an earthquake may never strike a building and if it strikes a building it’ll last perhaps less than a minute and so there’s this tension again between providing a technology, a system, for a brief period of time and for providing planning and qualities of space and function that are needed every minute of the time a building is occupied. As I mentioned in one of my observations, the seismic resisting structure, you know, will still be a challenge for architects because they are always hoping for minimal, slender, transparent structure and the new technologies can't deliver that. So there’s still going to be that challenge but as I hinted at earlier too the good news is that the new technologies will neither ease nor hinder. Now I do have to rephrase that a little. The new technologies won't hinder and in some cases they’re going to ease the spatial planning problem and that will occur when we use these rocking walls where the wall lengths can be shorter. That's going to very helpful in terms of architectural layout and planning. The other aspect to note about spatial planning and function is that base isolation also does bring opportunities and challenges at foundation level and the very need to provide for the moat and the rattle space and so on in this area, you know, has got planning implications and also the need perhaps for a crawl space to get in and check and maintain and if need be replace these bearings also has implications. But also there are opportunities because as you might be aware in some base isolated buildings this, this space here is used to accommodate services or even carparking and so, you know, it can be an opportunity for improved functional use of a building.

Another issue that is important to architects is this question of the way the structure integrates in with technologies like mechanical heating and ventilation systems and here I've shown a couple of building plans. In this plan here the earthquake loads are resisted in this direction by two shear walls and in this direction by a series of one bay moment frames and these arrows indicate the distribution of heating and ventilating ducts and other pipe work and we could imagine that the pipe work is initially distributed vertically up the height of the building either from the bottom up or top down and then at each floor level these pipes and ducts are put under the ceiling slabs perhaps in this sort of layout so the air can be distributed evenly through the floor plan.

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Now what is important is to avoid any deep beams running in the middle of the building because the deep beams are usually can't accommodate large holes that are necessary for air conditioning ducts and so conventional architectural and engineering practice is, where possible we put the seismic structure towards the outside of the building and that's exactly what's happening in this diagram where all the seismic resisting structure is on the perimeter, exactly as was the case with the Clarendon Tower. Moment resisting frames on the perimeter and that enables no beams or very shallow beams to enable free distribution of the ducts within the plan of the building. Now with the use of new technologies there may be times when some beam depths can be somewhat reduced and I imagine in some of the concrete PRESSS frames some beam depths might be lessened which is good news but by and large I think the size of beams and moment frames would be fairly similar irrespective of the type of new technology and so this type of conventional practice will probably still be widely adopted by architects and engineers.

Aesthetics is another key concern for architects and although I'm not really addressing the aesthetics of the overall shape of a building, here I am concentrating more on the type of cladding or the skin of the building and what I believe is that the introduction of the technologies we heard about yesterday are not going to have much impact except for base isolation. The thing is that even with new technologies the buildings are going to sway sideways during an earthquake approximately the same amount as with conventional design and so all the materials that we use as a building skin have to be able to accommodate the sway. It's been often referred to as drift. The building drifts sideways and you can see that if we have panes of glass inserted into some sort of, say, curtain wall system it's very important that we have separation gaps between the glass and the framing otherwise as the frame moves over the glass is going to actually burst and so in conventional practice if we look at a cross section through one of these framing members, we might call this a 'mullion' which houses the glass. We have provision in this detail for over 35mm of movement so that in an earthquake this part of the glazing frame can move horizontally quite freely and not induce any forces in the glass which, as we know, is very brittle and so for conventional construction, and even with the new technologies, apart from base isolation, we tend to need quite wide mullions and these are always displeasing to architects because they reduce that sense of transparency but the good news of base isolation is that the drift of buildings using that technology is approximately only one-quarter of conventional technology and so for base isolated buildings we probably don't need to worry about this extra allowance for separation gap and so architects will be able to have far more slender mullions than conventionally. They are fairly small but sometimes a significant detail of aesthetics. As an example of another type of cladding system on a building, now this is a building going up in Wellington, and the cladding system consists of these pre-cast concrete panels which are then glazed. A number of panels have already been connected to the building and here is a bay awaiting to receive this panel and you can see these steel connections to which the panel will be attached and they consist of steel welded elements with quite long slotted holes and so what happens is that the pre-cast panel sits on this beam here and it's going to be bolted to it but at the top the panel is lightly bolted with two bolts that are able to slide in the slot and so these panels are rather like the scales on the skin of a snake or the scales of a fish. The panels aren't going to be deflected or experience any force during the earthquake even though the building sways. Because of this ability for sliding at the top, these panels just go for the ride undamaged. Now this type of separation detail will be continued even using the new technologies. There's not going to be much change but for base isolation this detail can be simplified greatly because the amount of movement is so much less. And in terms of the interior partitions of buildings, in this particular building the architect has provided a channel in which the wall can slide so that during an earthquake this wall which will eventually be lined it can slide pretty freely and it will suffer considerably less damage than normal. Well this will need to be continued with new technologies but with base isolation I don't think such a detail is probably necessary.

Materiality – With the new technologies we are going to be able to use a wider range of structural materials which is very good news for the whole industry and it's really because the PRESSS technology has been adopted and transformed to be able to be used by timber construction and, as we saw yesterday, now we have these rocking walls made from laminated veneer lumber. We also have the ability to use a number of specialised energy absorbing devices – dampers, springs – and they can be of different material and they also provide opportunities for architects who can make decisions whether to expose them or conceal them.

Now I just want to really finish up with costs. I found it very very difficult to get accurate costs of these new technologies and so I call this my personal speculation but if we look at a conventional structure and assume it to cost 100 units, the entire building that is, the cost of the entire building is 100 units, my belief is that with new technologies the building cost will be round about,

you know, just over 100 units, possibly a wee bit more in some cases. However, due to the fact that some of these new technologies enable far quicker construction it could be that some buildings will actually be somewhat cheaper. The base isolation I've put in at 103+ units of cost because a few months ago myself and a colleague looked very carefully at the cost of three base isolated hospitals in New Zealand and each of those base isolated hospitals had a three percent cost premium because of the base isolation.
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JUSTICE COOPER:

Q. Was one of those Christchurch Women's Hospital?

A. That was the fourth hospital we looked at but the cost records were unavailable because of the damage from the February quake.

Q. I think we've had evidence which would suggest it was in line with the other ones that you looked at.

A. Yeah, yeah. With the other ones we were able to interrogate the quantity surveyor to try and really nail this percentage down and so we are pretty confident in that. The other cost we have is the post-earthquake cost.

Q. Sorry just before you move on, do you mind telling us where those other hospitals were, what city?

A. Yes certainly, absolutely. One was the new Wellington Public Hospital on Riddiford Street. The other was the new emergency department at the Hutt Hospital, Lower Hutt, and the third hospital, which was very different in its base isolation and its design actually were the two new surgical wings of Whanganui Hospital. I could say we expected the cost of the Whanganui Hospital to be a lot more than 3% greater than conventional construction because it's just a single storey building but what we found there was because of the ground level typically being lower than the level of the isolated superstructure the designers didn't need to have any moats or retaining walls or other expensive details and so even though intuitively we expected a high cost that was not the case.

ASSOCIATE PROFESSOR CHARLESON CONTINUES:

If we look at the post-earthquake costs, and this is incredibly crude, with conventional structure I think we could assume we might have to rebuild the building and also reinstate all its contents which could be 20% of the value of the entire building. It could be less, could be more. With new technologies there'll virtually be no structural damage but the contents of the building will not be protected and so there's possibly up to 20% damage to contents. With base isolation the contents get a very smooth ride, very little damage at all. So if you look at the cost of the new building, add to it the cost of the post-earthquake damage and loss I think these figures speak of the value of the new technology, there's a tremendous, you know, benefit.

The final point is maintenance. The new technologies definitely need more careful maintenance, and I'm of the opinion that there should be an annual check for each use of new technology, especially base isolation. I'm aware of one base isolated building where the whole base isolation system has been compromised because of a new addition to the building which has almost anchored part of the isolated superstructure and so the intention of the designers has been totally negated by this more recent addition. Also there are cases where clients fill up the gaps with rubbish and storage materials and so there must be an annual inspection of every base isolated building. The other architectural implication is that access is required and so people have to get into base isolated basements to do this check and also linings have to be removed for checking some of the sophisticated details that are part and parcel of the new technology.

I forgot about insurance. I'm running out of time so I don't really want to say anything about that but I think the main point is the base isolated buildings it's very important that the owners read the fine print of the earthquake policies because earthquake insurance is not available if your building does not suffer damage. I cannot go into that now.

So in summary I'd just like to say that the introduction of new technologies into mainstream design and construction practice is expected to have few significant architectural implications.

JUSTICE COOPER:

Thank you very much for that. We do have some questions for you but we'll ask them in the panel so thank you very much.

WITNESS EXCUSED

MR MILLS CALLS

TREVOR WILLIAM WATT (AFFIRMED)

Q. Welcome Mr Watt. I'll just again go through some details with you. Your full name is Trevor William Watt. You're a Director of Athfield Architects and I take it you head the Christchurch office for Athfields.

A. That's correct.

Q. You have both a Bachelor of Architecture with first class honours and a Bachelor of Building Science, both from the University of Victoria.

A. Yes I do.

Q. You were, as I understand it, the project architect for both the AMI Stadium and the Christchurch City Council Civic Building.

A. That's correct yes.

Q. And you are a Member of the New Zealand Institute of Architects and I take it you're representing them, in effect, in giving your evidence today.

A. Yes I am.

Q. Thank you very much.

MR WATT:

Good morning. This morning I'm representing the New Zealand Institute of Architects which, I guess, is a little bit daunting in that the members' views cover such a diverse range of architectural styles and everyone has different ways of dealing with the built environment and structures in particular. I'll endeavour to keep comments general to the profession as a whole but I'll no doubt include some more personal observations as an architect in Christchurch and specific ways our company particularly deals with certain situations.

So as an overall general observation all the new building technologies that the Commission has heard over the past couple of days does not create any major new concerns for architects. They are really only extensions on how architects have had to deal with the seismic-resisting aspects of structures in the past compared to the more conventional systems. I would agree from the evidence of the structures to date using these new technologies that the forms of the new technologies and the amount of structure is very similar to conventional systems. We’ve just heard from Professor Charleson. As far as that, um, potentially some of the benefits for a reduction in precast shear walls which, we would agree, would actually be a major benefit as far as the flexibility of the buildings but, in general terms, they’re very very similar and we’ve been dealing with them for a number of years.

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When it comes to the architectural quality of a building I believe it is more a result of a good working relationship and the result of the collective minds of engineers, clients, users and the architects rather than any particular structural system. The challenge for architects and engineers is to work collectively together to enhance all aspects of the building with the use of this new technology and not just the sort of structural components independently.

So just addressing some of the key architectural issue. The aesthetics. I guess there’s different ways with dealing with structures within buildings. You can either conceal them or expose them and it comes down to personal taste as far as architectural style but also whether it’s appropriate for a certain building type. So there’s such a diverse range of buildings and functions that one’s more appropriate than others potentially and that’s no different with these new sort of technologies. They don’t really change the decision where the systems are concealed or exposed. However, within our company we have tended to expose structure within buildings because we think it can positively contribute to the architectural quality and the understanding of the building. So the structure itself is effectively the decoration of the building and it does have other benefits and particularly we’ve found in the last sort of 18 months in Christchurch there are benefits that we didn't really think about at the time but because the structure was exposed it has had a positive benefit. So some of the new terminologies can have educational benefits within buildings and as Dr Pampanin talked about yesterday with his visit to the Nelson Institute of Technology building where the architects chose to expose the new technology as far as the dampeners and the walls and how the building was sort of, these new systems were put in place, the staff asked questions about it, they learnt about it and then when new people came to the building they educated people about the system as well which hopefully gives the users of buildings a little more comfort in the fact that there's a lot more thought as to seismic technology, a little more comfort about going into buildings but also potentially allows it to be integrated into future buildings as well, more people are aware of it. And I think that's going to be more and more important as we build new buildings in the Christchurch context, trying to get tenants back to say the CBD. I think it's important, everyone's going to start asking questions about what level the building's up to, how's it different, how does it perform in earthquakes. So we are also seeing that at Te Papa where they're exposing the base isolations, using it as an educational tool and in the new sort of BNZ proposal in the Square I think from the views that I've seen there's exposed sort of RK bracing with the dampeners on some of the facades. So it's all visible, it's also part of the architect, it's part of education, people, making them feel more comfortable actually going into building which is, I guess it's part of the role of the architects and the structural engineers. The one thing we've found that exposed structure can be benefit for inspections after an earthquake event and also beneficial for future maintenance. So instead of the structure buried between, behind layers of GIB board or ceiling tiles or plasterboard and walls, if the structures on show, the key connections are already on show, it makes it much easier for engineers, you know, give it a quick visual inspection of buildings and then ongoing maintenance of these things are easy to change out and maintain. We see that as a beneficial sort of side-effect of exposing the structure. I guess in a local sort of context in Christchurch there is a rich history, architectural history and using the exposed structure of buildings is an integral part of the, the building architecture. So the early works of Sir Miles Warren, Peter Bevan – in much of that building, those civic buildings around or hopefully around and even going back further to sort of Mountford and the neo Gothic sort of architecture of the Arts Centre, Provincial Chambers, original Museum buildings, they used the structure as the decoration of the building. It's not there just to keep the roof up but they used it as the sort of architectural device as well. So there is a rich history, there is a philosophy there already going back a long period of time and the architectural style of today may tend to, to develop along those lines where it's much more expression of a structure within buildings. I'm not necessarily saying go back to neo Gothic but the, the philosophy but in a contemporary sort of version. So what we're talking about now is not necessarily new as far as new architectural styles. There is a good root back into traditional and particularly in the Christchurch context.

JUSTICE COOPER:

Q. Is the, was the photograph on the right of the Town Hall?

A. Yeah that's probably James Hay but if you go into the foyer I guess all the in situ concrete, all the key junctions there were exposed but there was something, you know, Sir Miles particularly in the 60s and 70s most of his buildings were exposing the structure using the concrete block work, using the timber trusses. On the left there's Harewood Crematorium but in his own office buildings he used that as well and again Peter Bevan was doing similar sort of things in his buildings in the day so – and against that you actually obviously add you know some other architectural devices as well but the fundamental thing of the buildings is that the structure is the architecture just as in Gothic architecture you know the roof structures were all on display. They're not only there to hold the roof in place, they're also there to provide the architectural sort of interest and delight within the space and that's where we can see there's a great possibility on the aesthetics of the building of integrating the architecture and engineering in these new building technologies and later on I have a case study where we looked at doing that in some recent buildings as well. So it's not something that we as a profession need to be scared of. We need to sort of embrace it and maybe that will affect the appearance of the buildings in the future and, again, having those additional benefits of education and practical aspects on inspections after an event and future maintenance. We do similar things sometimes with services, you know, exposing services. It allows flexibility in the future of changing them out, but again it has quite a dramatic impact on what a building looks like and feels like. So all those things need to be taken into consideration.

So materials, traditional seismic resistance systems and larger buildings generally are constructed in steel and concrete. I guess with these new technologies that the use of timber also now exists which is really exciting as far as, I guess the architectural profession we're always keen to sort of explore these new technologies. The decision on what is a system to use in a building generally comes down to economics. You may look at structural engineers developing two systems and potentially, you know, concrete and steel, and a quantity surveyor would price up both options and make a decision on economics. It may come down to better construction, one system may be faster to build than others and that may be a critical requirement in a building. It could come down to either the contractor that's using, or the engineer's preference to use a particular system because they're comfortable in using that. So they may be more comfortable using sort of concrete rather than steel and just from that historical use and I guess the other one is it can actually be driven by the aesthetics of the building or the architects, architectural input, actually wanting a particular style for the look, the feel and so, and sometimes it can be a mix of those four things.

Q. Forgive me but is economics traditionally considered from the point of view of construction cost and given recent experience should that be sufficient? In other words should attitudes change to consider repair costs following an earthquake?

A. Yeah so that's just a recent thing obviously but prior to 2010 it was certainly just due to, just looked at pretty much wholly as the construction cost of the initial building. Certainly attitudes will have changed but when it comes down to the nuts and bolts someone has to pay for it and someone has to make the cost benefit analysis about how far do you go, to take that into consideration.

Q. So are attitudes changing in that respect?

A. Definitely. It comes down probably to who your clients are. I think if you're dealing with more institutions like educational sort of facilities where they're going to be the owners of the buildings for a long length of time then certainly they'll want to make more robust decisions on the resilience of not only the structure but other elements of the building. If it's an owner who's going to keep the building for a long time again they're more likely to make that long term decision. If it's more that sort of short term developer I guess that the jury's still out on whether that, how much of that will they put into play if they're only going to keep it for a short term and then flick it on. It comes down to the market and if it's going to be tenants who are actually going to ask more questions around that. We're finding obviously with buildings with the new structural codes we're spending a lot more money under the ground which leaves less money sometimes above the ground so there is a real pressure on where do you spend your dollars so in, with clients who have only a certain amount of insurance payback then buildings may be potentially underinsured, you're spending more money under the ground anyway, it doesn't leave a lot and it comes down to what rentals they can get off the, off the new buildings. This is an office sort of context, but certainly in, we've found in the institutional ones with the buildings we've done to date they are keen to provide that next level robustness to it which wouldn't have been there prior to that and I think I may cover that a little bit later as well. But generally from an architectural perspective there is no one material which is preferred over any other. There are in a situation, as especially Charles has said, where we want some lightness in the structure, maybe atrium spaces where you tend to go to steel because it provides lighter sort of member sizes but conversely if you want to feel the building a lot more solid and robust then we'd tend to go to concrete or any sort of combination.

So we've seen this several times the PRESSS technology and precast concrete so our belief generally these steel connections are hidden within the building behind ceilings. There's a science building so it has a lot of laboratories so it tends to probably make sense in this sort of hygiene type rational but I believe there is also some exposure of these connections and even the base of it, the columns within the café areas to add to that education of the building as well so it comes down to I guess preference to cover or not but this is one in concrete and also we've seen the next one several times the Nelson project in timber. Here I guess the aesthetics come into play where the architect did want to you know expose the structure, expose the new technology, expose the dampening devices in the building this here as well as part of that education as part of the architecture and with the educational type building too it's you know quite an appropriate sort of aesthetic and it's quite a different one but I think you'll find even in the Christchurch context and new builds that we'll get a much wider range of building aesthetics coming into play and certainly it appears that timber will play a role in that going forward.

So similar key architectural issues in relation to spatial planning and function. As we've seen the three devices generally that we deal with, working with engineers are the shear walls, cross-bracing and K frames and moment frames. The shear walls tend to be the most difficult for us to deal with in terms of flexibility. It's okay if you can sort of group that around the core of the building where you have the lifts, the toilets, maybe the plant rooms but even there you tend to want to get large ducts from those areas and services to the other parts of the building so you need big penetrations through and again it comes down to the design of the building everything's, everyone's different. If you've got a building with you know no opportunity for windows either side it's a lot more easy to accommodate it. If you're building in the round where you want it quite open and inviting a look making best use of natural light then you don't want your external walls to have to be sort of solid and I guess the key thing is the buildings are around for a long time, buildings develop and change then you want a degree of flexibility in space and use in the future as well.

So the next level down is the cross-bracing and K frames. Again as architects and I think Dr Sharpe made reference to it on Monday that architects tend to steer away from diagonals just because there's difficulties in intersections with partitioning and services. They're generally where you want to run services that's where the diagonal of the bracing would be and also it sort of interrupts those views as well will having a diagonal across that generally your view point. So moment frames are the ones we probably try to push for for their openness and degree of flexibility. Note the new technologies that we're talking about I use all these three sort of systems with the, I guess the rocking shear walls, the K frame and bracing with the dampeners etcetera or moveable or concentrating loads at certain points which can be easily changed out and I guess with moment frames where you've got the connection or the junction which is able to open and close but they don't markedly improve or lessen any of the advantages or disadvantages of the three sort of systems.

One of the issues though is the I guess the level of increased movement within these type of buildings. We need to look a lot more closely at the junctions with partitions and ceilings and services and the like. So just some examples. I think this one here maybe a retrofit but you know in buildings where you do have cross-bracing which when you start the life of the building some of those cross-braces may be buried within partition walls and another 10, 20 years they want to rip out those partition walls making it open plan and if you're left with K bracing or cross-bracing within those again that's probably not the best situation as far as protecting the future flexibility of use and viability of a building. You see in the bottom corner where we've got these diagonals we've got K bracing or like on the outside of the building. Again it's probably something that architects generally try to steer away from as far as having that diagonal sort of structure interrupting those views.

But again it's not saying that's a bad thing. Again some buildings you can actually treat as a positive and actually express these structures and here's one where it's got a frame right through the centre of the building and they're making it a key sort of component of the building itself. I feel that they paint it yellow so people don't bump their heads walking, walking through the gaps but again you can see the connections if there's an event engineers can get to those points really quickly. You don't have to start ripping off stuff and you can actually see all the importance of the connections.

And again they can form you know key architectural components to the building. We don't need to hide them, you can actually work with them so again it's just working really carefully with the engineers to ensure that you end up with beautiful connections and not just sort of purely practical sort of connections.

Q. Where are those buildings?

A. I think the previous one I think's a building in the States. This one I think's in Denmark and the bottom one's actually at the University of Canterbury, not, it's actually got exposed truss sort of system not necessarily seismic resisting but it's talking about that language and aesthetics of the building actually you can actually see how the building's clearly built and exposed so that the bottom one here is NZI3 building at the Christchurch university.

Q. How old's that?

A. It's only a couple of years old. So again it's actually got an exposed sort of gravity truss more than resistant frame but just there's a similar aesthetic I guess if you're looking at exposed K frames and stuff so we saying these new systems can actually affect the architectural style but you can actually turn that into a positive rather than necessarily just accepting it as being a challenge.

So with the issue of I guess having more movement with or potential movement within components of the building I guess that's also not really a new aspect for architects to have to deal with. We've always had to deal with seismic joints especially within link ways and junctions between different buildings. Personally I've had to detail joints with movements between 500 millimetres and 300 millimetres in all directions and keep them waterproof which is a challenge. Propriety systems are around to cover these junctions and deal with the water proofing but they tend to be really, really expensive and we tend to have to work through bespoke solutions using common construction methods and materials.

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So with the increased movement within these new resistant technologies there is also a likely desire to reduce the damage and downtime which is what you were referring to previously with earthquakes and then more attention needs to be required to these junctions but, however, the methodology employed to deal with these junctions already exists and this is also relevant to base isolated systems where you're basically dealing with the same amount of large movement gaps but at ground floor level.

So, I guess, another area which I'll probably focus on a little bit more than Professor Charleson's presentation are the secondary sort of building elements. So we heard from Dr Dhakal on Monday morning that the majority of the cost of damage and resulting downtime in some of these earthquakes is actually resulting from the secondary construction elements and not necessarily the primary structure. With the controlled rocking of these new seismic technologies it does appear to reduce the accelerations in the superstructure and the huge advantage of this new technology is reducing the risk of damage to its fit-out and contents. In relation to this the precast Presss building at Victoria University has been noted that as it is a science building the fit-out and contents are likely to be more expensive than the building itself. But, even so, in the context of actually new buildings in the future likely to need to be more resilient resulting in less damage and less downtime. Other aspects of the building construction will also need to be developed with new building technologies and techniques to complete the whole picture to ensure that the whole building is resilient and not just the structure and that this is an area where architects probably need to take more of a lead. In reviewing the performance of a number of buildings since September 2010 there are a number of aspects to the typical construction and design of buildings which need to be addressed by designers going forward or, at the very least, flagged to clients so they can make an informed decision as to whether they get implemented. These are not necessarily issues where building code requirements have not been met but the areas where there appears to be a benefit with minimising damage and the downtime after significant earthquakes.

So one of these areas is, I guess, the linings to egress stairways and, particularly, stair towers. These tend to always need to be fire-rated walls. The challenge there we tend to have to go with non-combustible materials because of the fire ratings. We can't use sort of timber based, you know, plywoods to give the walls more flex so we tend to use fire-rated plasterboard and the like. So there's a lot of potential cracking because it tends in stairways you're bridging across the floor and these areas tend to have a lot more movement than a lot of the rest of the building. So even though the cracking is on these on the joints it doesn't compromise the fire rating completely. The issue we've found actually comes when you come to repair these walls because of the difficulty dealing with the stairs you have to put in scaffolding which means that these stairs cannot be used for egress and that means buildings can't be occupied. Which, in itself, if it was just a single event wouldn't be too much of an issue but the fact, as we've learned in Canterbury, these events go on for a long period of time and each significant event you get cracking, have to repair, stairways are taken out of operation, you cannot occupy a building. So I think this is one area where we need to look at a lot closer as far as getting separation to the structure, potentially maybe more robust sort of detailing around it and making sure that these egress paths which are obviously fairly critical in an earthquake are a lot more robust and also help people to go back into the buildings in the future.

As we alluded to previously when we've got exposed structure but with outside walls it's a little bit more difficult to deal with. We've found that we've needed to cut inspection points in a lot of plus walls, particularly around the perimeter where owners have been particularly keen to view the connections with say the precast panels on the outside and they're quite keen to view all the connections to make sure the whole building is as robust and safe as possible. So, again, it wouldn't be so much of an issue if it was a single event but the fact that it keeps on going on and each time there's a particular event you want to get back to it again. So we've had to, in a lot of cases, install access panels in buildings. It makes it a lot more easier to check or looking at screw fixing some panels in situations so you're not, because the biggest issue with plasterboard is the stopping, the mess, and having to repaint the whole wall surface. It gets a bit tedious after you know the fourth or fifth time to do so. So having a little more accessibility and these things, I think, need to be designed in buildings from day one and that's probably one of the key lessons going forward.

Generally in office buildings with a lot of the exposed structure which we think sort of adds to the quality of the space you can see all these key structural junctions between beams and columns are all exposed. It makes it a lot easier to inspect after an event similar to the timber structures.

The other big area is, I guess, that separation between the primary structure of buildings and the non-load-bearing partitions, particularly if the junctions of the beams are columns. The knowledge has always been there that you needed to provide a separation. I guess when it came to the reality and the difficulty in sometimes achieving that and doing the cost benefit analysis with the quantity surveyor, weighing that against the risk of an earthquake or the cost of doing a little bit of stopping, a little bit of painting, it was never that economic sort of benefit but in the context of having to deal with this over 18 months and the disruption and downtime to tenants I think that's going to be something that's going to go forward a lot more. So I'm generally talking about a much bigger gap, maybe up to 25mm between structure and non-load-bearing walls. The challenges I guess for us is a lot of these walls are fire-rated walls, they're acoustic walls and sometimes external walls we have to deal with weatherproofing. So the detailed joints which move in all directions and maintain all those additional requirements and sometimes those requirements need to be tested systems. That's certainly a challenge but it's just something that needs to be worked through. It does have quite a significant cost implication if you go through all the partitions in a whole building and that's where the owners need to weigh up the cost benefit, how important the building is, how important is that downtime or damage but the important thing is the owner's aware of it from day one.

There's other areas where we've looked at suspended disc services and fittings where we've found that even though they're designed to the code at the time we did have failure in some of those and we've tended to put in more robust rods rather than the suspended cables and the like. Another one was furniture bracing where we've tended to have seen in buildings a lot of low storage units falling over into egress pathways so I think there has to be a lot more robustness into the whole package of buildings going forward. Having said that some areas did appear to work well, the unitised curtain wall systems and modular cladding systems where there's a little bit of movement in small portions across the façade and also internal non-plasterboard partitions. I guess those wood-based products like plywoods and Strandboard and timber boarding we have a lot more flexibility in the actual material itself, there's a lot more give. Unfortunately they tend to be about four times more expensive than standard plasterboard sort of walls so you have to weigh the capital cost versus I guess the cost of downtime and damage.

This is a, I guess, a case study trying to wrap up some of the things we've discussed. This is a building at Massey University that our company has been involved with for the last three years. It's a teaching block. It houses the College of Creative Arts which includes classrooms, workshops, studios and presentation spaces and is due for completion in May of this year. Key construction features include the first use in the world of LVL timber post-tensioned frames in multi-storey construction which is a system developed here at the University of Canterbury. It has a rocking post-tension precast shear walls taking the seismic load in a longitudinal direction. These are located against the stairwells and service areas enabling the main floors to be as open and flexible as possible and so that's important for future flexibility and the current use. There's also a world first in the use of pre-cambered composite LVL joists and prefabricated floor units.

So where the decision came to use timber. The timber structure was actually initially an architectural decision as in respect of the desired aesthetics of the building, its sustainability and it seemed to be an appropriate innovative material and technique in this creative sort of learning environment.

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The architects had participated in the competition for the Nelson job so it explored the materials and options at that stage and were keen to use it in this competition here and engineers which are Dunning Thornton had used the PRESSS technology at the University of Victoria with pre-cast systems and so working with the research team at the Canterbury University where modelling and testing was undertaken worked through the sort of new technology using the columns and the beams and the post-tensioned cables in between. The key advantage to this timber structure was the whole building could be prefabricated on the ground and offsite, including the columns, the beams, pre-cast walls, floor units and including the roof sections, the building sections on the ground where it's safer and easier to construct and then craned into place. This resulted in much faster construction time-frame. One of the challenges for the contractors. These structures tend to be a lot more flexible while they are building it so in this view you can see there's quite a lot of temporary sort of bracing and cables in place and until the whole system is together and locked into place there's probably a little more challenge from a construction point of view over and above conventional systems.

So just a detail – the cables going through the double beams. One of the issues contractors on site I guess with this particular building over conventional buildings is there does need to be a greater level of tolerance particularly at the base with the shoes housing the columns. You need to get these in the right place. I guess less tolerance in that. The issue with any new technology is the multi-factor for a contractor which can add a premium first time you go round. Fortunately we had the same foreman and contractor as used at Nelson so he was able to overcome some of those initial challenges.

The floor system was also unique in the fact that they came in these sort of 1200 sort of models offsite so what you see on the floor there is the finished product, pulling in the lifting eyes, and what you see in the ceiling is the underside of the floor units as well. So the only in situ concrete on the job is that stitch joint and gridline. There's no topping slab over the whole floor at all so all the structure is exposed and all the prefabrication, nature and construction nature of the buildings is exposed so it's a key aspect of the architectural component. As far as cost I don't have exact details but I believe the structure itself is probably more expensive than conventional means but where there's savings we're not adding any additional architectural treatment to the building. The structure is the decoration, is the architecture of the building. You don't have to add anything to it, not adding ceilings or floor coverings so overall the building ends up being cost neutral or pretty similar.

As far as building size, it is a five storey building. Generally the top three storeys are timber construction. The lower two floors are more conventional concrete construction because it's buried within a steep bank and there has been some challenging sort of connections where the two sort of systems do meet. Some other issues to deal with when you are exposing structures is obviously durability of timber when exposed outside is an issue which needs to be dealt with in traditional means. The cladding generally is a unitised curtain wall system which allows within each component a degree of movement and we've seen from experience down here that it tends to work really well with an earthquake event.

So in summary I would concur with Professor Charleson as far as the introduction of new technologies into mainstream design and construction is expected to have very few significant architectural implications. Architects on the whole are inherently interested in new technologies and new ways to design and construct buildings. These recent developments are pretty exciting to be able to explore with new projects. I believe there is a role for the architects to explore and potentially direct engineers towards these new technologies and we've heard from many pro-active engineers at the Commission but conversely there's others which do need a bit of a prod in certain directions from what they're used to doing and I guess overall the challenge for architects is to work very closely with the engineering community and create buildings which can possibly embrace the new technologies and create all round higher quality buildings.

COMMISSIONER CARTER

Q. As an architect are you enjoying the challenge of dealing with new things or in general is there any prejudice towards adopting new techniques?

A. I guess everyone's different. I guess our company we're never doing the same thing twice which is much to our detriment at times. I guess it's the nature of what we do, creative people. We like to challenge ourselves and we like to challenge other people. We like to challenge the owners and the clients to do things, you know, the way – create spaces. We like to challenge engineers to do things as well so this to us is pretty exciting. I mean there will be people who like to stick to their bread and butter and do what they're always doing and sort of churn out pretty conventional buildings. It comes down to sort of personal taste and all that sort of stuff but certainly from our perspective we are always keen to challenge all aspects of a building project from early design aspects right to the materials used on walls. It's not just a matter of churning out the same thing all the time.

Q. Do you think there's any preference towards any of the three, we know that the three primary materials, structural materials, have all got options for these new technologies. Do you have any preference in terms of, you know, further outfitting dealing with architectural detail after the structure is built?

A. Each building on a case by case basis. They all need to do different things and have different sort of responses. We deal with concrete steel and have to deal with timber as well so it's sort of a case by case basis. Maybe a client decision. We have some people come in who are quite keen to explore this sort of new timber technology using the cross-laminated timber technology in townhouse units and that's obviously been driven by they've seen it somewhere else. They want to explore it and it's actually been driven by the client rather than the architect. Conversely we would sort of float ideas and bounce ideas and also involve the engineers. With good buildings it's really the collective mind of all those sort of parties which is really important to get good results.

WITNESS EXCUSED

MR MILLS CALLS

PIERRE QUENNEVILLE (AFFIRMED)

Q. Your full name is Pierre Joseph Henri Quenneville?

A. Yes.

Q. And you are a Professor and Head of the Civil Engineering Department at the University of Auckland?

A. I am.

Q. You have a Bachelor of Engineering Degree with First Class Honours from the Royal Military College of Canada?

A. Yes.

Q. And a Masters of Engineering from Ecole Polytechnique in Montreal?

A. Yeah.

Q. And a PhD from Queens University in Kingston?

A. Yeah.

Q. You have specialised in the design of timber structures as I understand it?

A. Mhm.

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Q. And you are recognised for your research on ductile and brittle behaviour particular of bolted connections and other fasteners for timber structures.

A. Mmm.

Q. You've designed numerous timber structures in North America?

A. Mmm.

Q. I just need you to say yes a little more loudly so it can be picked up.

A. Yes, thank you, yes.

Q. And you are a member of the Canadian and Australian Timber Design Codes Committees?

A. I am.

Q. Thank you Professor Quenneville. I'll leave you to take us through your presentation.

PROFESSOR QUENNEVILLE:

Your Honour and Commissioners. This presentation is on new technology for timber structures but with the objective to mitigate damage. I truly believe that there is technology here existing that mitigate damages and I just want to add to what I was going to present so far. During this presentation I will go over some of the structural timber systems that are in use and propose, or timber earthquake, or to resist earthquakes sorry, go over some of the connections and highlight some of the drawbacks and then move on to talk about some existing concepts in other materials that could be adapted for timber systems, then move on. The main lateral load resisting systems that are available to timber designers are plywood shear walls and diaphragms. This has been used quite efficiently and I think the design of this is mastered by most engineers. The, there's a new system proposed by Professor Buchanan, Pampanin, Palermo, University of Canterbury and there is also the event of cross laminated panels which originated in Europe and is picking up in New Zealand, North America, Australia.

Plywood shear walls are essentially a system where the envelope is used as such, as the envelope, but also structurally and the lateral load resisting system is assured by the framing of the wall and the panelling by the, whatever panel material is provided. You can have walls that are 10 metres high. So there's, that's feasible. They're quite easy to detail and they can be used in non-residential construction or multi-unit residential construction and also residential construction as well. They can be fabricated on site and also pre-fabricated and installed as required.

The panel intent is to resist the lateral, horizontal force by shear, through shear and through the over-turning action and the resistance to those actions is assured by two different systems. The Pres-Lam system developed by Professors Buchanan, Pampanin and Palermo is probably the only system that incorporates all the features of lateral load resisting system in timber and has the advantage of mitigating damage. All the other ones that are proposed or existing will not have that feature of mitigating damage. They will all suffer damage to some extent. So the Pres-Lam system is probably the only one right now available on the market.

So it's been shown extensively yesterday and this morning and some of the features are used in NMIT in terms of rocking walls and energy dissipating devices.

The CLT panels as Professor Buchanan has mentioned, they're solid timber panels and they can be prefabricated to 100 to 500 millimetre thick in dimensions of three metres to 18 metres. They're quite stocky, they use low grade timber and the main feature of the use of CLT is that they allow for a large amount of prefabrication of the structural component. As I said their use is expanding and we're going to see some buildings in Australia and I wouldn't be surprised if in a year or so we'll see some proposals in New Zealand.

On the left side you see the, the basic configuration, they are glued on, they're wide-faced, the boards are glued on, they're wide-faced not necessarily on the side. They're using low grade timber and they are dimensionally stable because as we said before the shrinking and swelling of wood in the longitudinal direction of the fibres is always very small. So the transverse layers will restrict any swelling or shrinking of the other layers in the perpendicular side. These, the bottom right picture shows the extent to what prefabrication can be done. Because it's timber and they're using quite a lot of robotic manufacturing process all the openings and cuts can be done and the panels can be just lowered on a flat bed and delivered to site.

This is an example of a cross-laminated timber house. This house was, the panels were delivered and erected in one day and the use of new fasteners allows these panels to be erected quite fast.

They've been used in multi unit residential construction, so as walls and floors and roofs.

And this is the example of the seven storey CLT building that was tested at the E-Defence in Japan near Kobi. I was there in 2007 to witness that test and you can probably notice at the bottom corners of the building that there are some steel connectors that are holding down the panels to the foundation. Now these connectors are the only device that absorbed the energy. This building was subjected to many earthquakes tests during, while it was in place, and between each of the tests technicians would go and replace those connectors because there would be some damage at those locations. So although the principle is good the, the rocking mechanism is engaged but for absorption of energy it's not optimum. I was told that for the, when the test using the Kobi earthquake was made the base acceleration was in the order of .8 g but at the seventh storey the acceleration for 4 g and this is unacceptable. The people and furniture content were just going back and forth and it was quite dangerous to be in, in this one, in the top storey. However, it's, the CLT panel is here to stay. That's for sure.

1130

When we talk about those lateral load resisting systems they rely on the connection to absorb the energy so I'll talk about these connections for the shear walls and for the CLT panels. The shear wall resistance will absorb the energy or resist the load through the sheeting thickness, the number of nails and the framing density. The nails are the critical part to absorb the energy and that's any changes to the design that enhance the resistance of the nail connection will result in a stiffer shear wall or a one that will absorb more energy but there will be damage at the end.

For the overturning action this force is resisted by the end cores which is the, either the left or the right vertical members and peripheral of the, at the periphery of the panels.

The hold-down connects the panel to the foundation or to a shear wall segment below. These hold-down connections are designed as rigid they don't necessarily behave that way. So on the left you have an example of hold-down connections connecting a shear wall segment on the second storey to a shear wall segment to the bottom storey and at the connection with the concrete foundation the hold-down on the right side would connect the cord, the tensile cord for the foundation. So these hold-down connections are very critical in resisting the overturning forces.

This is a slide of a practical case where you have a bottom shear wall segment and to the top of it you have another shear wall segment and you have hold-downs at the bottom of the top one and hold-downs at the top and the bottom of the bottom shear wall segment.

These hold-downs are usually there could be custom made engaged with the, engaging the forces using nails or bolts and they just connect the panel to the foundation. The CLT panel connection is, is subjected to the same shear force and overturning forces and one can use custom made brackets or brackets that are off the shelf such as these, and normally these brackets are, would be nailed, screwed or bolted to the structural panel.

I have an example here of the shear connectors so lots of small connectors throughout the left of the panel and a bigger hold-down connector at the end of the panel edges.

Other fasteners that are new to the market are the fully threaded screws or ice strength screws and they come in quite various sizes up to one metres 16 millimetres in diameter. That's the optimum or the maximum size I've heard of. Practically the ones that are in the eight to 10 millimetre diameter and two to 300 millimetre in length are used and they are quite popular right now because they're self-tapping. They require minimal amount of prefabrication and they're quite easy to be installed.

Now for all of these shear walls or CLT panels as I said the connection is the element that absorbs the energy. On this slide you would see a force displacement and this is when a typical shear wall test is subjected to back and forth motion and if the, and this would be to many cycles for very small amplitude of forces and motion there would be very small forces and very small displacement and if some of the displacement, some of the forces are overcome then there is some inelastic deformations that are observed and the, when the cycle is reversed then there's a loss of resistance and we call this the pinching and you will see one would see this for any of the nailed, screwed or bolted connection.

COMMISSION ADJOURNS: 11.36 AM

COMMISSION RESUMES: 11.52 AM

PROFESSOR QUENNEVILLE CONTINUES:

On that previous slide I just want to add that the, as the number of cycles are imposed on the structure and that there's degradation of any of the connections that are joining the timber elements, one will lose resistance but also because there'll be less energy absorbed, there'll be more movement resulting from, from this. The, there will be, there would be permanent deformation in your structure and one would have to replace or repair extensively the structural elements.

The point that I would like to make today is that to mitigate the damage of the timber structural elements and absorb energy one should not rely on the timber connection only. Traditional connections will usually comprise of a nail, a screw or a bolt connected to timber and if there's deformation and absorption of energy that energy is gone. So for the next cycle one has to go beyond the last cycle displacement and then absorb the energy through deformation of the fastener and crushing of the wood. So what is taken in one cycle is gone and one would have to reposition to connect the connector or the fasteners if one would have, would want to use the building or continue to use the building.

So the, it is proposed, about two years ago we started looking at the concept of slip friction hold-down connectors for traditional shear walls and timber panels. This is not new technology. It's technology that has been used in other materials but essentially it's replacing traditional hold-down connectors such as the one we've seen with the slip friction connectors that have been used in the pre-cast concrete panel construction. So the, those connectors allow some resistance up to a certain threshold and then the true friction between the plates will restrain the movement and absorb some of the energy. So the principle is that plates are connected. The metal slide shows some of the earlier concept where you had steel plates and glass plates in between. The technology has changed. There's the possibility of using different types of steel to make it more simple and more, less costly but essentially you have bolts that are squeezing the plates together and through,

through friction between the plates shown on the right there will be some absorbing of the, absorption of the energy. These connectors would be positioned at the same place as traditional hold-downs or shear walls and CLT panels.

So the intent is to allow the rocking mechanism but to control the movement in the upward and downward movement during the event. So the, the, on these diagrams one can see that the traditional, traditional shear wall behaviour would be such one would hope that during wind action the shear wall would behave elastically without any deformation, any permanent deformation so there is back and forth lateral movement of the shear wall. In bigger events one will go, the amount of motion will go beyond the yield threshold and will go into the inelastic mode and there will be some permanent damage in the shear wall. The addition of the sliding friction device is to transform the system in a system where you have a rigid panel and springs at the bottom and in, again, under wind or serviceability level actions the panel, the shear wall or the CLT panel would react elastically. So no permanent damage, no damage to the connector. Everything is back to normal. In times of higher seismic event there is different philosophy that could be included and the, the actual slip friction device can be tuned so that the, at first the, before the nail connection or the screws or the bolted connection in the hold-down are mobilised beyond their yield level the rocking mechanism is engaged through these slip friction device so there will be slip between the steel plates and there will be some energy released and that's what we see at the base here and so if the, for the next cycle if there's no, if it comes back then there'd be no deformation no permanent deformation in the panel or the, the shear wall and it'd be just back to normal. In the event of a seismic earthquake which is beyond the capacity of the slip friction device then this, the inelastic behaviour of the shear wall would be mobilised and then there would be some, there could be some permanent deformation. But the tuning of the slip friction device could be such that you protect the main structural elements for most of the events.

Some of the performance criteria that we are looking at are the, at the, is negligible inelastic damage after the ultimate limit state event, that the maximum drift remain within the code limits, so that's 2.5%, that the, that there's, the shear wall or the CLT panel behaves elastically within the serviceability limit state but mostly it is that there is improved energy dissipation in the use of that device. There has been some comparison between, for traditional shear walls using traditional hold downs and the ones with slip friction device though this is again a low slip response for traditional nailed plywood shear walls and one can see that the yield limit of the nail connection has been overcome and there is some permanent deformation for each of these subsequent cycles and there's going to be pinching action for each one of them between each of these cycles.

120200

The one on the left is the traditional one and the one on the right is the one is the traditional shear wall but with a slip friction connector so the idea's that before the yield limit of the nail connections and the plywood shear walls is overcome the slip friction is engaged and energy is absorbed and then the shear wall responds elastically throughout the event. This shows very good energy absorption in both lateral movement back and forth.

And this example is one where the tuning of the slip friction device could be such that the slip friction device by itself is not enough and that the event is such that its capacity has been surpassed and that the traditional energy absorption in the shear wall is mobilised by nail ductile yielding of the nail and crushing of the wood. It's still possible if for cases where you have maximum occurrence event you have inelastic behaviour depending on the capacity of this slip friction device.

The case with CLT panels the graph on the left shows a behaviour which is truly just elastic. The hold-down is absorbing the or restricting the lateral movement and when it goes down its just pounding on the panels below. In the bottom right response there is absorption in the up and down motion of the panel with the slip friction device and if the motion is such that there's more compression required then this is only mobilised with compression of the panels on the floor. The energy absorption is mainly done when there's an upward movement of the panel.

This concept is new. We're at the point where we've developed a theory and we're confident it works. We're at the point where we're looking at different plate material to minimise the cost and make sure that these devices would be affordable for refurbishment of existing shear wall and for inclusion in new construction. In the next year or so we would like to do these tests with full scale modelling of shear walls. Thank you very much Your Honour.

COMMISSIONER FENWICK:

Q. One quick question and probably more later on at the panel but this is intended for domestic construction or for more major –

A. It is, um, it would be adaptable to all types – residential, multi-unit residential and heavy timber construction.

Q. So you see this as capable of going to multi-storey.

A. It is capable yes and it would be advisable to use at multi-storey.

Q. I notice in several of your illustrations of the load displacement it's gone much further in one direction than the other.

A. Mhm yeah.

Q. Is this because it was mounted so it could only slip upwards?

A. Well there would be, those graphs would be typical of the rigid panel type construction. The CLT panel would behave this way because once the panel is back to its original position it won't go any further. So those low deformation were at the actual hold-down locations. If one looks at the entire panel back and forth one could see that its in both directions, that the displacement would be increasing in both directions.

Q. I might follow it up later on in the panel, thank you.

COMMISSIONER CARTER:

Q. Would the damage go beyond the capacity of the slip friction device and get into the inelastic state, is that the damage that's then resulting in the panel as around the holding fastenings for the slip friction device I presume, is that correct?

A. Yes it is, it is and the trick is really to be able to make that connection so much more rigid that this does not occur if possible but it's to also tune that device that it has a lot of its range would include all possible events.

Q. So you'd still have things like reinforcing on the high compression face of the panel where it's impacting on the foundation.

A. Not necessarily because the CLT panel. They're usually so large that the compression area is massive and then compression, the problems associated with compression per degree are normally non existent.

WITNESS EXCUSED

COURT ADJOURNS: 12.09 PM

COMMISSION RESUMES: 12.16 PM

MR MILLS:

Sir there's just one matter I wanted to bring to your attention before the panel gets underway and you're probably already aware of this but we've got three members of the panel who haven't been on a speaker/commentator group and obviously you know who those are.

JUSTICE COOPER:

Yes well this is quite daunting for me to be confronted by a group of engineers and others with expertise in the construction industry in the front row when normally one has mere lawyers so positioned but can I just, I think seeing we have such a large group I'll just go through the formality of administering a joint affirmation if I may do it that way in which I ask you to solemnly and sincerely truly declare and affirm that the evidence that each of you give will be the truth, the whole truth and nothing but the truth. If you could all say, "Yes."

PROFESSOR ANDY BUCHANAN, DR CHARLES CLIFTON, DR STEFANO PAMPANIN, MR PIETER BURGHOUT, MR JOHN MARSHALL, MR TREVOR WATT, PROFESSOR ANDREW CHARLESON, MR ROB JURY, MR JOHN HARE AND PROFESSOR PIERRE QUENNEVILLE: YES

JUSTICE COOPER:

Thank you very much. Now the majority of you have already given evidence to us but there are some who haven't. Can I refer first of all to John Marshall.

MR MARSHALL:

Yes.

JUSTICE COOPER TO MR MARSHALL:

Q. Mr Marshall, could you just tell us your full name please?

A. John Brendan Marshall.

Q. Thank you.

JUSTICE COOPER TO MR BURGHOUT:

Q. And then there's a name which I may well pronounce but it looks like Pieter Burghout.

A. Pieter Dirk Burghout.

JUSTICE COOPER TO MR MARSHALL:

Q. And I think everybody else is a previous witness. So Mr Marshall can you just tell us what role you have and who you're representing here today.

A. Sure. I'm a chartered professional structural engineer.

Q. Yes.

A. I'm an immediate past-president of Precast New Zealand so I'm here today representing the precast concrete industry and the wider concrete industry.

Q. Thank you.

JUSTICE COOPER TO MR BURGHOUT:

Q. And Mr Burghout you're from the Construction Industry Council I understand?

A. Yes I'm the CEO of BRANZ, the building research association.

Q. Yes.

A. And in that capacity I'm, BRANZ is a member of the Construction Industry Council and I'm the elected chairman of the CIC.

Q. Thank you very much and perhaps for people that don't know, just tell us something about the Construction Industry Council.

A. It's essentially a grouping of 30 industry bodies that get together at a CEO level to discuss issues of industry importance. It's certainly grown in size since the leaky building saga of the early 2000s where the industry felt it had to have a better single voice rather than being so disparate as it can be accused of and the CIC was one response to that.

Q. Right. Thank you very much.

JUSTICE COOPER:

Now I want to put an issue on the table first of all on which I expect there's a range of perspectives but it's something which the Royal Commission will have to grapple with and it's, it's a question which is asked very much in the context of the Christchurch earthquakes and the extreme event which occurred on the 22nd of February last year and the question and I think probably the big question is whether coming from your different perspectives you consider that there needs to be change or refocus of the existing building controls having regards to the effects that that event had on, if I may use what I know is a loose term, on comparatively modern building structures. So that's a question, is that a reasonable way of putting it or – so can I ask for volunteers to enter that potentially deep water.

JUSTICE COOPER TO PROFESSOR BUCHANAN:

Q. Professor Buchanan?

A. Yes I would be prepared to make a start on this but there'll be plenty of other views. The, just to give a little overview I guess of where we've come from in the last few days. What we heard on Monday was we heard a lot of talk about performance based earthquake engineering and the ability of structural engineers to now design buildings and construct buildings in such a way that the performance under severe earthquakes is much, much better known than was in the past and what, and what we've heard today and yesterday is we've seen a huge amount of developments in earthquake engineering and this has been worldwide. It happened, it was all well underway well before the Christchurch earthquakes and over the last 10 or 20 years there have been enormous developments in earthquake engineering and new building systems and smart devices to make buildings perform much better in earthquakes and to monitor how those buildings will perform and so this really creates an enormous opportunity for us in New Zealand to actually show some international leadership because many of the new developments that we heard about actually are Kiwi developments from base isolation and performance-based design, displacement-based design, many of these things actually started off in New Zealand, many of them have been implemented in New Zealand but not very rapidly because earthquake engineering has not had a high profile in New Zealand because we haven't had a major earthquake for 80 years in a New Zealand city until now. So I just want to summarise by saying that but to answer your question, the question is whether or not we need to have changes in building controls to design new buildings which will have much better performance than the existing ones and the answer certainly is yes but the building controls on their own, there's much more to it than that.

Q. I agree with that.

A. And certainly what, as I said yesterday there are going to be lots more earthquakes in New Zealand. There's going to be a lot more earthquake damage in New Zealand and what happened in Christchurch is that we were very lucky when it came to loss of life but when it comes to buildings and we look at the number of buildings being demolished right now this is not acceptable in modern times and we've got to make sure, do the best that we can as a nation to make sure that when earthquakes hit other New Zealand cities we don't see, first of all we don't want anyone killed, but certainly we don't want to see all the buildings being demolished. And what we've heard about today and yesterday is the technology is there and we have a huge opportunity to implement it and by raising the minimum standard we'll make that happen and so I think I'd just like to stop there really. To say that regulation is important, it's not the only thing but we've certainly got to do something and we have the skills and the techniques and the expertise to make a major improvement in where we've come from.

Q. Yes.

COMMISSIONER FENWICK TO PROFESSOR BUCHANAN:

Q. There is a difference though isn't there between an opportunity to demonstrate this and do it and a requirement that it's done. Now I think the issue is, is this a requirement that we raise the standard everywhere for the type of event we've had, bearing in mind that the earthquake we've had, best predictions are that the return on that particular series of fault lines is 10,000 years or more, of that sort of order which if you cast it back takes you back well before the Greek civilisation. Okay there may be other faults that will go but even so it's unlikely to be an event which is going to occur very often in terms of our known history. So, yes, I agree there's a great opportunity but would you now say we have to lift the bar for every structure which is rebuilt? That's I think a different issue and it's one I think that needs to be addressed.

1226

A. Absolutely. Well my view is yes, we should lift the bar and what we've heard is it's not going to cost the earth. Let's lift the bar and let's move to a much higher earthquake standard of buildings throughout New Zealand and the demand for this is we're not simply talking about rebuilding Christchurch, we're talking about all the new buildings that are going to be built in New Zealand and we're also talking about retrofitting buildings. We've got to do something and I would definitely lift the bar but I would like to hear what my colleagues feel about it.

JUSTICE COOPER TO ASSOCIATE PROFESSOR CLIFTON:

Q. Yes well Associate Professor Clifton do you have a view on this.

A. Okay I've got some comments. There will be a greater emphasis in the future on low damage construction for new buildings and I think that that was bound to occur the first time that we were hit by a damaging earthquake in a major city and it's a similar occurrence that's happening worldwide but in terms of the building control system itself, one of the issues I think that urgently needs to be addressed is the quality assurance of design and construction, especially the quality assurance of offsite prefabricated construction and the regime of inspecting and ensuring quality. At the moment all of the quality systems, the frequency of inspection, the role of the construction reviewer etc is all based on monitoring onsite performance. Certainly from my experience in the steel industry there is actually negligible to no independent inspection of offsite prefabricated construction except in areas of welding, for example, in the steel area where welding is a known, it's a high technology trade. If you get it wrong the consequences can be disastrous. It has a well set up established regime of defects and inspection but it's one of the very few and even in that area most fabricators will tell you that they never actually see an independent inspector and they have to call them in themselves. So quality control of prefabricated construction is an urgent area to be addressed.

Q. I thought we might come on to how we might implement change if it's necessary and I put that in that category. I was keen to get views and if there are a range of views on this issue of whether the rules should be changed in response to the experience of the Christchurch earthquake in terms of whether we need to focus on provisions that give greater emphasis to damage protection. Now I think you've said, from your opening remarks, you agree that that should happen.

A. Yes I do. Certainly for all new buildings because then over time your building stock, the old buildings will disappear and your new set of building stock will become progressively more damage-resistant as time goes on.

JUSTICE COOPER TO PROFESSOR BULL:

Q. Professor Bull I think you've already nailed your colours to the mast on this issue quite firmly, am I right in that?

A. Indeed Justice Cooper. To answer that particular question I believe that we should be lifting the bar and there should be a change of focus which is toward property protection and investment protection because it has larger societal implications. People occupy the buildings, lose their business premises and these sort of ongoing downstream effects and it has already been raised by Professor Buchanan a number of times over the last few days, the costs to actually achieve better performing buildings is relatively small, often less than 5% of the total cost of the building to end up with a far better building stock and I'd just like to pick up a point from Commissioner Fenwick. Yeah these earthquakes we've just been through which, by international standards, are very very large and 10,000 year return period. In some respects some of the behaviour is attributed to those massive events but what we're also looking at is more of a, designers and researchers are also looking at, and I've discussed this with Professor Fenwick before, is that we are exposed to a different sort of earthquake, much like the one we had in September but instead of having a significant shaking of maybe 12–15 seconds the significant shaking could be 40 seconds to 60 seconds, a rolling sort of earthquake. In certain structures which typically in the commercial building area will suffer significant accumulative damage and the sorts of damage you'll see in those buildings will be very similar to what we saw here, different energies, different way the earthquake behaves but, in the end, the conventional buildings will be suffering similar levels of damage. In the sorts of earthquakes that designers have been thinking about in the last 20 or 30 years, the Alpine fault, the Wairarapa fault, the Wellington fault. It's a different sort of earthquake sequence but, in the end, we end up with buildings, relatively modern buildings in such a state of disrepair that we have to demolish them. So these are all part of the motivations to move forward for more resilient buildings.

JUSTICE COOPER TO MR JURY:

Q. Mr Jury you have on previous occasions, I think, perhaps come from a slightly different direction or where do you stand on this?

A. Well I had some sympathy with the view that Commissioner Fenwick expressed that earthquakes of the type that we are generally concerned about are low probability events.

COMMISSIONER FENWICK:

Can I just hold you there, I'm trying to be neutral and I'm not expressing a view I'm trying to draw attention to a wider scale of event to get a wider range. It's not my opinion, it's trying to set the scene.

JUSTICE COOPER:

Yes, no, we don't have opinions.

MR JURY:

Thank you Commissioner I knew it wasn't your view I knew it was just a view you expressed. I have, these are low probability events. We have in the past considered a philosophy where we have concentrated on life safety and damage protection has gradually been introduced and has gradually increased but the reality is that the majority of buildings built in New Zealand will never see an earthquake like Christchurch in their lifetime and I'm talking not only about the ones that exist now but ones that will be built in the future. Christchurch is a very low probability event, hopefully, and so I wonder whether we just need a balance there in terms of concentrating totally on damage protection. If we raise the bar, we can certainly do that for new construction, and for some of the technologies that have been outlined this might be at relatively minimal cost, but we set a bar also for the existing building stock and I don't think that we can sustain that in our community in terms of cost.

JUSTICE COOPER TO MR JURY:

Q. Economically?

A. Mmm in terms of cost. It's true that if you do a cost benefit analysis you can never make earthquake resistance a viable proposition from a cost benefit point of view. They're so low probability events by the time you include that likelihood it becomes a non-economic, from an economic point of view a non-starter. Where it's important is, of course, that these low probability events can occur and life safety is the primary objective of getting out of the earthquake with your life. You can always build the structures again. But, of course, Christchurch shows that if you are unlucky enough to get one of these events the costs are immense and so the community does have to decide whether it can live with the possibility of these large low probability but very large consequence events.

Q. Well designing for seismic resistance in Christchurch has historically taken place against the background of the possible rupture of the Alpine fault, hasn't it. Now it will be a different kind of event, as I understand it, of less intensity because of the attenuation of the time it reaches Christchurch but of much longer duration and this is perhaps the point that Des Bull was making about how do the rules look when you look at the performance of modern buildings against that possibility which doesn't have the long return period consideration and yet it's something that can be predicted to occur sooner or later, isn't it.

A. I agree with that. I think there's been a lot said about performance based design too, but the acceptable performance that we're expecting is not typically well defined and we need to sit down and decide what we will accept as acceptable performance in our buildings. I introduced, the last time I spoke on behalf of the Earthquake Society, a tolerable impact matrix. That was done prior to September 2010 obviously but if you look through that matrix for an earthquake like Christchurch earthquake in February in a city like Christchurch we would have expected far more in the way of fatalities for that return period event. That's what we were expecting prior to the earthquake.

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We've certainly got to review whether that is still a reasonable expectation and decide whether we're prepared to accept that, but we were expecting large numbers of collapses of modern structures. We were expecting large numbers of deaths if we got an earthquake of that sort of return period so I think there is an issue around deciding what we're prepared to accept and maybe it is that we can't accept damage, we can't accept $30 billion worth of loss but we need to have that discussion.

COMMISSIONER CARTER TO MR JURY:

Q. May I ask a supplementary question to you as you're on.

A. All right.

Q. The answer that we were given a moment ago about raising the bar I think needs a bit of interpretation, because to some people say raising the bar means increasing the investment that we're making and therefore increasing the cost and so forth. However raising the bar as we've heard from a number of you in the (inaudible 12:37:16) can be designing better things not necessarily more expensive things but better things and so we have seen huge examples in the world of consumer products where standards have been continually going up, up, up, prices are becoming, going down, down, down because people get more adept at doing things better and I think the thing that's troubling me and perhaps we're sort of just touching on some of our discussions here is and you may be able to help us with, is that if we design a building really well to the present code levels including the displacement provisions that are already built into the code we actually get closer to what everybody's been telling us we want to achieve. So I think we need some help in understanding what you're meaning by talking about raising the bar and I would wonder whether we're also talking therefore about the way design and approvals to design and construction is going on in the country which then gets back to His Honour's question about, "Do we need to do more to control it at that regulatory end or do we need more to advance the techniques and the knowledge and spread better knowledge amongst the design community", which is very disparate. The engineering design organisation is just taking engineering but I'm sure the same goes for architecture as well, is represented by a very large number of small firms all of whom have to address these very same problems and so there could be a question of variability in standards going on in our community right now that perhaps we should need to talk about. My question is could you reconsider the way you use the words "raising the bar" and help us to understand what you mean by that?

ASSOCIATE PROFESSOR PAMPANIN:

May I add something thank you for the additional comment. I think that first of all what you manage to put together is something quite unique I should say as regardless of the target. As an academic we would not be able easily to put around in three days a conference like this. I'm serious. To have the experts coming from academia, industry and contractors and user being around the table and debating so what I would say that it would be fantastic – not great – fantastic is to make this available to the real public to the general public because when we try to make a conference happening is basically what we call preaching to the converted. Is us talking to each other how great things are but not letting people know. Even yesterday on the media there are some interesting comments that you can read on line people do think that introducing new technology means excuse me a hell of a cost which is absolutely not true. So picking up what here the experts are saying that what we have been observing is the world has been progressing before the Christchurch earthquake. This what we call new technology which I don't like to call new technology, this old technology from thousands of years ago of human kind are now being reshuffled, retuned with new materials. Steel was not available to the people that were using iron or lead and we are then reinventing ancestors' best technology which can invade the market like it is happening even if we were doing nothing. It is happening already. So now the question for us would be as user, as a citizen or as a driver, do we want to facilitate the progress to happen or do we want to try to stop it? I would think that instead of saying that is a requirement it can be a facilitation, the mission that we have as a professional to make it happen in an easier way and we can discuss what is easier way. The first one is to kill the prejudice about cost. To tell to people it has been happening because no-one in the world in peace time before the earthquake would keep on making the same mistake of wasting money because not cost convenient so what has not been raised over here is that there are commercial interests of people in, around the world remaking the mistake of using new technology because they cost less to them as progress does. The more implementation the less they cost so can we try to facilitate a wider implementation which means education on one sense, incentives. Very often I give an example which happen in my country it was very hard to change the car stock. So the government came down with a stick and carrot approach. I do enforce the change of old cars but I give you major incentive cash or tax rebate when you buy a new car. So people were happy because they would think about changing their car but that was not too expensive so by basically having the incentive from the government they were able to have a cheaper, sorry a less expensive, not a cheaper, best product. So if we think about us in not enforcing or enforcing with incentives which means facilitating the progress to happen I think we're going to reach the goal. Nothing else could – the worst could be having the prejudice of holding back, holding back, holding back which I don't think no-one over here is trying to deal with and so again I really complements because we are trying to organise a conference in Christchurch in one month time the New Zealand Society of Earthquake Engineering and the most difficult things an organiser from the society was to get the people out of the industry into and to communicate to the public in a way that is typically not journal paper read by no-one else so already by summing together what these speakers have been providing as information and making that a special publication to the public would be, would be fundamental.

Last one is communication. We do need your help to channel the communication in ways that we can't typically touch and I would like to see for the next six months the communication from any media being about positive. It is there. Did you know about? Is like when the heat pumps came over people did not know what it was, myself either, because I'm using heat pump for air condition in my first country in Italy and then suddenly I got convinced that it does make a lot of sense and so just tell using media which means investment from the government to tell to people that have you, "Do you know that the new technologies just cheaper like a computer is and much more perform than 1980s one", and then let the market chose if they are really so in a way closed minded or if they want to just let it come in.

JUSTICE COOPER:

Right, thank you. Now Mr Burghout.

MR BURGHOUT:

The way the CIC's been discussing this so far is more about informed consent. What we're, what I think the earthquake will at least do if nothing else will bring this issue to the fore and all the public to be part of deciding whether risk should fall. In other words in the past I think esteemed individuals like round this table have said, "Here's what we think the risk is and here's how we think the code should handle it". I think now at least the public's going to be informed of that as part of that process and be part of that decision and wherever the bar is set or whatever language we use I think if New Zealand agrees where the bar is then at least we know where it sits and that is far better than necessarily people experts in the back room doing it. So step one is informed consent.

Now step two no matter where you set the bar there'll be technologies that keep moving you on and I think understanding that good, better, best type approach and the industry has to understand that for itself a lot better what is good, what's the code for, what level does the code set and what's above that. And thirdly going back to your regulatory framework, the CIC has often championed an idea of having a National Consent Authority, that asking for example Christchurch City Council's inspectors to look at a commercial building and understand everything about it and issue a code compliant certificate I think is, wouldn't work. We somehow need to have a better body of expertise to be able to handle consenting of complex structures.

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JUSTICE COOPER TO MR BURGHOUT:

Q. Well there's a couple of things there that I'd like to pursue with you if I can. First there used to be stories and this is sort of anecdotal and just things one picks up, living in Auckland anyway. There used to be stories of buildings that were built on the basis of planned obsolescence because of this mindset that property would continue to increase in value and it would be worthwhile to knock a building down and in

15 years' time put up something else, more rent would flow and overall you'd be better off. And as part of that culture the idea, and we've heard evidence from it in these hearings from Dr Sharpe of engineers dealing with clients and giving certain advice to make the building more robust and getting the answer: "Is it an absolute requirement of the Building Code and, if it isn't, take it out, we don't want to do it." Now you I think are probably better placed than anyone in this room to give us a sort of snapshot of whether those attitudes still have any currency?

A. They certainly do. They certainly do. In other words the average developer I think someone said earlier before that if you're a long-term owner the incentives change and I think you will think about the long-term life cycle of that investment. If you're a short-term developer you won't have that at all. It's the same applies in residential construction. If you say to the average home owner, "Did you know that the Building Code only requires your building envelope to last 15 years?" Most of them would look at you and say, they didn't realise that at all. It's not an overt conversation. Your structure has to last 50 years but your envelope only has to last 15 and I think the code has to make those decisions about where the trade-offs lie. I think the code did the best it could back in the '90s and early 2000s but I think the Canterbury earthquake throws that sort of decision up in the mix again and says as a society where do we agree the line should fall and there'll be some things that therefore are good better best above that.

Q. So part of the logic I think of what you've just been saying is that it might be necessary to devise, despite the Canterbury earthquakes, to devise some means of incentivising better practice.

A. Possibly, possibly. Incentives are always an interesting thing to put in the market and the distortions they create. It's a good policy conversation to have. I know the way we discussed it at the CIC only briefly was being able to appreciate for example building remediation to bring up seismicity level would be one way to go so at least as a building owner that fits within your normal taxation rules and methodologies but being able to accelerate depreciation for a retrofit was one of the things we talked about. We didn't come up with a view but that was one of the options we have discussed.

Q. Do you notice regional differences in attitudes?

A. Absolutely.

Q. And what are they?

A. Well not necessarily regional, more institutional. I think someone's already said that if you're a long term owner, if you're AMP your attitude will be different than if you're low key, low scale developer. The low key developer will say build to code. AMP or an institutional investor will say, "No, there's other things we're looking for and how do we build better."

Q. And just so that I'm understanding is that because the developer factors in the likelihood that he or she will no longer have an interest in the building?

A. It was the same issue that came to the fore during the leaky buildings. That actually was developers who were turning over properties pretty fast and had the least incentive to put in the best practice construction methodologies and the same would apply I would imagine in commercial buildings.

JUSTICE COOPER TO MR MARSHALL:

Mr Marshall do you wish to contribute to that part of the discussion?

MR MARSHALL:

Yeah, I support very much what Mr Burghout has to contribute. You know, we too see that a lot of decision makers need to have incentives and developers are a bit part of that. They tend to be short term and they want to build the building as cheaply as possible but they need incentives to invest in seismic resistant buildings – whether that's through insurance companies or whether it's through market value. I think that is the push forward to try and install these better details like I don't think we need to, well in our opinion, we don't think we need to increase the loads or anything like that within the code and we may alter the philosophies slightly and I think the current code probably provides a better, you know, to modern buildings based on the performance of modern buildings that the current code probably satisfies a slightly better philosophy that we've talked about over the last few days so I think local authorities as well need to have a better understanding of some of the newer technology and be accepting of it and I think, you know, rather than it be in the code it's more the detail. We've talked about there might be some cost implications but I think better details and it becoming common practice is the way forward and, you know, involving contractors and engineers and architects in the process in the building design early on can help make a better cost effective building.

JUSTICE COOPER:
What about you Mr Watt? It may be that clients of your firm are sort of self-selected but do you see resistance to better practices, damage limitation practices?

MR WATT:
I might draw a comparison with another aspect of the building which is usually in the news quite a bit as far as sustainability and green technologies as well so there are comparisons between the two. There is a minimum code requirement, say for installing insulation into a building to get you across the line as far as consenting and you'll tend to find developers and short-term investors just want that, but if you're a long-term investor in a property and an asset then you're potentially going to invest more, providing more insulation, more green technologies, high initial capital cost but over the life of a building you're getting great returns on the operational side of the building but again there's no incentive really for a developer to invest in that initial capital. He's unlikely to get that return back when he sells its. There's the green star sort of system that's just come into New Zealand at the moment which ranks how sustainable buildings are which we've worked through with the Civic building particularly and it's relatively newly brought into New Zealand at the time but it had been in Australia for a number years previously and when talking to even developers in Australia as well as institutions what tended to happen is

bringing that level of standard in actually I guess – to use the term – “raise the bar” but even the higher getting six green star in some institutions in civil buildings actually brought the whole housing stock and building stock up as far as sustainability across the board. So even developers were including these in buildings because that’s what tenants desired and wanted and obviously this is starting to get a bit more sort of flow in New Zealand. So potentially it’s not necessarily a code requirement but driven by the market and maybe with these new seismic technologies you can draw parallels. Once you start getting some happening then it lifts the standard across the board and even the developers to compete with more sort of premium buildings need to also lift to the next level as well. As I say, it’s difficult to work out how you can actually put it as far as a code requirement in engineering terms and I’ll leave the others to comment about that but I think there are some parallels on that. If you can start the ball rolling, start getting those high standards then it will tend to bring it up across the board and that’s certainly what we found once we looked at this internationally as far as sustainability.

JUSTICE COOPER:
Mr Hare, do you have a perspective on these issues? You’re here wearing a Society of Structural Engineers’ hat are you or just John Hare?

MR HARE:
Maybe either. I think it’s in general I think that where we can demonstrate that the technologies will actually truly deliver on an objective that we’d set then I think then, yes, why wouldn’t we do it as I think we’ve heard. I think we’ve got to be a little bit circumspect about how we get there though and some of the questions which have been raised in the last few minutes are quite relevant. We’re all people, the practitioners are anyway, people who spend other people’s money. We owe it to them to ask them how we’re spending it and to make sure it’s well understood when we do spend it what we’re going to achieve by doing so.
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I think Trevor has just referred to the fact that buyer power once removed is actually what's going to make a bigger difference to getting things done. If we have tenants who are demanding a higher standard of protection then that may well force the issue but that's got nothing to do with regulation.

I think, another point which I think Commissioner Carter touched on there for a while was the, that, you know where really are we going to make the impact in terms of who's going to use this and who needs chasing up with the regulations. The regulations have always been seen as setting the minimum standard as opposed to setting a higher standard and I think we've got to be very careful that we don't impose a level of cost, because we will be eventually, across the board, we should be looking at where we're going to get the most benefit from, from the additional.

JUSTICE COOPER TO MR HARE:

Q. They've been seen by the engineers and the regulators as setting the minimum standard but have they been seen by others as setting a maximum standard?

A. I think you could say it's a little bit like the speed limit out on the roads. Everyone might think it's 100 but everyone tries to go 110. In this case they probably try to go 90. So everyone's trying to do the absolute minimum they can to get by. If they perceive that every extra bit that they do is going to cost them a lot of money which they won't see a return on. A big handicap for example in seismic retrofit has been quite simply that someone will retrofit a building and potentially spend a lot of money doing so. At the end of it they have the same building and therefore the same ability to get a rental return from it. So unless we can help find a way of making people, allowing people to get better value from that in some way then they won't feel like there's any incentive to do it not in the sense of a Government incentive but just any. And so to stick with the horrible terms of raising the bar as we talk about it I'm not sure whether it should be aimed at the people at the top end, because there are people out there using this technology already as we've seen and doing a very good job of doing so in many cases. At the bottom end would we be better for example to be chasing the tail runners to make sure that we're getting the codes as they stand at the moment well applied because we would get an awful lot of benefit from doing that if we take the observation which has been made several times that those buildings which were well-designed, well-conceived and well-constructed haven't done too badly. People that have the ability to apply new technology will probably do so anyway with or without it appearing in the standards. The main thing there is to make sure that our regulatory environment, rather than enforcing it, doesn't put hurdles in front of it.

JUSTICE COOPER:

Yes did you – Professor Quenneville?

PROFESSOR QUENNEVILLE:

I do have comments Your Honour. I think that the financial advantage of low damage construction which is my definition of raising the bar will be a tangible marketing point for owners and developers and I think that the market will see a movement to this. So a portion of the public, the private sector may want to pay for these features, the load damage. The question may be, asked in a different may, would New Zealand want to impose true regulations that the low damage philosophy be imposed to all and really as John has said the good ones, those who can pay, will probably want to have and make this a selling point for their owners, for their house or for their rental facility. Personally on the regulatory side I would say that design standards have not all kept up with the research and development for whatever reasons. I think that the New Zealand public as a whole is not receiving all the potential benefits so the new information does not reach all engineers and I think that that is one avenue where raising the bar could be, could be done.

JUSTICE COOPER:

We're going to adjourn and resume. So if you could hold that thought. Except we won't be resuming with Professor Bull because he's leaving us.

PROFESSOR BULL:

I'm off to the United States this afternoon. Thank you Sir.

DR CLIFTON:

Justice Cooper.

JUSTICE COOPER TO DR CLIFTON:

Q. Yes.

A. Can I make just one very quick comment?

Q. Yes.

A. We're assuming in here looking from our current viewpoint that the standards will rise and that there will be an impetus long-term for the standards to rise. I think Andrew, Andy Buchanan yesterday showed a very important example of why that is not necessarily so. He showed the New Zealand Government House building I think it was, built in 1870 after the 1848 and 1855 Wellington earthquakes. An excellent earthquake resistant building and yet he made the comment that 30 to 40 years later we were back to building unreinforced masonry. So I don't think that the, necessarily the collective memory and the desire to raise standards will stand the test of time unless we are reminded of that by recurring earthquakes.

Q. Well that's one of the problems isn't it because some of our biggest earthquakes have occurred in Fiordland and places where nobody seemed to care.

JUSTICE COOPER TO PROFESSOR BULL:

Q. But Professor Bull, is there anything you'd like to say before getting on your plane to the United States?

A. Actually there is Sir. There's a couple of points that have been raised this morning. What raising the bar in terms of performance as against cost. Continually conversation seems to err on the side that somehow the public are going to be left with the impression that this is going to cost more and time and time again there's examples saying the premium is actually very, very small. But if we're raising the bar for performance as against raising the bar for cost, Mr Jury's already alluded to it that there, in fact there's two lines of performance. If we have a uniform, singular performance which is somewhere above what we're doing at the moment it's going to be very, very difficult to do this to existing structures and there really needs this, it's a double-barrel question. What should we do moving forward with new buildings and I think it's relatively straightforward to raise the performance bar with very little cost implication to the country. It's what the next question almost, not the elephant in the room but the herd of elephants in the room is what do we do with existing structures?

Q. Yes.

A. And there are two separate levels of performance needing to be teased out of this.

Q. Yes I've been trying to steer this conversation towards the future. I mean we're very conscious of the problems that exist with existing buildings but I think part of the context is actually what you're trying to achieve with your new building stock and then I think you turn back and you see well to what extent can we do that? But first of all you have to have, you have to have a set of aims I think. Well that's the way I see it anyway.

JUSTICE COOPER ADDRESSES HEARING

COMMISSION ADJOURNS: 1.04 PM

COMMISSION RESUMES: 2.02 PM

JUSTICE COOPER:

Unless anybody's thought of something that they want to say, it has occurred to them as inspiration over lunch on the subjects already discussed – is there anyone in that category? Yes, Mr Hare.

MR HARE:

There was the one question, the one matter which I'd forgotten earlier which you told me to hold until after lunch, which was simply a note that if you're looking at where the changes are to be made, or where changes might be most beneficial we spent a lot of time talking about new technology particularly as it applies to the main structure which of course is 20% or 25% of the value of the building, but I think looking at the performance of a lot of the, what happens with the non-structural elements at much lower and therefore more frequently occurring events it's possibly we would actually get the greatest economic return because those are the things that might happen more than once in a lifetime of the building. So not as Mr Jury said. The things that may or may not ever be experienced by a building and so looking at the performance of those and making sure we've got that well thought out would be actually a place where we could probably get a very good economic return for definitely very little expenditure, whether with the existing buildings or otherwise. And I know that Trevor's presentation this morning focussed on just a couple of aspects of that. So I think there's a lot of good return to be made from doing some very, very simple things which are probably just forgotten in the rush as frequently as not.

JUSTICE COOPER:

Yes. Does anybody wish to respond to that?

DR PAMPANIN:

I would like, yes, to confirm that work prior to the earthquake, the New Zealand earthquake, obviously there have been other lessons from the world, the structural elements became a major new task to be addressed from the scientific community before becoming implementation. After these, before these earthquake we got, at University of Canterbury we got research project really looking at ceilings, partitions, façades, how is the state of the art in the world in terms of reducing the damage at the low cost and how we can implement it. Believe it or not there are solutions already available in New Zealand which the industry is not able to enforce because again the client is asking, is that really needed and they would have been avoiding millions and millions of dollars of damage for the occurrence of earthquakes. We have example I can mention because it's well known. The city council buildings in September, Boxing Day and then February and then again June and they were reinstalling partitions in the same exact way because they did not have an idea. So the solutions are there, the industry actually is aware of them but they are not able to enforce it. So that's probably what an enforcement of something which cost basically equal or again information would be fundamental because, yeah, these minor earthquake which are happening every, every once in a while are costing quite a lot to the whole country.

I had one point before which is, I can raise at the same time, there is some kind of perception that we have the freedom in a democracy, excuse me if I play rhetorically, to let people decide what is good for themselves. If as a citizen I'm, I'm affected in my life by someone else property damage then your own safety or load damage concern is becoming a public concern. Let's think about me entering into a shop. Let's think about us now not having anymore a city building, a CBD, so I don't think we can allow private people to take their choice of what is going to be in the long run in the public, the public way, or public benefit and on that probably a little bit of a top-down enforcement would be useful. Talking about before I mentioned something which could have been better correlated to something that New Zealand has been implementing, think about the insulation. The enforcement of double glazing and insulation came down as a top-down. If we were letting people waiting to decide for themselves that would have been appropriate to change something in their own house it would have never happened. Now when we start getting the new buildings right now we have to think that in 30 years time what we are thinking being the best today would be seen as obsolete. People are going to smile. In 30 years time I think that we were not yet able to protect everything in a building. So what we're doing now might be in 30 years time required to be retrofitted. It is quite absurd but it is going to happen with a new thing. The difference between New Zealand and the world is that New Zealand has few major cities and having another major city being hit in the lifetime, in one century again, has an economic impact which is much, much bigger than any other country in the world in a way and so this has to be taken into consideration in terms of policy endorsements because it's quite different.

JUSTICE COOPER TO MR BURGHOUT:

Q. Mr Burghout do you wish to say anything in response to that?

A. The thought that was running through my mind is that while it's not, I can't quite say it, CIC policy, because we haven't discussed it that way –

Q. Yes.

A. – is that for me the code, you could say that the code is about life safety. That's its prime intent and then if you follow that analogy of where people choose to go higher, someone could choose to go higher in terms of other damage avoiding technologies. Again for me it comes down to a good solid debate, what is the code about, what is the minimum the code should set and therefore what is the good, better, best above that and I think you're right, there are some buildings where you wouldn't say it should be a developer's choice. It should be a citizen's choice that says actually if it's a public building here is the level the code has to go to because that's the minimum that we agree it should be at. So like I say, I think there's a balance there to be had somehow.

DR CLIFTON:

Can I make a comment on that?

JUSTICE COOPER:

Yes certainly.

DR CLIFTON:

I think if you look at standard construction and examples of really good, meet recent modern standard construction, we're not that far away from that ideal now. Take one of the buildings I mentioned yesterday. A $40 million building, it's cost $250,000 to bring it back into full service. That's 1% of the building cost. So if we take Andrew Charleson's table this morning that's, that was in the category that he was talking about for the new damage base isolated systems and yet that was a, to be crude a bog standard commercial building. So our current technologies, if things are well-designed, well-detailed, well-built they perform well and some of the systems will perform better than others in terms of their damage threshold but the good systems around now, the good standard systems will deliver the sort of performance we're talking about and it's not – and at a competitive cost.

JUSTICE COOPER:

Yes. Right can I just move to a smaller, it's a related issue in a way because when one thinks of new technologies it's possible to think about a number of impediments to their implementation. One is cost or perception of cost, but the other is the understanding amongst the relevant professions and we haven't had much engagement as the Royal Commission with the architecture profession for one reason or another and what I'd be interested in is the extent to which, perhaps Professor Charleson you're the one that should answer this first – to what extent are architects trained in the techniques available, methodologies available for seismic resistance?

PROFESSOR CHARLESON:

Well in our schools of architecture we have various degrees of time allocated to that subject and it changes. Like for example two years ago at Victoria University the structural content that we taught was cut by over 20% to make room for other material and restructuring in the course. But even then what we teach at Vic is, we teach a lot more structures than is taught in Auckland, Auckland University or Unitech, School of Architecture. So we, we basically, we try and teach the concepts of structure but we're fairly limited in the time the curriculum allows us. You know, because of all the competing pressures, all the knowledge that architects need to know over a wide range of areas. So –

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JUSTICE COOPER:

That's very interesting because we hear the same thing from engineers, don't we Professor Buchanan, and probably you too, that the extent to which structural engineering is taught to engineers is also being squeezed by all the other things the engineers are expected to be knowledgeable about. Does this suggest that if people – be they architects or engineers – are to be the designers of certain kinds of buildings they should have some additional qualifications?

PROFESSOR CHARLESON:

Well I think that's a very difficult one because currently and traditionally there has been this partnership between architect and engineer to realise a building and it is very much a collaborative effort. I mean I personally and I think it would be really interesting for Trevor to make a comment about this because some architects have a very, in my view, adequate structural knowledge and understanding and they are very good collaborators and a very good structural solution is achieved, but other architects, you know, can be quite poor and really have very little understanding. So it's really, but at the end of the day the architect, no matter whether they are competent or not in structures, they have to engage with a structural engineer and it's just so much easier for the more competent architects because they already have been thinking about those issues.

JUSTICE COOPER:

Do you wish to add anything Mr Watt?

MR WATT:

I will have to be careful because Professor Charleson was my lecturer in Victoria.

JUSTICE COOPER:

That explains why your career has been so successful.

MR WATT:

Back 20 odd years ago there was two choices as far as architectural schools in New Zealand. There was the Auckland one and the Victoria one. I guess the perception was that Auckland was slightly more sort of design focused. Whereas Victoria had more sort of a, and also a practical aspect as far as teaching sort of structures. It was sort of compulsory whereas in Auckland it was more an elective. So depending on what school you went to you probably developed a little bit more understanding so as far as our perspective we think it's incredibly important to have a good grounding on how buildings are put together on both the structural perspective and also talking with contractors on constructional aspects as well. So we're not necessarily interested in the numbers or the graphs but really the systems and the impact they have on planning and the other aspects of the building. So to be in a good position to communicate with engineers you need a good grounding on understanding of where they're coming from so that's why it's quite important in those early courses to understand I guess the broad range of what we're talking about without getting into the details. But, to be honest, the graduates coming out are probably not the guys that are making the decisions on what structural system is going into the buildings. It's probably those guys that have been in the industry for a number of years and I guess that's when how do you actually improve your learning on new systems while you're already in the sort of work force and there's probably, it's obviously professional development and the like but it's, I would expect that most architects round the country wouldn't have an understanding of any of these new building technologies that we've been talking about over the last couple of days. It's just the fact that there's not that mechanism there to do it.

JUSTICE COOPER:

Well what's stopping the Institute of Architects and/or IPENZ?

PROFESSOR CHARLESON:

Well I offered a continuing education course for all the architects in New Zealand to help them upgrade their seismic design knowledge and in the last five years I think two people have availed themselves of that course. There's just so many other easier options for architects to get their continuing professional development points and so they are reluctant to engage in something that is a bit harder.

MR BURGHOUT:

You might be turning them down next time you run the course perhaps?

PROFESSOR CHARLESON:

I guess the nature of the profession –

JUSTICE COOPER:

Well the seismic performance of buildings is something that should be a matter for compulsory continuing education. Is there such a thing? I mean I don't know but would people throw up their hands in horror at the idea of compulsory content of continuing education requirements?

PROFESSOR CHARLESON:

I don't think so but it would be unpopular.

JUSTICE COOPER:

Well that's all right. It wouldn't be me that was enforcing it but I mean what would be the logical basis for its unpopularity – just that people would find it irksome? So I take it the architects have compulsory continuing education?

MR WATT:

Yes they do and I guess you have to get a certain amount of points over sort of five years. It was just brought in within the last sort of five, six years and the number of points and the design, documentation, administration and practice, you have to get a certain number of points in those things because I guess the nature of the profession we cover all aspects of a building so from urban design to planning design, construction and the structures, mechanical service is the same. It's good to have an understanding about these things without being experts. So there's a broad range and structures is probably, you know, a small component of that when you're actually coming to design a building but obviously an important component but not the sort of only focus but I think and I guess particularly with Christchurch architects they would be really really keen to understand these new building technologies and I guess the documentation coming out of these sort of forums are going to be incredibly important. We also have an Institute of Architects and local branches and we have been meeting regularly, particularly since February, but I guess our main focus has been on more planning urban design issues, the City Plan and what shape the city is going to take rather than individual building design. So that might be a next step is actually addressing that and getting some of these guys round the table to do it. There has been a number of workshops and just a couple of weeks ago Ian Athfield was involved with Professor Buchanan and a lot of others who presented with the Peterborough Village. That was a group that got a lot of architects and engineers together to look at different structural mechanisms, foundation details which they could implement in that particular area of the town. So that was a day workshop. There was a public presentation evening which was attended by, you know, into the hundreds of people so they packed out so there's certainly a keen public desire for information and I think that will filter back through the sort of architectural community as well but, yeah, exactly what sort of forum that can do but the sooner they continue the educational I think is definitely critical.

UNIDENTIFIED SPEAKER:

I would like to comment on that.

JUSTICE COOPER:

I was going to ask Messrs Jury and Hare from the perspective of their professional engineering organisations what they think of continuing education and seismic awareness.

MR JURY:

I think it's extremely important. The structural engineers who we come in contact with as part of our operation vary widely in their capability in the seismic area and especially in today's circumstances where anybody who says is there anywhere remotely a structural engineer is grabbed and put into all sorts of tasks. It's not a technician's role, so providing a detailed code which allows somebody to work from Step A to Step Z and therefore have a good design come out the end is becoming less and less possible I feel and I think that we are finding some very good people coming out of the Universities who really understand the basics behind good seismic design but there is a whole range of capability and I would say a lot of people at the lower end of understanding.

COMMISSIONER CARTER:

Can I ask a question about the possibility of the peer review process actually becoming also educational in the sense that if a practice is not particularly well experienced in seismic work but is having to cope with it within their design, maybe going through a few peer review procedures would help lift the general capability of practices to understand this. This is a matter that has been talked about to the Commission, the potential for a peer review process to get designs right starting at an early stage in the design process. Is there some comment on that?

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MR HARE:

I think the peer review mechanism has been there for a while obviously, typically in the consenting process, and I think it's not yet achieved, perhaps, the success I think people might hope that it would have. There's been a question about the independence of the peer review process and, I think, at times how thorough it has been. Now I've seen when a peer review is well done it's a good process for both parties, both potentially learn from it and both potentially benefit from it. But it has not necessarily gained quite the attraction it needs to yet for it to be that process all the time. So I think as a means of training people I think it certainly has a lot of benefit and obviously it's really just at a much grander scale exactly what happens in any case in a practice for a young engineer who will start out and have their work looked at by a more senior experienced person. To get it successfully imposed in the regulatory environment as part of the consenting process I think we have to look a little more closely at how it's implemented to make it a effective. At the moment I think it's not necessarily achieving success.

COMMISSIONER CARTER TO MR HARE:

Q. Do you think it can be done if we do it better?

A. I think in practical terms, I think because of the devolution of the Building Consent Authorities as having the expertise to review the work properly I think it's almost inevitable that we have to go to that process and the trick will be to find the means of making sure that the appropriate reviewers are identified that can actually apply effective review as opposed to someone who can just rubber stamp.

JUSTICE COOPER:

Professor Buchanan.

PROFESSOR BUCHANAN:

Yes I want to go back to the education for a minute but I agree we get involved sometimes in peer reviewing but, and I can see there's a real difficulty peer reviewing and it really, when I was a young engineer just to get a building consent from the territorial authority, it was a very thorough

assessment that went on and that thorough, the territorial authorities don't have the capability now to do that and so more jobs go out to peer reviews that I suspect a poor peer review is pretty much not much use at all.
But I just want to go back to the educational side of things just wearing my hat as Professor at the University of Canterbury. We are well aware of the fact that Justice Cooper mentioned the fact that the structural engineering content at the University has shrunk and shrunk over the years as we've brought in more and more important things – environmental engineering and transport engineering and all these things which form part of a civil engineering degree – and suddenly this has all become very apparent after the earthquakes and we at Canterbury are certainly going to do something about this. So we're talking about establishing a Masters degree in Earthquake Engineering, a degree of Master of Engineering Studies in Earthquake Engineering. We're talking about putting on block courses, of course we'll work with the profession, we'll work with IPENZ and the Earthquake Society and SESOC because we realise it's not just a matter of getting more, giving a better structural engineering, bigger content to the existing students we have to be able to provide a service to those existing people and, for example, there are two young gentlemen at the back of the room who have decided to come back and do a Masters degree in Earthquake Engineering after graduating last year and there will be more and more people doing that. At the same time we need to be able to make sure that the educational offerings we give are suitable for the profession. The profession are recruiting engineers from England and America and places where they've got a very good background in structural engineering but not earthquake engineering and so there's a whole upskilling that needs to be done and we certainly will be part of that.

JUSTICE COOPER:

All right, thank you. Well we haven't got terribly much more time have we, Mr Mills, for this session.

MR MILLS:

Well I don't want to cut this short because it's a rare opportunity as you've heard to get this kind of collective group together. I think you should take whatever time you think is useful and I'll accommodate it somehow.

JUSTICE COOPER:

Yes, all right. Well can I just say to round off what Professor Buchanan was saying we've actually got a session planned later in the year which will focus on this very question but when you're talking about the acceptability of new technologies and working out the obvious that their implementation depends on knowledge about them it does raise the issue of how that knowledge is to be disseminated.

PROFESSOR BUCHANAN:

Yes I think I'd make the point here that it's all very well having new technology but we don't want people just to think that they have new technology. I mean the engineers who should be using the new technology are the people who are at the top of the game in existing technology.

MR JURY:

If I could make another comment. We don't want to employ professional engineers who are technicians. We want them to be thinking about what are the principles they're trying to follow and go looking for the codes to see what might be an appropriate way to deal with that. Technicians who just use the codes and come up with a good structure invariably miss the obvious.

PROFESSOR BUCHANAN:

I think, Rob, your colleague, Richard Sharpe, said on Monday that good structural engineering is an art as much as a science and I think this is something that has to be put across because all the buildings that we've seen, new buildings and existing buildings, damaged buildings, they are so different. There's no way that you can have a cookbook for the design of these buildings. If people are going to design a building which works, and I'm not only talking about earthquake engineering I'm talking about all the architectural services and the building services. If the building's going to work it requires very bright young people who understand the way that a building works so that they can then interpret guidance documents and standards to put it into practice. But I'm just reinforcing the point here that these are not technicians. Of course we need standards and we haven't heard enough about standards I don't think because they're needed too and we do need to set the bar somewhere but providing a resilient stock of buildings in this country is not about where we set the bar it's about educating bright young people and giving them a challenge and giving them the opportunities to learn and implement what is really a multi-disciplinary field in a way that the general public really have no idea.

JUSTICE COOPER TO PROFESSOR BUCHANAN:

Q. When you say we haven't heard enough about standards what in particular, what's the point your making there?

A. Well my point simply was we talked a lot about raising the bar but one or two people have alluded to this that when we, if people are going to use existing technology or new technology we do have to have some guidelines and some rules. I hesitate to use the word 'rules' because it's really guidelines or some standard procedures for making those things so that we have a uniformity across the country between different practices and what we tend to rely on is we tend to rely on New Zealand standards. We've heard a lot about New Zealand Standard 1170 Part 5, which is the earthquake standard, and in order to use that to design a building we have New Zealand Standard 30101, the concrete standard; 3404, the steel standard; 3604 or 3603 the timber standard; and some of these standards are very out of date and there's a real, and many of the people around this table have been involved in updating those standards but there is little or no government money that goes into the funding of those standards and that's a real issue that's going to have to be discussed at some time.

Q. Yes we're aware of that too and we intend to reach that issue in the course of the year. But it raises another issue which I, just given the focus of this session, do you see provision for the new technologies that we've been discussing being made through the existing standards or is there some updated as may be appropriate or should there be new standards altogether which confront this…

A. Well I think that's relatively easily answered. We, in New Zealand we have a performance-based building controlled environment and that allows a number of different approaches to designing a building and at its simplest level we have an acceptable solution or a designer can offer an alternative solution and it's a modern system and, in general, it works well and what that means is that if an engineer comes up with some new system of designing a building or some new materials there's nothing stopping them from using that, they would just have to offer an alternative solution which the territorial authority would accept provided that they agree that on reasonable grounds this meets the performance requirements of the building code.

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Q. But isn't that in itself something which might for some appear to be an impediment to the adoption of new standards because it seems to me that that means that every time you want to advance a proposal which doesn't confirm to what is the standard way of doing things you have an ad hoc, each time you have to convince consent authorities this is –

A. Yes, precisely, so what's happened, Dr Pampanin explained yesterday, what's happened in the concrete code, we have appendix B, the New Zealand Standard 3101 which is an appendix which gives the design rules for the PRESSS system technology to be used and so what's going to happen the way I see it is that we're going to have lots of good engineers with good ideas and these are going to be brought into the marketplace through the alternative solution and as these are adopted, as they catch on, then right behind that we need to have the facility to update the standards, to standardise these procedures and what was once a new idea will become standardised and next week there'll be a new clever idea.

Q. I suppose I'm, well next week, what I, I suppose what I'm asking in terms of the things that we've addressed this week, would they be facilitated by a new standard now or new provisions in the standards now? Are we in the position where new standards could and ought to be written for the new technologies?
A. The short answer is, yes, we are in that position.

JUSTICE COOPER TO DR CLIFTON:
Q. Dr Clifton what do you think?
A. In part we're in that position. Equally documents that are produced by reputable organisations, organisations that are known from their track record to be reputable to the industry, if they produce documents that outline the detailed steps for implementing these provisions that's just as good as being in the standard effectively.
Q. It may be just as good but is it as acceptable to the consent authorities?
A. Yes.
Q. You don't see any difficulties.
A. It, typically yes it is.
Q. Typically is it?
A. Yes.
Q. Is that, does anybody differ with that?

MR JURY:
I'd just make a comment that most of the examples we've seen over the last couple of days, of New Zealand design examples, have been in that regime. So councils have been prepared to accept the evidence of an alternative solution in order to put that in.

JUSTICE COOPER TO MR JURY:

Q. Yes I suppose I'm wondering whether there are other buildings that would have been built were it not for the perception that it might be difficult to push them through the system?

A. My experience is that it's not too difficult. I think John Hare made the comment about peer review. Typically a local authority, territorial authority would require a peer review of those alternative designs and provided that that is done well and quite often it is not, I agree with John, but provided that is done well the territorial authority has a lot of confidence then to allow that to proceed through the current processes and it's not a difficult process. It generally requires discussion right from the concept phase and they're very, I know we do a lot of work with Wellington City and they're very receptive to early discussions and continual discussions during the design process in order to facilitate this type of thing going through.

JUSTICE COOPER TO MR BURGHOUT:

Q. Pieter?

A. The way the Construction Industry Council's discussed this so far as being, we think the code should remain full performance based. I think is that, is that what Andy said and underneath that you'll find the different mix of documents that help support your consent application, be it a standard, conforming with a standard, be it best practise documentation or be it another mix of vehicles. The thing that we've been most concerned about is that the standards portfolio has been declining in age. If we want to have a vibrant building industry we need to have a modern dynamic suite of standards. We're not seeing that. It's being declining quite rapidly over the last few years and it's something that we've been quite worried about that if New Zealand Inc. wants to have a dynamic building industry it needs to have a dynamic suite of standards underpinning it.

Q. So let's just assume to play the devil's advocate that there's no more Government money.

A. Yep.

Q. What's the answer then?

A. The CIC has been discussing some ways. There are some self-funding opportunities that we think about but nonetheless if you think about some of the standards we're talking about they are huge New Zealand Inc. standards and in my view they should be funded by the Government. You can't do some of this work without good Government money underpinning some of the standards that we've been talking about. They deserve to be funded nationally and supported properly.

DR CLIFTON:

Can I comment? I wholeheartedly endorse that. I think the implication if you don't have a good set of modern kept-up-to date standards you will still get the very good buildings. They will continue to be built. The spread of quality will get wider and wider and the tail end will get lower and lower.

JUSTICE COOPER:

Does anybody have a different view?

MR JURY:

Just another comment really that our, the way we put our standards together it is a consensus process and therefore it involves an awful lot of people, certainly for the big standards. So it's a very expensive exercise in terms of man hours, typically. Whether that should be funded or the funding should be spread I think is a good point to discuss. I think things would happen quicker if it was funded.

DR PAMPANIN:

If I can add something by experience of how for some people just very recently after the earthquake they asked how long, how come city took so long to have PRESSS technology implemented in New Zealand and the reaction is actually it was quite fast. Typically it takes 30 years from when something has been developed in the construction industry to when it is applied. The standard, I totally agree with all the colleagues, in particular with

Rob Jury, saying that we can't think the standard being an encyclopaedic were engineered without the knowhow is going to learn the ropes to make something happen. So very often the non-existence of the standard has been used by many people in many country as an excuse to not implement something that they didn't know. If we go back to the route, to the basic route to make it happen is really education and you could not believe how easy it is for younger engineers. Let me make the example of, we do think that the training, two different way of training. The continuous education is basically a senior type. Senior engineers coming over and listening to a movie in a way, a performance, not having to do any exercise. They go back to their daily job. There's absolutely no motivation to get onto the lecture notes if you wished it had been given. So after a couple of weeks it is business back as usual and New Zealand and unfortunately the problem of having a booming economy forcing to not change what the people were able to do. Now you get a new engineer coming from education and you enforce that engineer to what we say is (inaudible 14:39:23) properly during the training at university. They're going to learn the ropes because they're obliged and then they would not care whether the code is an encyclopaedia or not because they will know where to go and find the documents and how to treat the quality control of that documents, to be not technicians but to be the assistant of these people who in the past had been trained much better in a way than what we are able to do so far. Let me just give you an idea of what the trend is in the world. In the world there are courses, Washington (inaudible 2:39:53) agreement, engineers are coming out after a five years degree. The Bachelor at Canterbury University is an exception of four, I will call it four plus, or a five minus, is not a five. So trying to squeeze in something you would not probably imagine that we're not teaching a seismic assessment retrofit. So hundreds and hundreds of engineers who have been trained in the last few years in this country who were supposed to be repairing and strengthening buildings did not have anything at university. They had to wait to enter into the consulting office to be mentored on something that they did not, they were not taught properly. Now that mentoring can happen if you are not a busy office. If you are a very good, busy office which is running a lot of work so you're not having the time to take the senior engineer's mentoring so the Master of Engineering that we're introducing as a fifth year is basically following the trend internationally where, not for new technology but for basics we must teach upfront and not waiting for people to catch up in 10 years time with the basics, the consultants that will require these people to be able to master.

JUSTICE COOPER:

Well there's just one or two questions that I think you wish to pursue Commissioner Fenwick.

COMMISSIONER FENWICK:

Well these are very much in detail so it's very different from the sort of questions you were asking (inaudible 14:41:16 - overtalking).

JUSTICE COOPER:

Yes I know. But I think we'll have to bring the session to an end in due course. So you did have a couple of questions you wanted to pursue didn't you?

COMMISSIONER FENWICK:

They will be quick, but the friction damping where you clamp the plates together. If I look at the illustration put on for us you can see the bolts, when it slides the bolts move and they put into bending. Now those bolts are in high tension. Now what worries me is, theoretically I'd say, if they're in tension they're going to be distorted by that amount, they're going to yield and flexure which means that they must, because they're in tension they must get longer each time. So I'm wondering, I know that they work quite well but I cannot see theoretically how they can work so can someone who is familiar with the sliding arrangement tell me what's wrong. I mean I can see that the bolts don't move. It's just a straight clamping force and they are held rigidly but with the sheet that you use for the timber at any rate and I'm not sure whether

Clifton's one had it or not, I cannot see how physically it can work. So if someone can explain that.
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DR CLIFTON:

There are two – there's the asymmetric friction component or slider and the symmetric friction slider. The asymmetric one is the one that puts the bolts into double curvature and so when you fully tension a bolt you tension that into the plastic range. When the bolt starts to slide it then goes into a combination of shear bending and tension and that combination causes it to lose some of the initial installed bolt tension and as it starts to slide it then reaches a stable tension sliding state where the axial force in the bolt remains constant as it slides and so the sliding capacity is generated at that stable sliding state and when we originally developed the concept, I developed the first bolt model for that which has been shown to be a good lower bound from some 95 experimental tests now. My conceptual thinking was that the bolt did lengthen. Last year I had one of my PhD students actually monitor the bolt lengths throughout the tests and in fact the bolts shorten. What happens is that when the surfaces slide together if you like the surfaces are, to our naked eye, smooth but in reality at a sort of surface level they are quite rough and as they slide together the peaks get scraped off and the surfaces slightly compress and the bolts actually end up about .03 to .04 of a millimetre shorter at the end of the sliding than they have at the beginning and that's the principal way that they lose the installed bolt tension.

COMMISSIONER FENWICK TO DR CLIFTON:

Q. So they do lose some tension?

A. They do lose some tension.

Q. And there must then be some limit in the sliding before they lose a lot more tension then?

A. They tend to, on the first full cycle they tend to lose about 90 percent of the tension that they are going to lose and on the second cycle they lose a bit more. What happens is that the first surface starts to slide, the bolt has an installed tension, the first surface starts to slide and they lose probably 50 or 60 percent of the tension between then and the second surface starting to slide, then they remain stable in that direction. As they come back again they go back past the initial straight position and then start to slide the other way and they lose another 10 percent to 15 percent maximum tension on the first cycle and from then on in they just cycle back and forth at the same level of tension. So the surprise, there have been a couple of surprises – one was that in fact the bolt shortened rather than lengthened which was quite a surprise. We were expecting a lengthening by about the same amount that we see shortening and the second one is that there is a bolt size effect that we've found in detailed testing. We've tested 16mm, 16/20, 24/30 millimetre bolts and the module assumes that the bolt is going to double curvature. On the smallest diameter ones you can actually physically see that happen. They tend to lose more installed bolt tension than the 20 and 24mm and those two sizes are the perfect sizes for that connection. The 30mm ones don't perform quite as well but we suspect that that's probably because we didn't have the equipment to actually fully tension them in the first place because one of these bolts, they're only a 20mm diameter bolt but the tension force when you clamp one of those up is the equivalent to 20 tonnes so if you have one of those simple connections that Pierre showed today before it starts to slide it has a clamping force across all those components that's over 100 tonnes and during the sliding you'll lose 60–70 percent, sorry you'll lose 30–40 percent of that and so you'll come down to about 60 percent of the original installed bolt tension and that's the condition under which they're assessed for design and the reason that you don't get a very high overstrength at the beginning is that because they slide first on one surface and then on the other they don't reach a very high peak and then drop because the sliding capacity is from both surfaces sliding and the sliding capacity of the first surface initially is not double the stable sliding capacity so they don't reach a peak and drop back, they actually climb up to their plateau and then stay there.

COMMISSIONER FENWICK

Thank you. The second point I have is more in connection with the sliding and the timber. When it slides up it seemed to go predominantly in one direction which I assume is up for the sliding, I don't know but, then that whole stick of timber on your wall of course goes up and it will pick up the axial load from the roof or the floor above or possibly several floors above which will of course attract axial load to that and tend to pull it down. How do you release it so it's not picking up a lot of surface axial load from all the other structural elements which aren't so trying to lift up.

PROFESSOR QUENNEVILLE:

(inaudible 14:47:47) design of shear walls or CLT shear walls do take into account the component of any live load or permanent load in the structure and this is something that needs to be looked at in a bit more detail at this point to make sure that when it goes up that we take the extra component into account.

COMMISSIONER FENWICK TO PROFESSOR QUENNEVILLE:

Q. That's been a major problem in structural walls where you do your analysis and you find you've got one axial load. In practice when you allow for that you suddenly find the axial load picks up a very large portion of the gravity load which was previously travelling down columns or other walls which were not being bent in the same direction so I imagine it's going to be a major issue in timber as well as...
A. I think that we're going to mechanism and it's probably feasible to decouple this and then avoid this issue that you're talking about.
Q. Yes, so the wall can actually move past.
A. Yes.

JUSTICE COOPER

This will conclude the panel discussion. I would like to thank you one and all for your contributions of thought and time. I must say as a non engineer, and today I should say a non architect, I am struck time and again by the altruism that the engineering profession shows towards its fellow citizens, contribution to voluntary work of all sorts before and after earthquakes is something of which the profession should be proud so thank you all.

COMMISSION ADJOURNS: 2.50 PM

COMMISSION RESUMES: 2.54 PM

MR MILLS:

Well we're now at the last segment of this hearing and as you know this is entitled Professional and Regulatory Implementation and in this we're going to hear from, initially from the Department of Building and Housing, we've got David Kelly and Peter Thorby and then there's John Hare again representing SESOC, Rob Jury for the New Zealand Society of Earthquake Engineers and Nicki Crauford from IPENZ. So do you want people to be sworn in.

JUSTICE COOPER:

Yes, well we generally have haven't we.

MR MILLS:

Yes.

JUSTICE COOPER:

Well we can just do it by way of a general affirmation probably.

MR MILLS:

That would be easier.

JUSTICE COOPER:

Perhaps, first of all, Mr Thorby could you just tell us your full name.

MR THORBY:

Peter Neil Thorby.

JUSTICE COOPER:

Peter Neil Thorby. Mr David –

MR KELLY:

Anthony Kelly.

JUSTICE COOPER:

Anthony Kelly. John Hare we know. Rob Jury we know. Ms Crauford your full name is?

MS CRAUFORD:

Nicola Laing Crauford.

JUSTICE COOPER:

Thank you. Do you all solemnly and sincerely and truly declare and affirm that the evidence you give to the Commission will be the truth, the whole truth and nothing but the truth.

PETER THORBY, DAVID KELLY, JOHN HARE, ROB JURY & NICKI CRAUFORD – YES.

MR MILLS:

Well now there's absolutely nothing for me to do so I'm going to sit down and we'll hear first from the Department.

JUSTICE COOPER:

Well who's, are you going to start Mr Kelly.

MR KELLY:

Thank you, Sir. What I thought might be useful is –

JUSTICE COOPER:

Can I say I'm sorry you've had a wait, we were reluctant to cut that last session short prematurely.

MR KELLY:

Thank you, Sir, it was actually very useful to listen to some of that and I think some of the content is quite consistent with what we're going to talk about briefly. What we thought might be useful is just to take you through a little bit of the current regulatory framework, particularly as it relates to innovation, talk a little bit about not just the theoretical framework but the perceived obstacles to innovation and some of the work that the Department's been doing as a result of government decisions in 2010 to try and address some of those obstacles within a more of a systemic way rather than just looking at innovation on its own.

JUSTICE COOPER:
This is before there was an earthquake in Christchurch.

MR KELLY:
It was, and the earthquake, of course, has informed our thinking even more, confirmed some things and probably changed our thinking. We all know the severity of the earthquake, the degree of shaking, of ground accelerations both vertical and horizontal, and it's, again, the reason for saying this is not to go over old ground but most buildings from our observations and from the feedback we've had from the engineering community that were built after 1995 performed acceptably and I think it was one of the previous panel members said that buildings that have been well designed, well detailed, well constructed have performed pretty well in general. So I think that's an important starting point.
The framework starts with the Building Act and the purpose of the Building Act include regulating building work and setting performance standards and we'll detail that a bit more, particularly ensuring that people can use buildings safely and that buildings have attributes that contribute to people's health and wellbeing. But one of the principles of the Act which is important to note is that it does allow for continuing innovation, or at least that's the principle, is that it is meant to allow for continuing innovation in building design and construction and, in addition to that, issues of durability are important and the importance of standards of design and building construction need to be in compliance with the building code. So that's a general framework.

New Zealand does have a long history of innovation in earthquake engineering and you've heard earlier this week about base isolators, reinforced concrete design and New Zealand led the world in that and particularly out of Canterbury University in the 1970s and '80s. Multi-storey wooden buildings. So we do actually have a long history of innovation in New Zealand and we've learned from others' experience and ensured that this is incorporated into building performance expectations and the construction methods. So that's the history of it.

What I'd like to do is just hand over to Mr Thorby to take you through the current regulatory framework and then I'll come back to what we're doing to try and advance that and improve on that.

MR THORBY:

Thank you. I'd just like to run through a few points around the current framework and explain a little bit perhaps and just talk about some of the barriers that we do see to it in practice and then today we'll talk about what we're going to do in the future.

So the Building Code is performance-based and outcome-based and this is quite different from many building codes around the world which are prestrictive. They prescribe how to do work rather than the New Zealand Building Code which describes the outcome that is required to be achieved. We're not unique in the world in doing that. There are other countries, such as Australia, the United Kingdom, in particular Japan to some extent, have followed the lead that New Zealand established in the early 1990s when New Zealand was probably the second country in the world to put in place a performance-based building code. I guess the challenge that we currently have, and I'll talk a little bit more about that later on, is that we're now moving into a second generation of performance-based building codes to address some of the acknowledged shortcomings that we currently have. There are checks and balances to ensure safe innovation. One of the benefits of a performance-based code is that innovation is facilitated within the framework. One of the detractions of a prescriptive building code is that innovation is stifled by that very prescription that's in the code. So whilst we recognise and we acknowledge that there are issues in practice, and we've heard of some, we recognise that the experience of some in getting innovation implemented in practice has met some obstacles and we've heard a little bit about risk aversion by building consent authorities but I must say, encouragingly and hearteningly, I've also heard many people in the last two or three days acknowledge that alternative solutions have been well accepted by building consent authorities so, I guess, there's been uneven experience in practice around that.

JUSTICE COOPER TO MR THORBY:

Q. So the principle means by which the current regime facilitates innovation is by means of the 'alternative means' route.

A. Yes it does and I'll give some examples of how that mechanism actually works in just a moment. We also, I think, would acknowledge that there is a need for, I guess, enhanced capability of some building practitioners and that practitioners are not even in their expertise and their application or their ability to adapt and adopt new technologies so there is, I guess, some experience around that.

We do know, and we have heard, that there is risk-averse behaviour by some building consent authorities and I think it's no secret that that is largely, if not entirely been driven, by the experience around weather-tightness issues over the last decade which, I guess, I'd make an observation that is an example of innovation that perhaps wasn't carried forward in a very safe and practical way. So there are some risks around innovation in a performance-based code. There's also, in my view and many views, a lack of understanding of what the system actually is and particularly how the performance-based building code works in practice. I'd just like now to bring up another diagram that's been presented in the information. I'd just like to take people through this diagram.

1504

The Building Act, as Mr Kelly has pointed out, establishes the framework, the legislative framework, for building controls and building standards in New Zealand and section 3 of that Act sets out the purpose of the Act and those are the four bullet points in the blue box at the top which is, in paraphrase, the health and safety of occupants, the physical independence and well-being of people in buildings, the ability to escape from fire in a building, and promoting sustainable development. So those are the four parts of the purpose of the Building Act and the reason I am highlighting this is to draw your attention to the comments that I've been hearing over the last few days around a desire, and I can understand the desire, to, to minimise damage in buildings. But in fact the Building Act doesn't, and through its purpose, drive one to do that in the Building Code as it stands at the moment. So the Building Code, the red box in the centre of the diagram there, is a regulation that is made under the Building Act and it specifies the function requirements and performance criteria for buildings. It's setting up the performance standards for buildings if you like and being a regulation it is agreed by cabinet. The Building Act as an Act of course is a statement of public policy passed by Parliament.

The next tier down in the system are two types of documents, verification methods and acceptable solutions, and those are documents that are issued by the Department. They are in some respect a tertiary legislation. The procedures around developing these documents is prescribed in the Building Act in terms of requirements to consult and there are two types. The reason that they are tertiary legislation is that if a building consent is applied for following either a verification or an acceptable solution the building consent authority is obliged to issue a building consent. So whilst it's not mandatory to follow one of those methods or acceptable solutions it is mandatory for a building consent to be issued if that pathway is followed. The reason, the difference between an acceptable solution and a verification method is this. An acceptable solution is a prescribed way of doing construction. It is a prescriptive method of doing a, doing a building, building work. The verification method is a detailed method of doing a specific design. So a lot of the comments we've heard so far about 1170 and the method of doing design is a verification method. It doesn't tell you how to build. It tells you how to do the design calculations and some of the numbers to use in that process.

Outside of that green box is an orange box and a yellow box. Under the Building Act the Chief Executive of the Department is able to issue guidance, section 175 guidance and, and I loosely describe that as a sort of guidance that you get from your mother – you ignore it at your peril. That's a very loose, loose description. The purpose of that is a highly considered set of guidance from the Department around almost any matter the Department may choose but it is often a tool that we can use to inform the sector, designers and others, around good practice without putting it into the constraints or confines of the verification method or acceptable solution.

I'd also like to refer to the two blue, light blue boxes at the bottom. One called standards and one called industry codes of practice. We have the ability to incorporate within a verification method or an acceptable solution other material and we can incorporate by reference and that is the method by which many New Zealand standards and other national standards are incorporated into the framework. A standard has no legal standing within this regulatory framework unless it is incorporated by reference into our compliance document or our verification methods.

Q. Is this what you call sighting?

A. Yes, yes. There are many standards that aren't referenced. They are outside of the reference process but they are still very useful information for designers to use. So the yellow rectangle is, is that whole domain of other information that designers and others can use to support their decisions about alternative solutions. The design methods they want to introduce use many of the methods that have been described by us in two or three days around innovative techniques would sit out in this area. They still need to be maybe tested and practised and there are various ways by which that is tested before, or even, it's not even necessary for it to be incorporated by reference into, into our systems.

So returning now to the previous slide that I had up before. Many, many designers are focussed on, on clients' documents including standards where there are alternatives. Many BCAs, if the building consent authorities, if there was not an acceptable solution they are risk adverse about an alternative solution. We also know that many standards are not readily accessible to the designers who want to use them. There is also a lack of available skills and resources to test, apply and peer review application of innovation and we've heard I think John Hare before talked, or Rod Jury talk about the peer review process and in some cases the difficulty of getting a sound peer review particularly around innovation. We've heard others earlier on also talk about a lack of training across the sector in terms of design and engineering and in fact building officials. In many cases there is insufficient research to support innovation before it is safely taken up in the construction process and for many types of, particularly large structural systems New Zealand may not have the infrastructure to actually robustly test some innovation before it can be put safely into practice. So these are some perceived obstacles to innovation quite apart from the cost arguments.

As always there are checks and balances to ensure that innovation is safe and the test is that at a minimum all building work must comply with the code. The building consent authorities establish compliance with the code on the basis of having reasonable grounds to issue that consent. It needs to have reasonable grounds that it does comply with the code and it is complying with the code and not a verification method or an acceptable solution that the test has applied to. A process for developing a verification method or a compliance document is robust and it is prescribed in the Building Act. We are obliged to consult publicly on proposals to make or amend a verification method or a compliance document and we consult widely before we issue that compliance document. Product Certification is another method by which innovation particularly around products as opposed to systems or philosophies of design is able to be supported by as manufacturer who has an innovative product and the Department also has a semi-traditional role in issuing a determination which is the consideration of a dispute between as party to a building consent and a refusal or otherwise to grant a consent. So often an innovative solution may be challenged or not accepted at the time of consenting and there is a semi-judicial route there to –

Q. Does that happen?

A. Yes it does happen.

Q. Because I'm aware of people sort of wanting to build buildings in places they shouldn't and that sort of issue that goes off down that route but is it happening, is it a resort for people who say, well I want to do this particular design this way and I've been turned down so give me a building consent please.

A. Yes and as I understand it we might have four or five a year that are based on a truly innovative system as opposed to a more administrative dispute around issuing consent.

Q. And what's the success rate then?

A. Look I can't answer that, I can't answer that question.

MR KELLY:

We could find that out during the break possibly.

JUSTICE COOPER:

Well in due course it would be interesting because if the answer is, well, they were all turned down it sort of puts your evidence in a different light.

MR KELLY:

Yes.

MR THORBY:

I think our approach to that is to test it robustly but with a view to making success rather than it being a barrier. So determination is a route to assurance of innovation but –

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JUSTICE COOPER:

But in due course I'd still like to see the figures.

MR THORBY:

So the department in this process has no role in endorsing a particular product or a building system. The problem is agnostic as to those things. It is responsible for the standards of buildings not the means by which these are achieved. We have set up the product certification scheme but we are not the decision maker in that scheme. We are responsible for setting up the body that does the issuing of certificates. As others have noted also though successful innovation requires more than a good idea. It needs to be able to be implemented in practice. It needs to be taken up by the sector and it needs to be supported by robust evidence of compliance with the code and that it lasts, that it's not a five minute wonder or a 10 year durability problem for example. Safe innovation is possible without changes to the code or the building regulation. We would assert that the current system is flexible to enable innovation.

So, as I said before, the Building Code is performance based. Solutions that comply with the code are in compliance documents or, should I say, acceptable solutions (inaudible 15:15:45) methods but they are not mandatory. There are alternatives to the verification method or acceptable solution route and these are called 'alternative solutions'. Often the term 'alternative solution' is misused to describe a route other than an acceptable solution but in fact a method by a specific design using a verification method is not an alternative solution. It is an approved method of doing a design and that is a common misunderstanding in the language that's used around the sector. As I said before a building central authority must accept it is compliant for building consent a design that follows a verification method or acceptable solution. Where this is not followed then there needs to be robust evidence put forward by the applicant that the design does comply with the code and I'd make the observation that in some cases that is not well understood and certainly not well carried out by the design professionals who are supporting a building consent application.

I think we have covered the material in this slide pretty well already and I'll move straight through to –

We've certainly seen some magnificent examples of the application of innovative construction over the last three days and I certainly don't intend to try to upstage any of that. There's been many examples that demonstrate that innovation can be implemented in practice and has been implemented in practice. For systems that were developed before 1990 and others that have been done and implemented since 1990. I'll refer to 1990 because that is when the performance based Building Code was first introduced in New Zealand and is a rather I think significant date for New Zealand's building controls framework.

As part of our regular work programme the code and compliance documents by which I mean the verification methods and the technical solutions are constantly kept in review. The Government for example has just approved extensive changes to the fire provisions of the Building Code. The department has started a review of the code clause for structure to make requirements clear and more specific and we have had a lot of feedback through consultation processes over the last four or five years that have highlighted to us that one of the difficulties with the current Building Code has been the lack of specificity and clarity in what those performance requirements actually are. I said before that we were moving into what I call a second generation of performance based Building Code where those performance requirements are a lot more specific as a performance requirement still. They are not prescriptive requirement. They are a clear statement of performance and the intent of that is to ensure that designers can be very clear about what the target is, what the bar is when they come to do their design – whether it be by way of an approved method through a verification method or whether it is by way of an alternative solution. There is clarity in the outcome if you like, the target.

JUSTICE COOPER TO MR THORBY:

Q. I suppose if you make requirements more and more specific you'd end up with a prescriptive system, wouldn't you? You're not talking a different in kind here are we between...?

A. I make a very clear distinction between being specific about the outcome that is being intended and being prescriptive about how to achieve something or what to do so perhaps by way of example the current Building Code in many of its performance requirements simply talks about adequate and reasonable as the descriptor of intended outcome and there is no clarity around what is meant by 'adequate' or 'reasonable'.

Q. What does it say about buildings being erected so as to resist earthquakes? Does it specifically...?

A. What it doesn't do is describe under what circumstances it needs to resist earthquakes, the size of earthquake it needs to resist or the nature of the damage that can be sustained as a result.

MR KELLY:

I think just to clarify, within the Building Code itself the performance measures are not specific. They tend to be reflected in supporting documents and we'll talk in a moment of what we are proposing is that at that code level it should be clear because they are policy decisions. They are not technical decisions, so for instance designing for a one in 500 year earthquake should be specifically decided as a policy decision informed by technical information.

JUSTICE COOPER:

The point I was trying to make was that the further you go along that route the more prescriptive your regulatory regime is becoming. I don't know whether there's a bright line between having a prescriptive code and making requirements more specific to adopt the language that you're adopting in this slide.

MR KELLY:

I think what we're trying to say it's not so much being prescriptive in the code but being clear about quantifying the performance level, the minimum performance level.

MR THORBY:

And being clear about the outcome that is intended to be achieved.

JUSTICE COOPER:

So it's the outcome rather than how you get there?

MR KELLY AND MR THORBY:

Yes, yes.

MR THORBY:

Yes, it's being clear about the target not the means by which it is achieved.

JUSTICE COOPER:

It's the required outcomes, is that right? That's the idea you're conveying here?

MR THORBY:

Yes. And there is nothing in the code that prevents construction above the code minima.

I think we've heard comments earlier on in the last couple of days about some owners choosing to build to greater than code for a number of reasons to meet their business objectives or investment objectives.

So finally, the work that we are doing, we have started on the structure clause B1 for the Building Code and that is to clarify the performance requirements to be a bit more specific about the intended outcomes to be achieved and along

with that consideration of the associated verification method so we do need to, and we are, considering the implication of what a change in the Building Code itself might mean with respect to some of the referenced standards such as 1170 and some of the material standards that others have referred to, NZS3101, the concrete one, the timber one, 3603, and steel NZS3404.
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So one of the implications of looking at the top of the pile is what is the implication for those other documents that are part of that same system.
Clearly the industry has a key role to play in the development of good practice guidelines and input into the technical solutions that are there for the industry to use. A further bit of work that the Department is working on – and I think Mr Kelly's going to talk about this a bit further shortly – is developing an alternative pathway for the assessment of innovative approaches and I think at that point I'll hand over back to Dave.

MR KELLY:
So just briefly talking about some of the work that the Department has underway to try and address some of the obstacles. The number 3 Building Act which was passed into law and assented earlier this week allows for risk-based consenting. Now that's a model where rather than what's been seen as a one-size-fits-all approach to consents it would look at the degree of risk involved. I think very relevant for the Commission is that a specific area here is around the commercial consenting and developing a much more robust process around the quality management of the design and the previous panel talked about the peer review for instance.
The second point there – the Department's expert panel that was looking across the investigation into the four major buildings including the CTV and Pyne Gould, one of their recommendations was to progress the idea of design features reports. So that's something that would look at the critical assumptions and design philosophy early in the piece rather than waiting for a peer review towards the end. Certainly I've heard comment from some engineers who say apart from the fact that the peer review process at the moment is inconsistent and sometimes patchy it often happens at the end of

the process and that potentially sets up a natural resistance to go back and really clearly look at the design assumptions. So that's something we think is an important element, perhaps, of a more robust process and the Department will be looking to work with industry to develop that so that it becomes a standard way of doing things.

The third point there is looking at options to move to centres of expertise in consenting. There are 69 consent authorities in New Zealand. What we know is that they have varying levels of expertise. They have varying outcomes, often with very similar buildings. Group Home Builders have told us many times that they will have a virtually identical design and it will get a completely different reaction from different consenting authorities. So it is important that there is quality and consistency in the consenting process and, particularly when it comes to commercial buildings. For a country of New Zealand's size we believe a small numbers of centres of expertise would be much more useful than having every council trying to do work that is probably beyond many councils' ability.

Then, finally, still working with consenting authorities to be assured that their level of competence is improved through the accreditation process.

Mr Thorby's talked about acceptable solutions. We are looking at how we can promulgate more acceptable solutions and particularly where across consenting authorities acceptable solutions could be developed where innovative or alternative solutions have been used more than once and seem to have a good body of evidence and then codifying that so that it becomes a standardised way of getting through the consenting system. It's important to build a better understanding of the code performance requirements and the role of the compliance documents across the sector. As Mr Thorby said I think there's quite a, there's not a strong understanding across the sector of what the Building Code is, of what compliance documents purposes are and how the other supporting documents are meant to support that process. Use of technology to improve access to the Building Code. We certainly have clear feedback from the sector that they don't find access to the Building Code easy and we want to look at how we can improve that, particularly using technology. It's critical in our view, from the Department's point of view, that we work with a sector to continue to build capability, both in the initial training and also continuing professional development. Sir, you referred earlier to future discussion. We certainly are interested in participating in how we maintain the professional competence and, particularly, we're thinking about engineers and architects and we have had some discussions with IPENZ already about that.

Finally, in this area, the Department, as part of its broader programme, is looking at occupational regulation. So, in other words, how do we get consistency across the professions and trades in terms of establishing appropriate competence, then how do we establish whether they meet the requirements, and then there's also issues around sanctions where people don't work in the way that they're meant to. It is an important part and that is inconsistent across the various professions and trades at present.

So the final area is around research. The Department is committed to learning and working with the sector to learn from performance of buildings in Christchurch – both the good and the not so good. We are working with the Natural Hazards Platform to encourage investment and appropriate research and it's application and the Department will encourage additional funding where appropriate to support that research. Commissioners, that's our presentation. Thank you.

JUSTICE COOPER:

Thank you very much for that. We'll take the afternoon adjournment now and look forward to discussion after that.

COMMISSION ADJOURNS: 3.31 PM

COMMISSION RESUMES: 3.50 PM

JUSTICE COOPER TO MR MILLS:

Q. Well I wonder how we should proceed from this point. I haven't had any riding instructions for this part of the afternoon.

A. I think we're waiting to see Sir whether you had any questions the Commissioners wanted to ask now. Alternatively we'll just move through the other speakers in order.

Q. Yes.

A. And then we can do, at this time we can have a brief session amongst them if that's what seems to be sensible.

Q. Well I'm not sure whether, are people expecting to sort of commentate are they or – no, they're not? So what, I think that we probably do have some questions and perhaps if we asked them that would provoke more pointed discussion.

JUSTICE COOPER TO MR KELLY:

Q. There's just a couple of things that are of particular interest to me, but one, Mr Kelly you talked about this potential to move to centres of expertise in consenting for particular types of construction. Is that, that's something which is in a work programme is it or something which is going to be or what's the status of that?

A. It's part of the work that we're doing as part of the Building Act reforms and something that we're due in due course, I can't remember the date, to report back to our Minister in terms of a proposal.

Q. Will that be sometime this year do you think or perhaps next year?

A. Yes, yes it should be this year.

Q. Because without quite using the language you've used here we have in our own discussions been considering something along those lines. Had you considered that there might be a centre rather than centres of expertise?

A. We're open to either.

Q. Yes.

A. There's probably a little bit of analysis to do in terms of volumes and what do we mean by the more complex commercial work. So that probably just needs a bit of working through, what types of work you might want to centre in one or a small number.

Q. Well that was going to be my next question. Is it we're still considering the representative sample of buildings here in Christchurch that we have to consider but the buildings which seem to have been problematic are commercial or residential but they're multi-storey.

A. Yes.

Q. And they're the buildings which are more expensive and where one would expect naturally a greater range of engineering issues, structural issues would need to be identified and solutions found. So however that set of buildings is addressed that's the sort of thing you're looking at too?

A. That's correct, yes.

Q. And has there been any consideration that the Department of Building and Housing itself might be the centre of excellence?

A. It has cropped up but we haven't, we haven't really progressed that. We haven't closed it off so it's really an open question but it's not our starting point.

COMMISSIONER CARTER TO MR KELLY:

Q. My question also is, my interest is also in that topic and my question is, have the building consent authorities in any, either some individually or some collective form, local government, come up with any suggestions because they really have, I mean we've referred almost second-hand to the issues that we believe they, they face. I'm just – but the only time we've heard from them so far and we will hear more later, has been in the URM and other buildings hearings in which they talk about the difficulties they have in assessing the level of strengthening to bring forward but I think all of us that are involved in the industry can think of a number of examples of buildings which have been very difficult for the building consent authority to handle and I'd like to add to what His

Honour just described in commercial and residential. You know there are some really big projects, look at the covered stadium at Dunedin for example. Other large venues that – we can expect to see more of those sorts of buildings being looked for by the community as they move into new areas and these are a real challenge for everybody. The designers as well as the authorities that are responsible for them and I think we do need to have some clarity around exactly how we get the best answer for those. The other thing is they're very, they're marvellous learning experiences for the staff of everybody concerned. If we can devise good ways to do it they become the practical examples of how we start to spread the knowledge and ideas of how things should be done. There's a limit of how far you can take a student in a few hours of tuition during a four or even a five year degree programme and lots of the training of the sort that we're talking about to get a really good answer is going to come as they gain experience in, in working. We want to try and enhance that experience as fast as we can. So certainly I think this is a subject that is very, very worthwhile -

A. Yes.

Q. – working on the best possible answer we can conceive and I welcome the further comments from our other members of the panel here because they are very close to this issue in some of their work.

MS CRAUFORD:

I'd like to ask the question, how can the regulatory system encourage innovation? Now I think it's, I think we've established that it doesn't actually create a barrier but should it be more of an enabler to new innovation and I think we've certainly seen and made reference to the risk adverse BCAs and their lack of knowledge and expertise and how they're relying very much on peer review which is, which is variable and then how do the BCAs know whether the peer review has been done well or badly. Whilst I think centres of expertise are likely to assist I would be, I would encourage the Department to think about a single national body for resource consents because I think the issue of national consistency –

JUSTICE COOPER:

Building consents?

MS CRAUFORD:

Building consents, sorry. But the issue of consistency nationally is, is really important and, otherwise innovations have to be peer reviewed and accepted by many BCAs around the country.

COMMISSIONER FENWICK TO MR KELLY:

Q. Can I just seek clarification on two points. First of all the consenting process you're processing, with a centre, is that going to be, that's going to replace peer reviews or be in addition to peer reviews?

A. It works together with peer reviews. So the, what I'd described as, perhaps just move away from peer reviews. I think a peer review is an important part of a robust quality management process for commercial buildings. So that early peer review and the expert panel's recommendation about design features I thinks a really useful and important part but I think there's more to it. There are issues that I think have been raised here and elsewhere about the connection between the design and the construction. A real concern by engineers that they might be employed to do the design but then they're not involved in the construction process. So that's another important part of that overall quality management process and then also centres of expertise in the consenting system. So they go together. I don't think there's one single solution. I think there's a number of things that need to come together. I think the question earlier around, could you use, I think it was Sir Ron Carter's question around, could you use that approach also to help develop young engineers in terms of having an experienced person sitting down early in the piece and testing the thinking. So I think all of those things start to build something more robust which in addition to a robust consent hopefully starts to lift the skills which is another area that I think's been identified both here and elsewhere as being an issue.

Q. Can I just raise that issue again that Sir Ron raised there. If you're going to raise the standard through this process then you can gain much more by talking directly to someone with a paper and a pencil and a sketch than you can by email or any other way.

A. Mmm.

Q. So I wouldn't like to see a single centre in Wellington where in Christchurch a young engineer or engineer would have to actually travel up to go to this. It would be much more direct if they just went down the street and so they could readily do that rather than, you know, only being able to do it once every few months.

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JUSTICE COOPER TO MR KELLY:

Q. Yes well I suppose there are pluses and minuses of whichever solution is adopted. If you have too many centres of expertise you potentially have watered down the concept but I suppose, in fairness, this is not something that's got to the stage where you're proposing anything.

A. No, no.

Q. You're just saying that you're considering it.

A. Yes the concept that, but I think it's got reasonably strong interest from most parties. I think, Sir Ron, you were asking about the consent authorities, um, there's no formal response from consent authorities in total but discussions I have had they've viewed that as an interesting concept that they think has some merit.

Q. It certainly, to take up Ms Crauford's point, would, if there were some sort of, something along these lines, it would foster innovation one would think as a matter of logic because once a particular design had been approved by the centre or one of these centres of expertise you would think that similar designs could also rely on that fact.

A. Yes.

Q. And possibly even there might be some knowledge disseminated from the decisions that were coming out of such a body which, when people became familiar with them, would also enhance the acceptability of innovation.

A. Yes I think that's quite right.

Q. Did you get the figures for the success rate of people on appeal to the Department?

A. Determinations. Haven't got the figures but, in general, just talking to the manager of that area, what the process typically can be is that the decision initially is to accept why the consenting authority turned down the proposed innovation because of the lack of evidence but then there's a second go-through where the applicant does provide the evidence and it gets accepted. So it's actually a process of learning for the applicant what level of evidence they need to provide. At times I think people don't understand.

Q. But you should have published guidelines which get people over that hurdle.

A. We have published guidelines.

Q. They don't read them.

A. Yes.

Q. Oh okay, that's a good answer, Mr Kelly.

A. So we have published them and we're trying to educate people about that process. The education is often the hardest part of it, to get people to understand and do the work that they need to do.

Q. The idea that you would, just to, I'm not arguing with my colleague here but there would be a risk, it seems to me, that you would want to avoid, for example, that proposals for buildings in Christchurch were peer reviewed by practitioners in Christchurch as a matter of course and that a development proposal in Christchurch was never considered by anyone outside Christchurch. Might that not mean that some of the advantages of this sort of system were lost? I suppose you can deal with it by ensuring the peer review was from somewhere else but…

A. I think the question is –

Q. Well Christchurch, I should add, read Wellington or Auckland or Napier.

A. I think there's two parts to that. One is in terms of thinking about a peer review. One of the concepts is to come up with a panel that would be developed in consultation with IPENZ and Structural Engineering Society and the Earthquake Engineering Society so that you have an agreed panel that can work across the country, so that you actually ensure the quality because there are, at times, suggestions and we heard earlier that sometimes the peer review is not up to scratch. So it is lifting that bar and that would look across the country. The other that I think is thinking about how else do you disseminate that information. It's not just through the peer review and the consenting but what other processes could we put in place to educate through professional societies and so on about new innovations, new designs. One of the significant challenges for the Department is to get better at our own education. We, in the past, have developed compliance documents, acceptable solutions, but we haven't always been good at then taking that out and applying those learnings so that's a significant challenge for us but I think that's for the whole of the sector, I don't think it's just for the Department.

COMMISSIONER CARTER TO MR KELLY:

Q. There's an issue that sort of has been underlying some of the matters that we've had to consider in the last few weeks and I see the management of the whole process as being part of the perhaps a causative feature in things that have gone wrong. The thing that I think those of us who have worked for a long time in this industry realise just how complicated it is in terms of the participants and as New Zealanders become more siloed in terms of specialist skills I think we haven't done enough to actually make sure that the areas of this particular skill are well acquainted with each other and actually determine where the boundaries between one group's contribution is and the next. That is not always a technical matter. It can quite often be in the construct of the contract where the legal responsibilities have been carried for particular decisions and often, particularly in complex large structures, it's not particularly clear just where the responsibility of the engineer lies within the context of the whole process of determining how things are done, how health and safety is managed, what's the role of engineering within this and could be broader or smaller and I think there's a quality assurance matter missing in a lot of the practice that we see going on which can be covered by the teams that are brought together of builders, architects, engineers and so forth, legal advisers and owners, actually making sure that the process is tight and that the parties understand their particular roles and standardised procedures that we've grown up with for decades become entrenched and often now are inadequate to cope with the actual decision making process that is implicit in carrying out the work. So I know I should be asking questions, not making statements, but I would like to rephrase that back to: how do you feel about this question of integration of skills and is there a role which you can give guidance to in what DBH cover?

A. I think that is consistent with what I was talking about around that quality assurance approach. In the work that the Department led and reported on in 2010 the issues of skills was raised as a concern from the sector and it was skills across the board, it wasn't just in one area, and some of the larger construction companies particularly referred to their concerns about what they call construction management and I think they're talking about what you're talking about, Sir, which is how it all comes together and that is something that we are focusing on but I think what is important is that it's not a matter of us necessarily coming up with a prescriptive approach but it's actually trying to work with the sector to establish what is best practice and encouraging that best practice but allowing that to evolve over time so that for the more complex jobs the application should put forward their process to demonstrate how they will achieve the things that you're, rather than a prescriptive you must tick these boxes.

Q. Yes I don't think there's one solution to this.

A. No I don't think so and all of these jobs are different as you will have heard and as you will know. All of the larger jobs they are individual buildings.

JUSTICE COOPER TO MS CRAUFORD:

Q. Ms Crauford is there anything further you want to say about the discussion to date?

A. No not about that, other things.

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JUSTICE COOPER TO MR JURY:

Q. Mr Jury.

A. Yes I'm just going to make some comments relating to the presentation that Mr Kelly and Mr Thorby made. They made the comment that they were concerned that maybe the status of the building code was not clear to the people that are required to use it and I would agree with that. I know in our practice that we’re continually telling our engineers, have you looked at the building code? They’re very standard, focussed in terms of applying standards and not building code focussed. So the building code is readily available. It’s just that there has to be continual pressure for people to realise that the building code is the father document of all these documents. I think also it was alluded to there is a very fine line between performance requirements and as you Sir mentioned in having performance requirements which then become very prescriptive. And so if performance requirements are going into the building code they need to be that, they need to be performance requirements and not tangled up with the design process. So that would be another comment and the design process is more appropriately dealt with perhaps in the standards. Maybe that requires some discussion, but maybe that’s the case. And I think another point is too that I think our engineering profession is only really getting to grips with the issue of what is required in terms of review and QA. The larger firms have the ability to be able to apply QA systems. The smaller firms which might only be one or two people have great difficulty in applying a QA system that might be able to be done in the larger firm. We know from our experience in dealing with consenting authorities that many consents put forward to council are based on the assumption that the council is doing the peer review and it is just not, just not set up to do that function, even for small jobs. It is able to have a look at the job and decide whether things generally are being applied correctly and whether anything obviously is missing but it's not set up to find the, the hidden error if you like in the calculations etcetera. So there is a need I think for the profession to make it quite clear to its members that checking and verification is, is an essential part of any design, that every, every engineer should accept that he can make an error and that it needs to be reviewed by somebody else and he should not expect the consenting authority to pick that up. For more complex jobs certainly the peer reviewer has an extremely important role and I think most problems come about because the peer reviewer is not understanding of (a) the liability he is taking in doing a peer review but also his responsibility in carrying out a peer review which in many cases is equal or not greater than that of the designer.

There was also a comment made regarding about damage to structures and whether that was included in the Act and I'd agree it's difficult to see that it's covered in the intent of the Act but in the Building Code there is a requirement in there relating to amenity of buildings which I think can be interpreted as damage and damage that occurs in the various levels of earthquake can certainly be considered as coming within that definition.

Q. Aren't buildings supposed to be able to be safely occupied for their lifetimes. Is there some performance requirement like that in the Building Code?

A. Yes I think, I think that's where the problem arises in that these things are not well defined. I think they're defined in legal terms. It might require legal precedence to sort them out. So we say that a building should be able to be, the risk of injury or death in a building should be acceptable in an earthquake. It doesn't say what size earthquake or whatever and of course it's going to vary depending on the size of the earthquake. So it's not very well defined exactly what the performance objective is, and so I think that certainly needs to be sorted in my view because not only is it a problem for the profession, it's a problem for the standards writers. They are working in a vacuum of deciding what is the performance objectives they're trying to meet when they're writing the standards and in, in discussions around standard committee tables even within the standards committees there's a huge variation of understanding about what the intent is. Not only understanding but view, different views are expressed about what it means. It would be good to have that sort of thing tidied up and then everybody could be working on the same, in the same direction. That's all I …

Q. The, there was an issue that you raised, I think it was the third to last issue but now it's gone out of my mind. Can you remember what the point was you made two points ago?

A. Performance requirements, status of the Building Code, consenting authorities, amenity?

Q. No the point is, I've let the moment pass I'm afraid, but on this question of clarity. Many years ago when I used to look at the Building Code and more recently it struck me that there wasn't, there doesn't seem to be any obvious hand of a legal draftsman or draftsperson behind it. It's not, it doesn't read like one might expect a legal document to read in some respects and Mr Jury has raised some of them. Can you explain why that is? Was there a conscious effort to make something supposedly more user-friendly than you might expect from a legal drafting style?

A. Well the code documents themselves are in fact drafted by the Parliamentary Counsel Office, PCO, so they are drafted by, by law drafters but having said that the, the preparation of that material is done by technical people so –

Q. Yes.

A. So the challenge I guess for PCO is to turn that into –

Q. Well they have to use the concepts that they've been given, my understanding.
A. Yes, yes they do.
Q. And the concepts –
A. Yes.
Q. – were not –
A. And those concepts are agreed by Cabinet.
Q. Yes.
A. And so those are there to form the basis of drafting instructions.
Q. Well I certainly wouldn't want to criticise Parliamentary counsel because they achieve very high standards but with the move to a performance-based system it did seem to me when I was a legal practitioner that brought with it some lack of precision as the prescriptive approach was departed from?
A. Yes I think that's an observation that we're making now that there is debate as to what the code actually means.
Q. Yes.
A. What the interpretation of reasonable or adequate means.
Q. Yes.
A. And that is the challenge that we have. While I have the microphone if I can just respond to one of the points that was being made around what the code is aiming to achieve and because of uncertainty about both the demand, the size of event that the building, a building is going to be subjected to and uncertainty about the capacity of construction it's actually impossible to have zero risk. So the code is constructed to, to deliver an outcome around a minimised but still finite risk. The concept of zero deaths in a 500 year earthquake for example is not achievable other than as a highly desirable but can't be guaranteed construct. So the risk, the performance material –
Q. You can't make it a requirement?
A. So you can't make it a requirement, but what you can do is to set bounds around expectations and one of the things that is done in the code at the moment through citation of NZS1170 is to have scalers for

outcomes based on different importance levels of building. So for a more important building the same performance outcome's expected in a larger earthquake than is expected for say a standard building under the same event. So there are some scales but they're all aimed at achieving the same risk outcome.

1620

Q. I've remembered the point I wish to pursue with you Mr Jury and it was your observation that there are perhaps designers who rely on the consent authority to be effectively the peer reviewer. Now again, and you can correct me if I'm wrong, but my impression is from many years ago that that would have been a legitimate stance for people to take with certain local authorities, probably Auckland, Wellington and Christchurch at least, that you would expect them to be staffed by people with expertise, structural engineering expertise, who would be able to pick up a problem with a plan. Now am I looking at the past with rose coloured spectacles or was that a set of expectations that you could legitimately have 20 years ago and 30 years ago?

A. I'll answer it this way but I think a professional engineer has to be satisfied that his design is adequate. I'm not sure what approach he would take to make sure that the consenting authority was adequately reviewing his drawings. I think that he has it in his hands or her hands to do that themselves and that's where the responsibility should lie. When a peer reviewer becomes involved then that invariably is an independent review and that holds its own liability as well and responsibilities and everybody gains comfort about the extra eyes that are looking over the solutions.

Q. That's a fair answer to my question but let me put a more precise question. Did councils used to have more in-house structural engineering expertise than they do now?

A. The simple answer to that is yes.

Q. So why has that changed?

A. I think the expectations of, we do quite a lot of checking for the Wellington City Council as one of the firms that are involved in that checking. Our involvement there is we spend a relatively limited time looking through the applications that are made for consent and we're primarily looking to satisfy ourselves so we can advise the consenting authority whether it looks reasonable that they should be able to issue a consent from structural ground so it's a relatively limited overview that the council is doing there and the issue I suppose, I wouldn't like to say it's around cost, but the time scales that are targeted are around the consent costs.

Q. And I suppose there's an eye on the insurance premium as well?

A. Possibly, yes, yeah.

JUSTICE COOPER TO MR HARE:

Q. Can you respond to that, set of thoughts?

A. I would probably tend to echo those particular comments that certainly there was a time when there was an expectation particularly in some councils more than others that you would get, shall we say, raked over the coals a lot more on the consent process and people who had genuine technical ability could argue the case. I think it certainly feels now as if it's a lot more about compliance review – have you checked this box and have you done that – which has got less to do with the actual quality of the design and, to some extent you know, I would express a concern I suppose that we go to a compliance process which is a lot, you know, we have a lot more compliance burden as opposed to really putting more quality back in a design which is what we're all trying to achieve and so whatever we do, whatever we impose, that's what should be our goal. I think, you know, as far as the expertise within the BCAs goes I think is probably irretrievable to some extent and so it would require a new mechanism to be set up. There's a certain appeal with what's being discussed here.

Q. If the system, and I'm going to exaggerate it for effect, but if the system is that the councils don't have the expertise and they farm the checking work out to a consultancy which does have the expertise, bart on the basis that you don't spend your money on this – just have a quick look at it, does it feel all right – and the result of that is an approved set of plans out the end of the system. Where does the public interest get looked after. You see that system has become completely privatised effectively.

A. Yep, and as you put it that way I can't, you know that's what we have at the moment and you're clearly, we're not all completely comfortable with the outcome, and so unless you can bring that level of independence and thoroughness back into it, well more importantly the integrity of that thoroughness back into it so that you can demonstrate that it's followed a decent process then I don't think you're able to say you've achieved anything better with the outcome than what we have now. It strikes me in the process we're talking about if we're looking at a system to encourage or enable innovation which is I think where we started that that probably needs a different mechanism than what we need to progress for example a tool panel warehouse out in the industrial sub-division which is a lot more straightforward and that would be the basis of the risk based process that's been briefly touched upon. But certainly at the moment where you've got anything where there's an attempt to trim costs you can only in the context of looking at engineering processes, trim costs by trimming time effectively and so as we know, as I'm sure Robert will endorse, it's always the devil's in the detail so it's a little detail somewhere which is wrong which could prove to be the Achilles heel of the building. How do you track each one of those? You can only keep cutting down and sort of gradually greater detail till you get to the point and it's very difficult to sustain that level of investigation for every building consent application. Where we are going to say that we need that process at any level we must be applying it to the more complex and more difficult tasks.

Q. I think that's a given for this discussion because I mean the vast number of building consents for a one-storey residential house somewhere in the suburbs, they're not an issue are they?

A. No.

JUSTICE COOPER TO MR KELLY:

Q. Mr Kelly is it the Building Act that's recently passed actually adopts the stance that really all the main emphasis should be on the quality of the work of the initial designer. Isn't that the way so that council responsibilities are actually now being reduced in this field?

A. What the Act is trying to emphasise is being clear about who is accountable for what and yes it is saying that the designer and the builder as the principal players need to take the major accountability that we shouldn't solely rely on a consenting process that as other speakers have said while at times there's criticism of consenting authorities being inconsistent, equally there's criticism of a variability of designers. Some are very good, do a very thorough process. Some do not. And in a service that we provide which is called a multi-proof service for a group of volume builders we have seen exactly that. That some of the quality of the plans that are coming in to us are really inadequate so what that Act is trying to do is say as the designer you have an accountability and a responsibility and you need to be held to account for that. At the same time the risk base consenting is meant to reinforce that. However, the risk base consenting it will come through regulation. We won't do that until we're satisfied that there are a set of conditions that have been satisfied, including sufficient licensed building practitioners, issues around liability and consumer protection so there are a number of things we will need to work through before we move to a fully risk based approach. So it's quite carefully worked through but we do have an end point very much so that the designers and the builders are held accountable for what they do.

Q. So is that accountability looking at things, you're putting systems in place after a problem has arisen aren't you and you're hoping that by doing that that the problem won't arise in the first place because people will look forward to that potential accountability but there are accountabilities now aren't there. I mean a person who builds a building that is defective can be sued for negligence, which is accountability isn't it?

1630

A. They can be but, for instance, in the case of builders, as we know with leaky homes, if the business doesn't exist they've gone and so that's a real issue.

Q. And so how does the Act deal with that?

A. So the second part of the Act will be talking about consumer protection, there's another, sorry there's another bill before the house –

Q. This is the number 4 bill.

A. That's correct.

Q. But what does it say about local authority liability? Doesn't the legislation that's recently been passed say something about local authority, or Building Consent Authority liability?

A. We will address that through the risk-based regulations in terms of clarifying what's the hurdle for different types of buildings. Local authorities, for instance, it may be, and this hasn't been determined yet, but for very simple structures it may be that a local authority responsibility will be defined as ensuring that it is designed and built by a licensed building practitioner. For instance a garage, a stand-alone garage, where the risk is relatively low –

Q. I'm not thinking of that I'm thinking of an office building in central Christchurch.

A. So the current interpretation by the courts is that the consent authorities do not have the same duty of care as they do for a residential building. It puts it much more on the designer and the builder so what we're trying to do is reinforce that and to get a more robust process around that, not a compliance process but actually more quality into that system.

Q. Well I can understand why you might be doing that but how do you put the quality assurance into that system? If that's not at the consenting stage.

A. So part of the consent process is to satisfy the consent authority that there is a robust process around design and construction. At the moment it's a peer review in most cases and the view of many in the sector – the Department accept it and the government accept it – is a simple peer review as it happens at the moment, is not sufficient because the consent authorities are relying on that peer review process and they cite that as well we got a peer review therefore we've discharged our duty. What we're saying is it needs to go to a more robust and more rounded quality assurance process which will include peer review but will include other elements as well and the point I made before about the connection between design and construction is another critical point that needs to be addressed.

Q. So who pays for the peer review?

A. The applicant. That would be the proposal. So it is part of the construction cost and we will have to be mindful for how much that is.

Q. And who chooses the peer reviewer?

A. That's part of the work we still need to do and that's what I was referring to earlier about the concept of a national panel that would have appropriate people on there. Certainly there have been suggestions at times that the people being chosen to be a peer reviewer are not up to scratch. Now that will vary and I'm certainly not talking about Mr Jury's firm but that's part of the other piece of work we need to do is how do we make sure that the peer reviewers have the adequate skills to do the work.

Q. And that's a different concept from the centres of expertise that we were talking about earlier.

A. That's right but, as I say, I think these things come together as part of an overall approach.

Q. We'll need to think about that but the system as you're describing it it would seem to require some such centre of expertise.

A. That's right so that if I think about various local authorities I've worked in there is pressure on the council from time to time. So if you have a centre of expertise that can look at the evidence provided and be much more robust and say yes I understand what that means as opposed to many councils, that would be really quite difficult at the moment because of what was said earlier, they don't have the engineers and that's been an overall movement to outsource their engineering work across the whole range of factors. It's not just in the building consent area but in their design area, whether that's in the infrastructure or elsewhere many councils have outsourced that work.

COMMISSIONER CARTER TO MR KELLY:

Q. There's an issue around the compliance process perhaps in the most authorities now rely on the person who submits the application having it supported by somebody who notifies the council that they're properly qualified to assert that what they have done was in compliance with the codes.

A. Yes that's certainly got to be part of it yes.

Q. That was quite a, I know that that was quite a well argued position some decades ago that inconsistency between councils would be helped if, in fact, the people who were submitting the documents were appropriately qualified to say that they had done the work in accordance with the codes.

A. Yes.

Q. And I think Ms Crauford might want to comment upon the compliance procedures and the CPEng and so forth that is implicit in what we've been hearing.

MS CRAUFORD:

Yes it is implicit and you're referring to producer statements to give BCS that assurance that –

COMMISSIONER CARTER TO MS CRAUFORD:

Q. Well as I understand it has not the regulation or the Act, the Engineers Registration Act, which was replaced by the certification process, and placed the responsibility upon IPENZ to actually administer the purpose of the Act and come up with the standards.

A. Yes that's right.

Q. That engineers would have to meet in order to be able to be classified by IPENZ as CPEng.

A. As a chartered professional engineer, yes that's right.

Q. And that includes a process of re-examination every few years to see that they're keeping abreast of the matter.

A. Re-examination somewhere between two and six years so it's a risk-based approach. If the engineer is thought to continue to be competent it would be five or six years but if there is any concern about the engineer then they would be brought back for a competency assessment earlier than that.

Q. But the system also relies upon the code of ethics with the engineer having to maintain that they're not holding themselves out in a field of expertise that they don't possess.

A. Working within their area of expertise, that's correct, yep, so we would expect engineers to do that and at the moment we don't publish the area of expertise of each of the chartered professional engineers although we are under discussion with the Department as to ways in which we might look to do that in a way that is useful to people because if it's too wide then it's not very helpful or if it's too specific then the engineer concerned may find it too restrictive, so it's a question of trying to find something that is actually useful to the general public but also to engineers.

Q. Would you say, though, that that procedure for accepting compliance documents meant to the Building Consent Authorities that they had less need for having their own engineering departments, is that a reasonable assumption?

MR KELLY:

I'd probably turn it round the other way. I think that they have relied more heavily on engineers than they did in times past and I worked for a smaller local authority in the 1980s and as a graduate engineer I did design checking but I think, and it's a personal view, what's happened with the change in local government over time they've outsourced so much other things for you know valid business reasons, they don't hold it so they are putting greater emphasis on the engineer to certify that they've done the work. The issue that Ms Crauford's raised is that the councils, or some councils are now saying well how do we know that that person has the right skills. Yes they might be a chartered professional engineer but how do we know that they're competent to design what might be a complex structure. So that's the further discussion we're having about how could we get to that point that gives consent authorities but also building owners confidence.

COMMISSIONER CARTER:
So that means, I think, from what Ms Crauford described is that we are reliant on the individual engineer for taking responsibility that the field in which he is working is one in which he's adequately competent.

MR KELLY:
Yes.
1640

MS CRAUFORD:
And to some extent that was always going to be the case even if there is a label next to that engineer to say what their area of expertise is. There's still going to be an issue that they have to remain within their area of expertise and rely on the Code of Ethics to do that.

MR HARE:
If I may, the point that's been discussed I guess many times at different places but the CPEng qualification is I think, it's a relatively low bar to entry –

MS CRAUFORD:
It's an entry level qualification.

MR HARE:

Other countries obviously have a higher level qualification for people, professional qualification for people doing certain things. So far that hasn't happened in this country.

JUSTICE COOPER:

Well it has for bridges hasn't it?

MS CRAUFORD:

Dams.

JUSTICE COOPER:

Dams.

MR HARE:

Dams, sorry, but certainly not, not in the sense of buildings though but that would take, it's not, those places typically are looking at examination based qualifications for a higher level. There's still, there is still the same obligation to keep current and so it's arguable whether you get that much better result but certainly the, you need to have people who are experienced and knowledgeable in these fields to do these advanced designs.

JUSTICE COOPER TO MR HARE:

Q. You've worked in the United States. They have quite definitive status for qualifications I believe. Does that do a better job than we're doing here?

A. They have the structural engineering licence which is ahead of the professional engineering licence and there are some obligations which only a structural engineer can do which is typically in California, public work, hospitals or public schools. In some jurisdictions some tall buildings have to be signed off or supervised by an SE. I don't observe there to be any increase in quality of the design work done in most cases as a consequence. Usually it's, there's a much heavier compliance burden with those particular sorts of projects.

MS CRAUFORD:

The system that we have here is benchmarked against other international systems and is favourable in that sense.

JUSTICE COOPER TO MS CRAUFORD:

Q. You've covered that very well in your report to us.

A. Yeah, yes.

Q. And I should say, not that I want to stop you saying anything you want to say that we have actually strayed in this discussion into an area that we are intending to visit in hearings later in the year. It's just that it was thought appropriate to hear from the Department now because all these subjects inter-relate. How do you foster innovation? Well it needs to be seen in the context of the overall system so that's why you're here today but it's fair to say we won't be confronting these issues head on until, until later in our proceedings. Not that that was intended to stop you saying anything you wanted to say.

A. I think it's more appropriately covered in your, one of your later sessions.

JUSTICE COOPER:

Yes, all right. Well Commissioner Fenwick is there anything else you wanted to cover in this session:

QUESTIONS FROM COMMISSIONER FENWICK – NIL

QUESTIONS FROM COMMISSIONER CARTER – NIL

JUSTICE COOPER:

Is there anything else that any of you wish to say?

MS CRAUFORD:

No.

JUSTICE COOPER:
Mr Kelly?

MR KELLY:
No thank you Sir.

JUSTICE COOPER:
Well once again I thanks to you all for your, for your time and the thoughts that you have shared with us and these subjects except in so far as they relate to the new technology. The substance of the new technology matters will not be dealt with in our report which is due at the end of June but we do feel obliged to say something about new technologies in that context. So the difficulty with this task and I'm not complaining about it, it's just a fact of life, is where do you draw boundaries between different subjects? So it's been reflected a bit this afternoon. But anyway we're very grateful to you all for your contributions. Thank you very much. So now we will adjourn and there won't be any public hearings for a while now but I can assure you we will be working away. Thank you.

COMMISSION ADJOURNS: 4.45 PM

HEARING CONCLUDES INTO NEW BUILDING TECHNOLOGIES