Opening statement by Counsel Assisting – Unreinforced Masonry and other earthquake prone buildings

Introduction

This is the third of the hearings the Royal Commission has held. It addresses 3 very significant, different but related issues:

- *The performance of unreinforced masonry buildings (***URM***) in the 2010/2011 Canterbury earthquakes*.

- *The Earthquake Prone Building policy that is established under the Building Act 2004*: What it means, how it is being implemented by territorial authorities throughout NZ and what the Canterbury earthquakes have taught us about its effectiveness.

- *Other buildings that are not currently classified as earthquake prone, but are not built to the standards now required for new buildings*: whether these too ought to be required to upgrade because they do not meet current legal and best practice requirements for the design, construction and maintenance of new buildings. Both the PGC Building and the CTV Building illustrate the need for a careful consideration of this issue.

There will also be a separate hearing on the individual URM buildings where, as a result of their total or partial collapse, 41 people died. These hearings begin on 12 December.

Because of urgent issues of public safety the Interim Report issued by the Royal Commission in October has already made some preliminary recommendations about URM buildings. The Commission recommended that every local authority urgently compile a register of URM buildings and that throughout NZ steps be taken to eliminate falling hazards such as chimneys and parapets. In areas of moderate to high seismicity the strengthening of masonry walls to prevent out-of-plane failures was recommended.

This hearing now provides the opportunity for wider and more intensive consideration of the lessons to be learnt from the Canterbury earthquakes, what they tell us about the performance of retrofitted URM buildings and what can be done to reduce the life risk and the economic consequences of their collapse. The Commission will also hear evidence that addresses the difficult social and economic choices involved in the cost of upgrading the earthquake resistance of URM buildings.

Key terms defined

(a) Unreinforced masonry

In New Zealand the terminology URM is used to refer to a building that is constructed of clay brick or natural stone units bound together using lime or cement mortar, without any reinforcing elements such as steel reinforcing bars. The greatest number of URM buildings in New Zealand is found in Auckland, although they are also found in large numbers in each of the other three major cities – or they were until such devastating losses occurred in the Christchurch CBD. In its Interim Report the Royal Commission estimated that prior to the Canterbury earthquakes there were about 4,000 URM buildings in New Zealand.

They are disproportionately represented in what most of us think of as heritage and character buildings and the tenants they often attract enliven many of our commercial centres. The current controversy in Wellington over the future of Cuba Street illustrates this issue. As the Commission observed in its Interim Report, many URM buildings are treasured as valued records of our history and many others are used as small-scale commercial premises, much valued for their traditional character.

In New Zealand most were built between 1921 and 1930 although they were not formally banned until 1976. The characteristic they all share that makes them such a

concern in an earthquake is that they are brittle. They can change from acceptable performance to collapse with only a slightly more intense earthquake ground motion.

(b) Earthquake prone buildings:

This terminology comes from the Building Act 2004 (**the Act**). The earthquake prone provisions in the Act have been widened since the September earthquake in respect of their application to Christchurch, Selwyn and Waimakariri. First following the September earthquake and then after the February and June earthquakes: Canterbury Earthquake (Building Act) Order 2010 and Canterbury Earthquake (Building Act) Order 2011. The effect of the Orders is to treat buildings in these districts as earthquake prone when they would not be under the general provisions of the Act.

The earthquake prone provisions of the Act do not apply exclusively to URM buildings, although the nature of URM buildings is such that unless they have been retrofitted (had their structural performance improved) they will invariably be classified as earthquake prone. Prior to the 2004 Act URM buildings were the only building type described in this way (the Building Act 1991 described them as “earthquake risk buildings”), but this is no longer the case; any building that does not meet the seismic performance standard required by the Act is now an earthquake prone building.

Section 122 of the Building Act says that a building is earthquake prone if in a moderate earthquake "the building" is "likely to collapse causing injury or death, or damage to another property". The focus is on the performance of a building at what is referred to by structural engineers as its ultimate limit state. The concern is with life safety; preventing damage to the building is a secondary consideration.

The NZ Society of Earthquake Engineers (**NZSEE**), in an important report issued in 2006 entitled "Assessment and Improvement of the Structural Performance of Buildings in an Earthquake", interpreted the words "likely to collapse" to mean that collapse "could well occur". The NZSEE also preferred to read s 122 as a reference to an overall expectation of performance in an earthquake, not just a moderate earthquake, and supported an amendment to s 122 to clarify this.

The use of the words "the building" in s 122 is important. Several of the submissions received from territorial authorities have expressed concern that this does not give them the authority to require the strengthening of *parts* of a building, such as chimneys and parapets, unless it can be shown that the building as a whole is likely to collapse.

The legal arguments around this are discussed in an appendix to the DBH submission.

If the building as a whole must be earthquake prone, and it is not where only parts of the building can be shown to be likely to collapse, the local authorities are thrown back onto their powers under s 121 of the Act to deal with "dangerous" buildings. However s 121 specifically excludes a danger that arises as a result of an earthquake; the danger must arise *"in the ordinary course of events".*

The problem with the wording of s 122 did not exist under the forerunner of the Building Acts – the Local Government Act 1974. This defined "building" to include "any part of a building".

Urgent attention to this issue may be required to ensure that local authorities can insist that steps must be taken to address the features of URM buildings that are potentially the most hazardous to the public.

In general, the issue of whether or not a building is earthquake prone does not apply to residential buildings, although in the wake of the Canterbury earthquakes there may be a mood to reconsider this, at least in relation to key elements of residential buildings such as chimneys and foundations where the old adage "a stitch in time" may commend itself.

The question of what is a "moderate earthquake" is essential to an understanding of the earthquake prone provisions. This is defined in regulations made under the Building Act (regulation 7 of the Building (Specified Systems, Change the Use, and Earthquake-prone Buildings) Regulations 2005, SR 2005/32). A moderate earthquake is one that would generate shaking *at the site of the building* that is:

- Of the same duration
- But only a third as strong
- As the earthquake shaking that would be used to design *a new building at that same site*.

Put more simply, a building is regarded as earthquake prone if it has less than one third of the capacity to withstand a moderate earthquake that a new building at the same site would have.

The appropriateness of using new building standards as the reference point for determining the performance of an existing building, rather than having an entirely different set of standards designed specifically for assessing the seismic performance of existing buildings, is an issue that is expected to be the subject of discussion amongst some of the expert witnesses in the course of the hearing.

Because the new building standards (**NBS**) for a site differ between areas of the country, depending on the seismicity

risk GNS Science has assigned (the so-called ‘z’ factor), the strengthening required to bring a building above the earthquake prone standard in Dunedin, for example, will be different to what is required in Wellington.

Different views appear to be held about the legal effect of the one third of NBS benchmark. The interpretation most territorial authorities seem to accept is that they have no power under s 124 to require a building owner to carry out improvements to the seismic performance of a building beyond the level of one third of the NBS. The contrary and apparently minority view is that once a building has been determined to be earthquake prone a territorial authority can specify whatever steps it considers necessary to reduce of remove the danger. The Commission may wish to give further consideration to this issue in light of the evidence that will be given at this hearing about the performance of buildings strengthened to the one third of the NBS.

Significant issues about the adequacy of the one third of NBS have emerged from the way retrofitted buildings have performed in the Canterbury earthquakes. The evidence seems to be that at least in the ground motion effects Christchurch experienced, strengthening only to that one third standard offered few gains over not strengthening at all.

The origins of the one third of NBS are touched on in the submission received from the Department of Building & Housing. A representative of the Department will be appearing to speak to this submission. The Department's submission acknowledges that the definition was intended to target the buildings that were "least safe" in an earthquake and the decision to peg the definition of an earthquake prone building to one third of the new building standard involves a decision on what is an acceptable life safety risk. It is not clear how the conclusion that this represented a level of risk acceptable to New Zealand society was arrived at.

The NZSEE in its 2006 report recommended that all buildings that are at less than 67% of the NBS should be seriously considered for improvement in their structural performance and that any earthquake prone building should be brought to a standard that is "as near as is reasonably practicable to that of a new building".

It is significant, as DBH notes in its submission, that the earthquake risk from the structural performance of a building is not linear. The risk from a building that is expected to perform at two thirds of the standard of a new building is 3 times that of a building constructed to the new building standard, whereas the risk with a building that is only one third of the new building standard is 20 times that of a building constructed to the new building standard. The

Department in its submission describe a building meeting the one third standard as a “significant” risk, but even at two thirds of the NBS, the Department describes it as a “considerable” risk.

The Building Act requires all territorial authorities to have an earthquake prone policy. However, apart from the need to have one that meets the minimal requirements of section 131 of the Act, what the territorial authority chooses to do is entirely a matter for it. All that the Act requires the territorial authority’s policy to state is:

- The approach it is taking.
- Its priorities, and
- How the policy is to apply to heritage buildings,

In practise, at least prior to the Canterbury earthquakes and the wake up call it may have delivered to the rest of the country, a significant number of territorial authorities did virtually nothing. Many adopted what is referred to as a “passive” policy where no steps are required to improve the earthquake performance of an earthquake prone building unless there is an alteration to that building or a change in its use.

Even where so-called “active” policies were adopted by territorial authorities, very long time periods (sometimes as much as 50 years) have often been given for buildings to come up to even the one third of NBS.

To the extent that this extensive delegation of decision making to local communities was intended to allow each community to make its own assessment of how it values life safety over the retention of older buildings and other demands for scarce resources, there seem to be very few examples of territorial authorities using this delegation to actively engage with the affected communities of interest in an informed way, even though s 83 of the Local Government Act 2002 requires territorial authorities to follow a consultative procedure in developing and adopting their earthquake prone policies.

Whether the extent of the discretion vested in territorial authorities is acceptable, or whether a greater level of national direction or standardisation should be required, are important issues. So too is the question of whether a higher standard of earthquake performance should be required of buildings in the four major CBDs, simply because these centres are so significant to the economic performance of NZ. The impact of the Canterbury earthquakes on the Christchurch CBD, and the wider cost to the national economy, has made this issue one that warrants attention and it is addressed in some of the submissions.

(c) Buildings that are not earthquake prone but do not meet current legal and best practice requirements

Under the existing law there is essentially no ability to require a building that is not earthquake prone to have its structural performance improved. If the building is not dangerous or insanitary or earthquake prone, the owner can only be required to improve its performance if it is "altered" (section 112 of the Building Act) or there is a "change of use" (section 115). The territorial authority then has the power to require the building to comply "as nearly as is reasonably practical" with the current building code. However, it is only where there is a change of use that the requirement to comply with the current building code encompasses structural performance. Where it is an alteration the required compliance with the building code relates only to fire escape and disability access. Ironically, this can be an impediment to earthquake strengthening because the owner is making an alteration and is then required to meet the frequently significant expense of providing disability access. The lack of equivalence between life safety and amenity values is an issue identified in some of the submissions.

The DBH submission suggests that the Government of the day, at the time the Building Act 2004 was enacted, intended that one consequence of the delegation to local communities to determine their earthquake prone policy

would be to generate a greater understanding of earthquake risks and this would lead to voluntary strengthening of buildings that were not earthquake prone. If this was the hope it seems clear it has not been realised. Whether the Canterbury earthquakes will have a long term effect in shifting attitudes towards this issue from owners, tenants and users remains to be seen. There are some early indications that insurance issues may effect change well after immediate memories of the earthquakes begin to fade around the country.

The reports received by the DBH on the PGC Building, that will be the subject of a later hearing, carry the important message that although the Canterbury earthquakes provide lessons that can improve new buildings, there may be greater risk reductions in taking an active approach to the screening of existing buildings for initial structural weaknesses and ensuring appropriate retrofitting takes place. This would require legislative change as would a requirement for maintenance at specified intervals, another issue that is touched on in the submissions the Commission has received.

Hearing structure

The hearing that commences today is essentially divided into 2 parts. The first focuses on URM buildings, what has been learned about their performance as a result of the

Canterbury earthquakes and, of particular importance, what has been learned about the effectiveness of strengthening to one third of the new building standard and the effectiveness of a number of frequently used front line techniques for reducing the life safety dangers of URM buildings. These include the tie back of parapets and chimneys. The evidence of what has occurred in Canterbury earthquakes is alarming and appears to call into question some of the core assumptions that underpin the existing earthquake prone provisions in the Building Act – and also many of the policies that have been put in place by territorial authorities in establishing their own earthquake prone policies. The extent to which this poor performance has revealed a problem with the techniques themselves, or is the result of poor installation practises and inadequate Council supervision, does not seem to be entirely clear.

These and other important issues will be addressed by Associate Professor Jason Ingham, who will be the first of the witnesses to give evidence in this hearing. Associate Professor Ingham, together with Professor Michael Griffith of the University of Adelaide, were commissioned by the Royal Commission to prepare a report on URM buildings. The report provided to the Royal Commission is in two parts. The first is dated August 2011 and it focused on the performance of *unreinforced* masonry buildings in the Canterbury earthquakes. The second, dated October 2011, focuses on the performance of earthquake

strengthened URM buildings in the 22 February earthquake. Both of these reports are available on the Royal Commission website. The first of the reports was available to the Royal Commission prior to its Interim Report being finalised, the second report was not.

Jason Ingham is an Associate Professor in the School of Civil & Earthquake Engineering at the University of Auckland. He is the Deputy Head (Research). In addition to a Masters in Engineering with distinction from the University of Auckland he has a PhD (Structural Engineering) from the University of California at San Diego and an MBA from the University of Auckland. He has a list of achievements and honours far too long to do justice to them here, but his full CV is on the Royal Commission website. They include the John B Scalzi Research Award from the US Masonry Society, invited conference addresses in Australia, the USA, Korea, Chile, Italy, Greece, China and Brazil, several of which have dealt with issues arising from the Canterbury earthquakes. He has published extensively in both New Zealand and international journals.

Professor Ingham will speak to the reports he and Professor Griffiths prepared for the Royal Commission by reference to a series of power points.

This session will be followed by Mr Bruce Chapman, the Chief Executive of the New Zealand Historic Places Trust. The Trust lodged a written submission with the Royal Commission and sought the opportunity to be heard.

On Tuesday morning at 9.30am the first of the two expert peer reviewers retained by the Commission to consider the Ingham / Griffiths report will be joined into the hearing by video link.

The Commission will hear first from Mr Bret Lizundia. He is a consulting engineer and a principal in the firm of Rutherford & Chekene in San Francisco. His peer review paper is on the Royal Commission website. He has over 23 years of experience in the structural design of new laboratories, museums, academic centres, libraries, aquariums and office buildings and the seismic evaluation and rehabilitation of existing buildings. He has had a particular focus on unreinforced masonry buildings, including earthquake reconnaissance, loss estimation and technology transfer of advice to practicing engineers. His recent portfolio of work includes the seismic rehabilitation of the Frank Lloyd Wright Hanna House, a national landmark structure located at Stanford University. He was the project manager and co-author FEMA 547, *Techniques for the Seismic Rehabilitation of Existing Buildings,* and a co-author of FEMA 306/307, *Evaluation of Earthquake Damaged Concrete and Masonry Wall Buildings*. He is the

recipient of the Earthquake Engineering Research Institute's prestigious Shah Family Innovation Prize and the HJ Brunnier Award from the Structural Engineer's Association of Northern California.

Mr Lizundia will be followed by Mr Fred Turner, who is also from California. He is a structural and civil engineer and is on the staff of the California Seismic Safety Commission, a Public Policy Agency in State Government. In that role he advises the Commission and other state and local agencies on policies for earthquake risk management. He helped co-ordinate California's Earthquake Loss Reduction Plan and Multi-hazard Mitigation Plan and monitors earthquake-related efforts underway by state, local and private sectors. He also manages California's Unreinforced Masonry Building Programme that encompasses 26,000 brick, stone and adobe buildings in California's active seismic regions. He chairs the American Society of Civil Engineer's Masonry Issue Team that is developing an international standard for the seismic evaluation and retrofit of existing buildings. He has a long history of involvement in historic preservation efforts for heritage buildings and is the former Chairman of the City of Sacramento's Design Review and Preservation Board.

He has visited Christchurch since the earthquakes and has written articles on both the September and February events.

After both Messrs Lizundia and Turner have concluded their comments they will be joined by Associate Professor Ingham for a panel discussion during which they will be available for questions from the Commission.

In the final session on Tuesday the Commission will hear from ICOMOS NZ, which is an international non-governmental organisation of heritage professionals dedicated to the conservation of the world's historic monuments and sites. The organisation was founded in 1965 as a result of the international adoption in Venice of the Charter for the Conservation and Restoration of Monuments and Sites and is UNESCO's principal advisor in matters concerning the conservation and protection of historic monuments and sites. The New Zealand National Committee of ICOMOS was established in 1989 and incorporated in 1990.

ICOMOS will be represented at the hearing by Jeremy Salmond, Architect, Ian Bowman, Architect, Bruce Petry, Architect, and David Reynolds, a Heritage Consultant.

On Wednesday morning the Commission will hear, by video link, from Dr David Hopkins. Dr Hopkins is a consultant to the Department of Building & Housing, but is presenting this submission in his own capacity.

Dr Hopkins will be followed by the Property Council of New Zealand. The Property Council has filed a written submission that comments specifically on the issues raised in the Ingham, Griffiths paper and has asked to be heard in support of that submission.

Following the Property Council the Commission will hear from Adam Thornton of Dunning Thornton Consultants, a firm of structural engineers. Again, this will be done via a video link.

After the Commission has heard from Mr Thornton it will hear from Joe Arts, a well known Christchurch CBD property owner. His family owned part of 1905 Duncan Building on High Street in Christchurch. He wishes to address the Commission on his experience as a property owner in dealing with problems of earthquake strengthening.

Finally on the Wednesday the Commission will hear from Suzanne Townsend, the Deputy Chief Executive of the Department of Building & Housing.

Thursday is expected to be a lay day although, if necessary, it will accommodate any required hearing time. The reason for providing a lay day is that Part 2 of the hearing, which focuses specifically on the earthquake prone policies of a number of New Zealand territorial

authorities, has two aspects. First, the Commission will hear from each of the four major cities. It will also hear from Gisborne District Council and Napier City Council and Local Government New Zealand. Gisborne and Napier have been asked to appear, Gisborne because it has been very actively focussed on its earthquake prone policy since the 2007 Gisborne earthquake and Napier, at least in part, because it is the custodian of a unique part of New Zealand's build environment.

In addition, and at the request of counsel assisting, eighteen territorial authorities have provided written advice about their current policies and any review of these policies that have been engendered by the Canterbury earthquakes. These reports have been placed on the Commission website and made available to the Commissioners.

Second, there will be a panel discussion in which each of these authorities will participate. As the combination of the presentation from the territorial authorities and the panel discussion is expected to run into a second day, this has had to be arranged when the two days are consecutive. This could not be accommodated in the first week of the hearings.

Dated 7 November 2011
Stephen Mills QC
Counsel Assisting