**Section 3:**

**Roles and Responsibilities**

Under its Terms of Reference, the Royal Commission is required to inquire into the roles of central government, local government, the building and construction industry, and other elements of the private sector in developing and enforcing legal and best-practice requirements for the design, construction and maintenance of buildings to address the known risk of earthquakes. We are also required to make recommendations on the adequacy of legal and best-practice requirements for building design, construction and maintenance insofar as those requirements apply to managing risks of building failure caused by earthquakes. In this section we address relevant findings and conclusions from this part of our Inquiry

**3.1 Introduction**

In the course of our Inquiry, we identified some

systemic issues relating to the regulatory framework for buildings, such as misunderstanding of the framework; a complex and sometimes confusing suite of regulatory documents; and quality assurance issues. We issued

a discussion paper in July 2012, seeking comment on these matters. We received 29 submissions. At a public hearing held on 11 and 12 September 2012,

we then heard evidence on building legislation, regulations and compliance methods, and also the roles and responsibilities that underpin the building and construction industry.

The key issues raised in submissions and at the hearing were the need for effective leadership of the regulatory requirements for building control and the need for assurance of the quality of structural design and construction of buildings that can be described

as “complex”. The latter issue focuses on the design and construction of *new* buildings in that category. We have discussed the performance of *existing* buildings in Volumes 2 and 4 of this Report, and the

emphasis in the Terms of Reference on central business district (CBD) buildings does not call for a consideration of new, simpler structures (for example, stand alone dwellinghouses).

This section begins with a brief explanation of

the current “performance-based” building control framework as it relates to the issues noted above. (There is a fuller description of the history of building regulation to deal with earthquake risk in section 2 of Volume 4 of this Report.)

**3.2 Current building control framework**

The hierarchy of New Zealand building controls is illustrated in Figure 16 below. This shows the legislative framework – the Building Act 2004, Building Regulations and the Building Code – and the ways

in which compliance with the Building Code may be demonstrated.

**BUILDING ACT 2 0 0 4**

**BUILDING REGUL ATIONS**

**THE NE W ZE AL AND BUILDING CODE**

**OB JECTIVE**

**FUNCTIONAL REQUIREMENT PERFORMANCE**

**Complia nce Document s A lternat ive solut ions**

**Compa rison to Complia nce Document**

These paths are deemed to meet the performance requirements of the Building Code that they cover

**Veri ficat ion Met hod s**

**Accept a ble Solut ions**

**NZS 4121**

**Determinat ion**

**Prod uc t Cer t i ficat ion**

**E nerg y Work Cer t i ficate**

**Compa rison to document**

– Standard

– Technical information

– Tests /research

**In- S er vice Histor y**

Proposed work in this category must demonstrate compliance with the performance requirements of the Building Code to the satisfaction

of a building consent authority

**Figure 16: Hierarchy of New Zealand building controls (source: Department of Building and Housing, 20111)**

3.2.1 Building Code

The Building Code (which is Schedule 1 to the Building

Regulations 1992) sets out the minimum standards for all new building work. It states how a completed building and its parts must perform. It contains no prescriptive requirements stipulating that certain products or designs must be used. This “performance- based” approach is intended to allow development and innovation in building design, technology and systems.

The Building Code provides the requirements against which a building must perform to comply with the Building Code by prescribing the functional requirements for buildings and the performance criteria with which buildings must comply in their intended use, and outlines how compliance with the Building Code is achieved.

All building work must comply with the Building Code whether or not a building consent is required in respect of that building work. A building owner has to achieve the minimum building performance criteria set out in the Building Code. To issue a building consent, a building

consent authority (sometimes abbreviated as BCA) must accept evidence of compliance with the Building Code and/or a compliance document (see below), and/ or a determination made by the Ministry of Business, Innovation and Employment (MBIE).

We make some other observations about the Building

Code in section 2.2.3 of Volume 4 of our Report.

3.2.2 Compliance documents

Compliance documents provide rules about design that, if followed, result in compliance with the Building Code. They are published by MBIE, which is the government department responsible for the

administration of the Building Act 2004. The two kinds of compliance documents are verification methods and acceptable solutions. Some 300 standards developed by Standards New Zealand are referenced in the compliance documentation of the Building Code.

Section 25 of the Building Act 2004 provides for compliance documents to be used in establishing compliance with the Building Code and section 25A provides for these to be available on MBIE’s website. The chief executive of MBIE may place a notice in the Gazette that a compliance document has been issued that explains a specific method of compliance with

the Building Code. Building work that complies with this document will be treated as having complied

with the provisions of the Building Code to which the document relates.

A building must not be constructed, altered, demolished or removed without a building consent (section 40). An owner who intends to carry out building work must, before the building work begins, apply for a building consent to a building consent authority.

3.2.3 Verification methods and acceptable solutions

Verification methods are tests that prescribe one way to demonstrate compliance with the Building Code. They can include calculation methods, laboratory tests and tests in situ that may involve examination of plans and verification by test, where compliance with specified numbers, dimensions or locations is required.

Acceptable solutions are step-by-step instructions that show one way to comply with the Building Code.

3.2.4 The role of Standards in the performance-based building control framework

Within a performance-based system, Standards are needed for two reasons. First, to determine or evaluate the performance level of buildings, systems

or products; and second, to give specific performance levels for buildings, systems or products that can be classified as a type of product standard.

These Standards are developed and approved by the national Standards-setting body, following international practice. In New Zealand, this is the Standards Council. Standards New Zealand is the operating arm of the Standards Council, which develops, reviews and updates Standards. The majority of Standards are developed in partnership with Standards Australia.

Standards often provide the links from the Building Act

2004 and regulations to the performance metrics for materials, products, and systems. Where Standards are referenced in verification methods, they provide data to be combined with judgement by a designer or regulator.

When Standards are referenced in acceptable (deemed to comply) solutions to demonstrate compliance with a performance level cited or referenced in regulation

(i.e. the Building Code), these solutions must be accepted by a building consent authority when considering an application for building consent.

3.2.5 Recent changes to the Building Act 2004

The former Department of Building and Housing

(DBH) undertook a review2 of the Building Act 2004 in

2009/10. That review found that the building regulatory framework functions adequately, but that it is too costly and inefficient. In addition, the review identified:

• there are problems ensuring responsibility sits in

the right place;

• there are weaknesses in consumer protection;

• the system is out of balance with undue reliance

on building consent authorities; and

• a change in culture and behaviour across the

system is needed.

The enactment of the Building Amendment Act 2012 is intended to:

• clarify accountabilities for the compliance of design and building work by designers, builders, building owners and building consent authorities; and

• provide for a risk-based consenting process where

the amount of checking and inspection is aligned

to the risk and complexity of the work and the skills and capability of the people doing the work.

We mention these changes because they are relevant to the issues we have noted above. In making our findings and recommendations on the issues discussed in this section, we have therefore taken into account the existence of these provisions, although they are yet to be brought into effect through regulation.

**3.3 Quality assurance**

The Royal Commission received submissions and heard evidence about the importance of quality assurance processes, and the need for these to be carried out

by appropriately qualified and experienced persons. This is particularly the case for complex structures, where the design of the building is more complicated and requires particular knowledge and skill, and where the consequences of failure are potentially greater (for example, from higher rates of occupancy).

Quality assurance should occur at a number of points throughout the design and construction of complex buildings. At the design stage, a suitably experienced practitioner should carry out a rigorous examination of the design specifications including both the foundations and the structure above ground. There should be engagement at the outset between architects and engineering designers.

Quality assurance systems should ensure construction work is properly supervised and monitored by the design team, in addition to the inspection and monitoring by the building consent authority, to ensure that construction is undertaken in accordance with

the design, that any design variations are properly documented and consented, and that accurate as-built plans are filed prior to the building consent authority issuing a code compliance certificate on completion of the building work.

3.3.1 Current functions of building consent authorities and territorial authorities

Building consent authorities are responsible for the regulation of building activity within the districts of territorial authorities. Under section 12(1) of the Building Act a building consent authority:

• issues building consents (except consents subject

to a waiver or modification);

• inspects building work for which it has granted a

building consent;

• issues notices to fix;

• issues code compliance certificates; and

• issues compliance schedules.

A building consent authority may be an independent organisation and not part of a territorial authority.

An independent building consent authority performs the functions of a building consent authority, except that it must obtain a project information memorandum from the territorial authority, provide copies of all building consent documentation to the territorial authority and notify the territorial authority when it has issued a compliance schedule.

A territorial authority must perform, either in-house or through an independent or another building consent authority, the functions of a building consent authority for its own district. In addition to these functions, a territorial authority:

• issues project information memoranda, building consents where the consent is subject to a waiver or modification of the Building Code, certificates of acceptance and compliance schedules;

• enforces notices to fix;

• administers and enforces annual building warrants

of fitness;

• decides the extent to which buildings must comply with the Building Code when they are altered, their use is changed, or their specified intended life changes;

• performs functions relating to dangerous,

earthquake-prone or insanitary buildings;

• determines whether building work is exempt under

Schedule 1 from requiring a building consent; and

• carries out any other functions and duties specified

in the Building Act 2004.

Territorial authorities maintain records of all building consents including as built plans, usually within a document management system. These records are usually only directly accessible within the territorial authority.

3.3.2 Profile of building consent authorities There are currently 66 registered and accredited territorial authority building consent authorities and

three registered and accredited regional authority

building consent authorities. Five private organisations providing contract services to local authorities have also been accredited to the building consent authority standards but are not registered private building consent authorities under the Act. They work under

the jurisdiction and authority of the local authorities they are working for.

Building consent authorities have varying capability and capacity; typically this will be in direct relationship to the profile of building activity in their district. This activity will consist of different kinds, and quantities,

of residential and commercial building work (both new buildings and alterations to existing structures).

A large proportion of consents issued by building consent authorities is for residential buildings. By value, non- residential3 building consents comprise 35–45 per cent of all building consents issued nationally. For the large building consent authorities of Auckland, Wellington and Christchurch, the non-residential proportion increases to 50–55 per cent by value.4 Ninety per cent of non-residential building consents comprise work

less than $500,000 in value and include alterations and additions to existing buildings.

Estimates from MBIE indicate that the number of building consents in 2010 for complex new buildings was approximately 13 per cent of total new non- residential buildings (or one per cent of the total number of building consents).

Complex building consent applications are the highest risk, require the highest levels of competence for their assessment and are the most time-consuming to process. Metropolitan building consent authorities issue most of the complex commercial building consents, typically have more highly qualified and experienced staff, and regularly use specialist professional engineers (structural, geotechnical, etc.) where these are required to review complex commercial designs.

The Royal Commission has heard evidence that small to medium-sized building consent authorities do not have a sufficient volume of complex building work to maintain staff with the highest competency levels; rather, they have an accredited process to outsource the assessment of complex commercial

consent applications either to another building consent authority that does have the appropriately qualified and experienced staff or to local professional engineers with the appropriate qualifications and experience.

3.3.3 Building consent authority accreditation Building consent authorities must operate in accordance with regulations 5 to 18 of the Building

(Accreditation of Building Consent Authorities)

Regulations 2006 and be accredited every two years. Compliance with the Regulations is being required

on a staged basis from 1 February 2007 through to

1 December 2013.

The accreditation of building consent authorities is undertaken by International Accreditation New Zealand (IANZ). IANZ is part of the Testing Laboratory Registration Council, an autonomous Crown entity established in 1972. To operate as an accreditation authority, IANZ must comply with the ISO/IEC 17011

*Conformity Assessment – General Requirements for Accreditation Bodies Accrediting Conformity Assessment Bodies5* Standard. IANZ also meets the requirements of the Asia Pacific Laboratory

Accreditation Cooperation (APLAC) and those of the International Laboratory Accreditation Cooperation (ILAC). IANZ services include formally recognising the technical competence and management effectiveness

of laboratories, medical testing and screening, inspection bodies, and radiology services, amongst others.

Mr Geoffrey Hallam is the Regulatory Affairs Manager employed by IANZ. In his evidence to the Royal Commission, he explained the two-yearly accreditation process for building consent authorities. This is a comprehensive review that includes reviewing

the building consent authority’s documentation systems to ensure compliance with the Regulations. IANZ

assesses each building consent authority on-site over a

3–5 day period. All stages of building control are sampled, and the process includes a technical assessment of the review of building consent applications (building design and specifications) through to observation of building officers undertaking site inspections. At the end of the assessment, IANZ prepares a full written report and discusses any corrective actions required with the building consent authority.

Mr Hallam also explained the processes a building consent authority would follow in order to be able to issue building consents for complex buildings, as follows:

• Every application is allocated a level of building

complexity.

• Every building official has been assessed for

competence using the same complexity levels.

• The accreditation regulations require work to be

allocated to persons assessed as having the necessary competence for the project.

• Applications for building consent are checked for completeness before acceptance (not technical).

• Building officials (or contracted experts) undertake detailed assessment of the submitted plans and specifications to establish compliance with every applicable clause of the Building Code.

• Further information is often required during

this process.

• Formal peer review may also be requested.

• When compliance of an application with the Building Code is confirmed, a Building Consent is granted.

• During construction, building inspectors confirm that construction is in accordance with the consented plans and specifications.

• If construction is significantly different from the approved design, remedial action is required or approval of an amendment to the design is required.

• Records of who worked on each project are retained (building consent authority staff and contracted experts).

• Building consent authorities contract out work

they do not have the competence to handle in-house. This is a managed process.

• Work may be contracted out to other

building consent authorities or to appropriate professionals.

• Decisions made during processing and inspections are recorded as are the reasons for decisions.

• Engineered designs are, by definition, unique. Therefore consideration of the need for peer review of a design is case-by-case. Decisions should be risk based.

• IPENZ Practice Note 2 defines types and scope of peer review. When a peer review is requested, it must be clear what type of review is required.

From the submissions received from the building and construction sector, we conclude that there is a general consensus that building consent authority accreditation is a thorough process that has significantly improved

the quality of building consent decision making over the past five years. We accept that is the case.

However, the currently large number of building consent authorities still results in inconsistent application requirements and consent decisions around the country. This adversely impacts the efficiency of national design and/or construction companies and poses risks to the quality of the review of structural design during the consenting process. However, we also heard evidence from Mr Nick Hill and Mr Peter Laurenson representing the Building Officials Institute of New Zealand (BOINZ).

It was their view that the systems and competency levels of building consent authorities are continuing to improve. In addition, some building consent authorities

are working in “clusters” to develop common processes and to share skilled and experienced staff. The Royal Commission supports such initiatives, which indicate it

is likely that national consistency will continue to improve.

3.3.4 The competence of building consent authorities

Regulations 9 and 10 of the Building (Accreditation of

Building Consent Authorities) Regulations 2006 require

a building consent authority to establish and assess the competence of staff and allocate work in accordance with these competencies. MBIE has developed a National BCA Competency Assessment System to provide to the candidate and assessor a detailed specification of the knowledge and skills that are required for a person to be competent at a particular level. There are six competency specifications, one for each of the national competency levels (Residential 1–3 and Commercial 1–3). Each competency specification contains:

• competencies required by Regulation 10(3) of the Building (Accreditation of Building Consent Authorities) Regulations 2006;

• performance indicators to meet the competencies

in Regulation 10(3); and

• guidance for assessors and candidates for meeting

the performance indicators.

Regulation 18 will require staff to have appropriate qualifications, by 1 December 2013, that are commensurate with the complexity of the buildings they are assessing. Mr Hill gave evidence that building consent officers generally had qualifications at a trade level rather than degree level. He noted that MBIE

had only very recently recognised eight qualifications applicable to building consent officers – six at degree level and two at diploma level. He considered these higher-level qualifications for building consent officers would help lead to a generational improvement in professionalism. BOINZ has worked with Otago Polytechnic to develop and provide the Diploma in Building Control Surveying. BOINZ also provides structured continuing professional development for

its members, to ensure knowledge and skills are maintained. The Royal Commission considers the requirement for building consent officers to have formal qualifications to be an important step in continuing to improve the capability of the sector. The Commission also sees the provision of ongoing professional development provided by BOINZ as an important means of ensuring building consent officers remain current in their knowledge and skills.

It is appropriate to record that we were impressed by the effort that BOINZ is putting into the continuing professional development of building consent officers. We consider that they should continue to be supported by Local Government New Zealand and territorial authorities.

3.3.5 Review of the structural design of complex buildings

The Building Act 1991 required producer statements to be supplied by or on behalf of the applicant for

a building consent (or by or on behalf of a person who had been granted a building consent). Such statements certified that certain work would be, or had been, carried out in accordance with the

technical specification. Contrary to the position under the Building Act 1991, producer statements are not expressly provided for in the Building Act 2004.

However, a building consent authority could have regard to a producer statement or its equivalent in deciding whether it is satisfied on reasonable grounds that the provisions of the Building Code have been met.

A submission by Dr Barry Davidson of Compusoft Engineering discussed the common process of using producer statements for consenting the structural design of complex commercial buildings.

Current Building Consent Process with Regards to

Structural Design:

(i) On application for a Building Consent by the owner or his/her agents, the structural designer usually provides two copies of the structural drawings, specification and calculations, and often a Producer Statement 1 – Design (PS1) stating

that the design complies with the Building Code and all applicable structural Standards.

(ii) Often depending on the size of the project, prior to issuing a Building Consent, the Territorial Authority (TA) may check the design documentation themselves, simply accept the PS1, or it may request that an ‘independent’ engineer carry out a design review, and

when the reviewer is satisfied that the design complies with the Building Code, he/she will issue a Producer Statement 2 – Design Review, to that effect.

Notes:

(a) On many projects, there may be a number of PS1’s issued by the design engineer, to cover a staged consent process that allows, for example, foundation construction to proceed before the design of the superstructure is completed. In addition, sub-contractors

supplying the likes of precast floor systems and timber roof trusses will issue PS1’s to cover

their proprietary designs.

(b) For more complex projects, discussion between the TA and the owner may take place at the beginning of the project to nominate a designer reviewer who can perform the review at stages during the development of the design, to match the staged consent process.

(c) For many projects, staged construction starts before all of the design (and review) is completed, but each stage is supposed to be fully consented before it starts on site.

Notwithstanding the change made by the Building Act

2004, building consent authorities generally accept producer statements as suitable documentation

for assessing compliance with the Building Code for complex building designs, and some building consent authorities require them. In fact, the evidence considered by the Royal Commission indicates that many building consent authorities rely on these documents as an effective means of collecting and

recording information required to process an application for a complex building consent, and as a basis for peer review. However, because peer reviews and producer statements are not a requirement of the 2004 Act, there is some confusion over their standing.

3.3.6 Quality assurance issues raised in evidence

Submissions and evidence from the New Zealand Construction Industry Council (NZCIC), Dr David Hopkins, Mr John Scarry, and others identified issues with peer review and the consenting process for commercial buildings. These issues are summarised as follows.

• There are too few qualified and experienced engineers on the staff of the regulator (MBIE) and the building consent authorities.

• Most building consent authorities lack sufficient structural engineering resources to maintain technical oversight of complex commercial designs, especially for staged construction. Most simply do not receive the volume of consents to justify having these skills available in-house. Rather, they use the resources of a larger building consent authority, share such resources within a building consent authority “cluster” 6, or employ the resources of

a professional engineer or engineering firm to

undertake the review in accordance with their accredited process. Only the large metropolitan building consent authorities typically have such resources in-house. Submitters raising this issue also considered that there were too many building consent authorities, resulting in skilled resources being spread too thinly across the authorities

and causing inconsistency in consent information requirements and decisions.

• Consenting by building consent authorities is focused more on process than on technical design (especially the structural integrity of the design).

• There are a variety of processes for documenting, reviewing and consenting complex commercial buildings, including:

– widespread use of producer statements by designers and building consent authorities

to assess the compliance of designs with the

Building Code; and

– the common use of a staged consenting process for commercial buildings, which requires appropriate knowledge and oversight to ensure the overall structural integrity of the building as a whole across the stages.

However, as Dr Davidson submitted:

The Producer Statement process overlooks the demands of the commercial world and human nature, and many of the parties that now dominate the design and construction process are not structural engineers and have limited structural design knowledge.

• Designers often use building consent authorities in lieu of internal peer review processes to assess whether designs comply with the Building Code. There is also some “gaming” of the system to cut costs and/or manage missed client deadlines by submitting incomplete building consent applications and relying on the building consent authority to identify areas of non-compliance. Sometimes the building consent authority is then wrongly blamed

for delays.

• Several submitters questioned whether the statutory

20 working day timeframe to issue a building consent is sufficient time for processing a building consent application for a complex commercial building. They question whether this could result

in insufficient technical/structural review during the building consent process.

• There is a lack of personal and firm responsibility for

design (and product use) failure.

• Insufficient resources are applied to research and education. Submitters considered research and education to be below the level needed to maintain adequate competence within the sector. As a

result, building and product failures are not (or not

sufficiently) investigated, particularly where there

are confidentiality clauses in insurance settlements. This means that findings/issues from building failures (and product failures) are not publicised and lessons are not learned across the sector.

• Building information, such as as-built plans and specifications, are not readily accessible on a regional or national basis, which makes national analysis of trends and performance issues difficult, if not impossible.

• The relatively small size of the New Zealand commercial building sector means that reviewers are in many instances not independent of the

designer or the owner or his agents. This can mean:

– the same engineers regularly review the structural designs of the same designers (with a risk that they get “comfortable” with a “type” of building design);

– a lack of independence;

– potential for a conflict of interest; and

– the designer is not involved in supervision/ monitoring of construction due to “cost” or because of other client commitments.

• Not all designers have equal ability and knowledge. The current process of using the Chartered Professional Engineer (CPEng) quality mark

assumes that designers with that qualification are

capable of designing and/or reviewing the design of a complex structure. However, there have been cases where significant buildings have not been adequately designed. In addition, under the current process (when a designer repeatedly uses the same design reviewer), a common mistake is made in thinking that, because someone has designed one type of building on many occasions, they are expert at it. It is possible that a particular design/review team is consistently getting the design wrong. All designers make mistakes at some time.

• The insurance industry provides negative incentives to the process. Dr Davidson states in his submission that “the insurance industry negatively influences a positive long-term outcome for quality designs” because “after a building failure, the negotiation process between insurance companies ensures that information about the situation is buried” (through non-disclosure statements).

3.3.7 Addressing the issues raised

The Royal Commission heard suggestions for addressing many of these issues.

The NZCIC proposed a regulatory model supported by most submitters, including IPENZ. This model strengthens current processes by requiring (by regulation): (i) designers to observe construction and provide evidence that their designs have been correctly constructed; and (ii) builders/constructors to provide evidence in support of the application for a Code Compliance Certificate (in addition to the observation/ inspection information collected by the building

consent authority) to demonstrate that the building has been constructed in compliance with the design. The NZCIC model recognises three occupational groups – designers/architects, engineers and constructors – who need to be regulated differently to reflect their differing roles and responsibilities.

IPENZ noted in its submission the need to differentiate between building types.

Residential buildings typically pose less risk to life than commercial buildings. The regulatory framework needs to acknowledge this by being more explicitly risk based.

The Building Amendment Act 2012 attempts to address this with new provisions for determining the approved risk profile for the proposed design and a quality assurance system that will apply to building work.

The New Zealand Registered Architects Board (NZRAB) provided the Royal Commission with an interim report by a working party it established to consider the implications of the Canterbury earthquakes for the architectural profession. This report made a series of specific recommendations particularly focusing on

the need to include greater involvement of structural engineers in projects, particularly at an early stage, as follows:

• Encourage architects to advise their clients of the benefits of engaging a structural engineer at an early stage of project design;

• Review the relationship between architects and structural engineers to achieve adequate structural design input at an early stage of

the design. The structural engineer should be

engaged at the same time as the architect;

• Ensure architects request structural engineers to advise of inter-storey deflections at the serviceability and ultimate limit states early in the design process;

• Ensure that architects work closely with structural engineers in designing seismic load transfer elements in multi-storey buildings;

We consider that these recommendations are sensible. Dr David Hopkins and others recommended a review

process that specifically includes a design features report7. (An example of a Design Features Report that he provided is set out in Appendix 5 of this Volume.)

In his submission, Dr Hopkins expressed the opinion that a design features report “is a very good discipline for design engineers, plays an important part in quality assurance and can give building consent authorities a good starting point for their consent process”.

The Building Amendment Act 2012 may resolve some of these issues with the current review process by requiring building consent authorities to approve

a risk profile for the building work and the quality assurance system that will apply to the building work before a building consent application is submitted.

Regulations will be developed based on the results of two pilots currently in progress. At a high level the two approaches do not appear incompatible. A design features report could form part of the risk profile of the building work.

Mr John Scarry reminded us that design features reports and peer reviews do not compensate for a lack of structural experience of the original designer. However, he suggested that peer reviews should be a two stage process – once, early on, at the what he

called the ”butter paper, thick marker” concept stage, and then at the end of the design process.

3.3.8 Discussion – quality assurance

**3.3.8.1 Key issues to be addressed**

In summary, we have heard and accept evidence that:

• Building consent authority performance and staff competencies have improved significantly over the past five years through a comprehensive accreditation process. However, with 69 building consent authorities, there is still inconsistency of consent processes and decision making around the country.

• Building consent authorities have insufficient numbers of experienced structural engineers reviewing the structural integrity of designs at a detailed, technical level.

• There is sometimes a lack of involvement of structural engineers at an early stage in the design of a building.

• Not all CPEng qualified engineers are necessarily capable of designing, or reviewing, complex structures.

• There is insufficient external peer review by

independent, experienced structural engineers.

• Where peer review occurs, there is sometimes no

express assurance about the independence of the reviewer.

The Royal Commission agrees that these key issues need to be addressed in respect of buildings whose design may involve challenges for the designer, and whose failure in an earthquake may have serious consequences in terms of the safety of their occupants and the public. In the discussion that follows we propose that “complex structures” should be the subject of a special process designed to give greater assurance about the quality of their design than is currently the case.

**3.3.8.2 Complex structures**

It is difficult to lay out a precise description of what constitutes a “complex structure”. However, we are satisfied that such structures would normally involve common features which, alone or in combination, could result in the structure being considered complex. These would include matters such as building irregularity, complex gravity or lateral load paths, the need for complex analytical methods in the design process, eccentricity, and particular site considerations,

including soil structure (requiring special care in the design of foundations), combined with considerations of scale and design occupancy numbers. Given the importance of the changes we are suggesting, we recommend that MBIE should develop criteria to be applied in determining whether a structure is complex for these purposes, in consultation with the Structural Engineering Society of New Zealand (SESOC), the New Zealand Society for Earthquake Engineering (NZSEE), the New Zealand Geotechnical Society (NZGS) and other relevant groups, including building consent authorities. When developed, the criteria should be given regulatory force.

The classification of any particular structure as complex should be based on a two-stage process. The first

stage would essentially be a preliminary filter that resulted in the exclusion of many buildings as not needing any consideration as potentially complex in nature. The second stage would involve a consideration of a Structural Design Features Report that would be required for any building not excluded in the first stage. A decision would be made at the second stage as to whether the building should be treated as complex and therefore subject to the special consenting processes that we propose for complex buildings.

The first stage can be based to some extent on the “importance levels” for buildings, set out in Table 3.2 of AS/NZS 1170.0:2002, *Structural Design Actions Part O: General Principles*8. We consider that all buildings in categories 3, 4 and 5 in that Standard

should be subject to the new process that we propose. These categories are set out in the following table, extracted from Table 3.2 in AS/NZS 1170.0:2002.

**Table 2: Building Importance Levels – extract from Table 3.2 in AS/NZS 1170.0:2002, *Structural Design Actions Part O: General Principles***

|  |  |  |
| --- | --- | --- |
| **Importance**  **Level** | **Comment** | **Examples** |
| 3 | Structures that as a whole may contain people in crowds or contents of high value to the community or pose risks to people  in crowds | Buildings and facilities as follows:  (a) Where more than 300 people can congregate in one area  (b) Day care facilities with a capacity greater than 150 (c) Primary school or secondary school facilities with a  capacity greater than 250  (d) Colleges or adult education facilities with a capacity greater than 500  (e) Health care facilities with a capacity of 50 or more resident patients but not having surgery or emergency treatment facilities  (f) Airport terminals, principal railway stations with a capacity greater than 250  (g) Correctional institutions  (h) Multi-occupancy residential, commercial (including shops), industrial, office and retailing buildings designed to accommodate more than 5,000 people and with a  gross area greater than 10,000 m2  (i) Public assembly buildings, theatres and cinemas of greater than 1000 m2  Emergency medical and other emergency facilities not designated as post-disaster  Power-generating facilities, water treatment and waste water treatment facilities and other public utilities not designated  as post-disaster  Buildings and facilities not designated as post-disaster containing hazardous materials capable of causing hazardous conditions that do not extend beyond the property boundaries |
| 4 | Structures with special post-disaster functions | Buildings and facilities designated as essential facilities Buildings and facilities with special post-disaster functions Medical emergency or surgical facilities  Emergency service facilities such as fire, police stations and emergency vehicle garages  Utilities or emergency supplies or installations required as  backup for buildings and facilities of Importance Level 4  Designated emergency shelters, designated emergency centres and ancillary facilities  Buildings and facilities containing hazardous materials capable of causing hazardous conditions that extend beyond the property boundaries |
| 5 | Special structures (outside the scope of this Standard – acceptable probability of failure to be determined by special study) | Structures that have special functions or whose failure poses catastrophic risk to a large area (e.g. 100km2) or a large number of people (e.g. 100,000)  Major dams, extreme hazard facilities |

We would then add all residential and commercial building of three or more storeys in height, provided that, in the case of residential buildings, they contain three or more household units. In our proposal, all the buildings in the categories described would require the preparation of a Structural Design Features Report. The provision of such a report would not be onerous, when compared with other requirements of the application process. Our intent in casting the net reasonably wide, however, is to ensure that the complexity issue is addressed in respect of all buildings whose failure in

an earthquake could have serious implications for the safety of the occupants or passers-by.

On receipt of the Structural Design Features Report, the building consent authority would make a judgement as to whether the proposed building should be regarded

as complex, having regard to the considerations that we have outlined above. We expect that the majority of the buildings would not be regarded as complex after consideration of the Structural Design Features Report, and in that case, the building consent application could proceed and be processed from that point in the normal way. We propose a special process for the buildings

that are considered complex at this second stage. This is discussed in section 3.3.8.4 below.

**3.3.8.3 Structural engineering expertise**

To address the issue of insufficiently experienced structural engineers designing complex structures and undertaking peer review of these structures, we propose a new category of structural engineer, to be known as a Recognised Structural Engineer. These

senior, very experienced structural engineers would be required to certify the adequacy of the structural design of complex buildings. We discuss the qualification requirements for a Recognised Structural Engineer in section 4 of this Volume.

To address the issue of insufficient engineering input at an early stage of design, we consider that the structural engineer responsible for a design should be engaged at the same time as the architect (or other designer) of the complex building.

**3.3.8.4 Building consent process**

We have concluded that the design of complex buildings (as described above) requires a higher level of competence than the design of buildings that are more straightforward. We consider the appropriate regulatory procedure to ensure this occurs is the preparation and submission of a Structural Design Features Report at the outset of the building consent authority assessment of the building consent application.

This could be achieved with minimal change to the existing process. In making the recommendations that follow, we are aware of the requirements of the

Building Amendment Act 2012 for commercial building consents, and that the supporting regulations are

under development. Without seeing the regulations, we cannot be certain about the “fit” between the new legislation and the approach that we recommend. However, we do not see any necessary inconsistency between the provisions of the 2012 Act and the measures we are recommending. In any event, what we recommend here are provisions that we consider should apply.

The proposals that we make are summarised in the recommendations that we now set out.

**Recommendations**

We recommend that:

162. Building consent applications for:

• buildings in importance levels 3, 4 and 5

in Table 3.2 of AS/NZS 1170.0:2002;

• commercial buildings comprising three

or more storeys; and

• residential buildings comprising three or more storeys with three or more household units

should be accompanied by a Structural Design Features Report, which describes the key elements of the design, including the foundations and gravity and lateral load resisting elements.

163. A structural Chartered Professional Engineer should be engaged at the same time as the architect for the design of a complex building.

164. After consideration of the Structural Design Features Report, the building consent authority should decide whether or not the structure should be regarded as complex.

165. The Ministry of Business, Innovation and Employment should develop criteria to be applied in determining whether a structure is complex, in consultation with the Structural Engineering Society New Zealand, the

New Zealand Society for Earthquake Engineering, the New Zealand Geotechnical Society and other relevant groups, including building consent authorities. When developed, the criteria should be given regulatory force.

166. If the structure is determined to not be complex, the engineer who provided the Structural Design Features Report should certify the structural integrity of the building’s design.

167. If the structure is determined to be complex, a Recognised Structural Engineer should be required to certify the structural integrity of the design.

168. On receipt of the building consent application, the building consent authority should decide:

a whether it has the staff with the appropriate competency (qualifications

and experience) to process the application in-house (including any decision as to whether the structure is complex and whether any additional peer review

certified by a Recognised Structural

Engineer should be required); or

b whether it needs to refer the application to another building consent authority that has the staff with the appropriate competency (qualifications and experience) to process the application.

3.3.9 National consenting system

Several submissions discussed the idea of a centralised national consenting system. Another possibility discussed was providing for a fewer number of building consent authorities, organised on a regional basis.

We accept that reform along these lines would enable the creation of viable groupings of specialists, including experienced senior engineers, resulting in improved decision making, in terms of consistency and quality. Another likely benefit would be the creation of an improved career path for building control officers. Such a system would also have the benefit of facilitating the identification of emerging issues and trends.

However, the timely processing of building consents is also an important feature, which has received particular attention in recent years. It is important that the consenting system operate in a timely way. We consider that the consolidation of the building consent process into one national or several regional centres would inevitably

lead to greater delays. Further, establishing a national

system would be a major undertaking and would be difficult to administer. It would be a major change to

the current building regulatory regime and would require more detailed consideration of the principles behind

a locally-administered regulatory regime than we are required by our Terms of Reference to consider. Nor do we consider such a change is justified by the experiences of the Canterbury earthquakes and the

evidence before us. We consider that the key matter for consideration, under our Terms of Reference and from what we have learnt in the course of our Inquiry, is the provision of assurance that complex structures are designed by appropriately qualified and experienced people. We consider the measures outlined above to

be sufficient to address that key concern.

**3.4 Leadership**

3.4.1 The regulator

The overall leadership of the building and construction sector rests with the regulator, currently MBIE (formerly the Department of Building and Housing). The role of the regulator is to:

• set the policy and regulatory framework;

• issue and review compliance documents;

• publish guidance information on the requirements of

the Building Act and the Building Code; and

• review the operation of territorial authorities, regional authorities and building consent authorities in relation to their functions under the Act.

The Act sets out the role (section 11) and responsibilities (sections 169 to 211) of the chief executive of the responsible department. This includes monitoring current and emerging trends in building design, building technologies and other factors

that may affect the Building Code and compliance documents, and issuing guidance information to the sector. The chief executive also has the power to provide a warning about, or ban the use of, a building method or product (section 26) and to make

a determination9.

3.4.2 Other industry groups

Leadership is also provided by other groups within the building and construction sector. This includes:

• learned societies such as SESOC, NZSEE, NZGS, the New Zealand Concrete Society (NZCS), the Heavy Engineering Research Association (HERA) and the New Zealand Timber Design Society;

• professional societies and industry bodies such as IPENZ, the Association of Consulting Engineers New Zealand (ACENZ), NZRAB, and BOINZ, who maintain the qualifications, training and interests of the professionals, officials and trades that operate in the sector;

• research organisations, particularly the Building

Research Association of New Zealand (BRANZ);

• NZCIC; and

• Standards New Zealand, which develops, reviews and updates New Zealand Standards and is the operating arm of the Standards Council.

3.4.3 Technical leadership

Lack of strong technical leadership from the regulator was a key issue raised in submissions. Many submitters argued that MBIE and the building consent authorities had limited structural engineering capability. Rather, MBIE is perceived as being focused on policy and regulatory tools (which are important) and as not providing sufficient focus on technical compliance requirements, particularly about the structural aspects

of complex buildings.

The Royal Commission heard from Mr David Kelly, Director of Canterbury Rebuild and Recovery at MBIE, that two key leadership roles were established in 2008: Chief Engineer and Chief Architect. Mr Kelly explained that the role of the Chief Engineer is to:

• provide high-level technical leadership and advice

to the Ministry;

• develop a critical understanding of future and

current trends;

• provide strategic and technical advice to the sector;

• foster strong relationships with the sector; and

• facilitate the Engineering Advisory Group (which was established as a result of the Canterbury earthquakes and consists of highly experienced technical experts).

As discussed above, and in our discussion of the building failures in the Canterbury earthquakes in Volumes 2, 4 and 6 of our Report, structural design is of critical importance in ensuring the safety of building occupants in an earthquake.

We consider the role of Chief Engineer is critical for technical structural engineering leadership for the building and construction sector. We support the Ministry’s initiative in creating this role. However, we consider the role should be further strengthened, and supported with additional capability, by:

• emphasising the structural engineering nature of

the role – Chief *Structural* Engineer;

• focusing the role on complex building designs;

• collecting and analysing complex commercial building consent applications from building consent authorities to enable:

– assessment and monitoring on a national basis to identify trends in design, structural engineering approaches and construction techniques;

– identification of potential issues and risks associated with particular types of buildings or construction techniques identified from the analysis of consent information;

– identification of the need for compliance information, guidance material and, in conjunction with IPENZ and the learned societies listed above, training requirements, particularly in relation to structural design, construction methods, site supervision and monitoring; and

• promoting, authorising and communicating to

the building industry and the public standards for building design, construction and materials.

We also heard evidence that the current role of

Chief Engineer appears to be under-resourced.

Mr Kelly explained that, as a result of the Canterbury earthquakes, an Engineering Advisory Group consisting of highly regarded and experienced technical experts had been established to support the Chief Engineer.

We agree that it is important that sufficient technical engineering expertise is provided to support the

role and functions of the Chief Structural Engineer. We recommend the continuation of the Engineering Advisory Group as an ongoing function to provide expert advice to the Chief Structural Engineer. We also recommend that MBIE consult with the relevant learned societies about the membership of that group, on an ongoing basis. The membership should always include senior, practising structural engineers.

**Recommendations**

We recommend that:

169. The role of Chief Engineer should be renamed Chief Structural Engineer to reflect a greater focus on the structure of complex buildings and should be further strengthened and supported with additional capability.

170. The Chief Structural Engineer should have the statutory power to collect consent applications for complex structures (as part of the Policy and Regulatory Work Programme in Recommendations 173 and

174 below) for the purpose of analysing trends, identifying issues and risks, and sharing knowledge with the building and construction sector.

171. The Engineering Advisory Group should continue as an ongoing function to provide expert advice to the Chief Structural Engineer.

172. The Ministry of Business, Innovation and Employment should consult with learned societies, such as the New Zealand Society for Earthquake Engineering, the New Zealand Geotechnical Society and the Structural Engineering Society New Zealand, about

the ongoing membership of the Engineering

Advisory Group. The membership of

the Group should always include senior practising structural engineers.

**3.5 Clarity about roles and responsibilities**

The majority of submissions received identified a lack of clarity in relation to the roles and responsibilities of participants within the building and construction sector.

Particular concern was expressed about not always having clear policy made centrally, such as whether protection of life should be the sole objective of building design or whether maintaining building serviceability after an earthquake should also be the goal. Dr Nicki Crauford of IPENZ noted in her evidence that “policy decisions should then inform legislation and regulations and flow through to the Building Code, Standards and guidance documents… and these policies need to be sufficiently comprehensive so compliance documents

do not become policy by default”. This is a valid point.

The Standards Council gave evidence that this lack of clarity has hindered the prioritisation and funding of the regular review and update of those New Zealand Standards referenced in the Building Code. The submissions from NZCIC and IPENZ pointed to the

benefits of having a national policy and regulatory work programme for the building and construction industry covering a rolling 3–5 year period. Development of this work programme would be led by MBIE and set out:

• a clear statement as to what the regulatory

framework aimed to achieve;

• the specific work programme and responsibilities

for delivery;

• how participants would comply with the

requirements of the regulatory framework; and

• how the success of the programme would

be measured.

There was a general consensus among hearing participants that such a work programme should be established, led and funded by MBIE, in consultation with SESOC, NZSEE, NZGS and other relevant groups, including BRANZ, NZCIC and representatives of the building consent authorities. There was also general consensus that MBIE’s role as the central regulator should be to have responsibility for developing building policy, including determining the level of risk that can

be tolerated, and the Building Code and Standards needed to ensure the design and construction of

safe buildings. It is important that the public have the opportunity to contribute to the formulation of building design policy.

3.5.1 Uncertainty about who should develop

Standards and when

Evidence heard by the Royal Commission indicated uncertainty within the sector as to who should develop Standards, how frequently Standards should be reviewed, and how the review and availability of Standards should be funded.

A lack of clear responsibility and funding for the review and updating of Standards referenced in the Building Code has resulted in some Standards now being out

of date. International guidance advises that Standards should be reviewed and, if needed, updated, every

5–7 years.

Dr Peter Mumford, a Director within the Economic Development Group at MBIE, gave evidence on the history of the funding of Standards. He explained that government originally subsidised the Standards Council

by up to 50 per cent of its income; however, this approach came to an end in 1986 when it was agreed that an annual grant would be provided to the Council to contribute to its international activities and that “the Government [would] give favourable consideration to funding standards by designated grants proposed in departmental estimates”. In other words the funding

would come through the department responsible for the area of regulation and it was up to that department to determine funding priorities.

The funding model was moved to the current funding model in 1989/90. Dr Mumford said in evidence that there were three reasons for this shift.

Firstly the need for the Council to operate a commercial model and, in this context, to achieve financial self-sufficiency and that’s part of the objective. The second is the need for the Government to meet its international obligations in relation to standards. It has a set of international obligations with respect to Australia, and with respect to the WTO. And thirdly, and importantly in this context, the central role of regulators in determining whether

a standard is required to support regulatory outcomes... I quote from the report to Government in 1986… “Individual public sector agencies have a responsibility for the public good in their respective areas and they are the qualified agencies to determine whether a standard is the appropriate method to provide public protection in their areas”. So it put the responsibility with the government agencies that have the responsibility for, if you like, delivering on the public good.

For the 2012 financial year, Standards New Zealand received approximately $7.5m in revenue and incurred a deficit of approximately $250,000, which it funded from reserves. Revenue comes from the sale of Standards and from industry and government departments funding the development and maintenance of Standards. Standards New Zealand has meagre reserves and insufficient funding to self-fund the review and updating of Standards on a regular cycle.

Where Standards are in the public arena, the Standards Council encourages the relevant public agency to fund the review and update of the Standards, but it is the agency’s decision based on funding priorities. Therefore the work priority of Standards New Zealand is driven by those organisations that are prepared to fund the work.

Overseas jurisdictions typically have more resources as a result of larger populations or government support. Standards Australia has a large investment fund of approximately $180 million and is able to fund the development and maintenance of Standards from the interest earned by the fund.

It is clear that designers, engineers and building officials place significant reliance on Standards as key compliance documents. Currently there are approximately 300 standards referenced in the

compliance documents of the Building Code, thereby becoming part of the regulatory framework. The consequence of not updating critical standards is that developments in engineering understanding, such as those resulting from the Christchurch earthquakes, may not be incorporated in a timely manner.

Because of limited funding, Standards New Zealand typically manages the development, review and update of Standards using “volunteers”. These are usually industry experts and academics who contribute to

the review of a Standard in addition to their paid employment. This often results in lengthy timeframes for completion of the review, as business demands often take precedence.

The Royal Commission considers that Standards that are relied upon by structural engineers during complex building design should be reviewed and updated as a priority, and funded as part of MBIE’s work programme undertaken by the Chief Structural Engineer.

A contributing issue identified in submissions was that the purchase price for New Zealand Standards creates a barrier to their accessibility and use. Standards referenced in a compliance document are freely available at MBIE offices. However, engineering professionals and other building practitioners appear to access all Standards, regardless of whether they are referenced

in a compliance document, through Standards

New Zealand. This incurs a cost, as Standards

New Zealand charges for such access, in accordance with its funding model.

In conclusion, the Royal Commission considers:

• Standards are a critical part of a performance-

based regulatory system.

• Standards relied on for the purposes of building design need to be regularly reviewed and, if required, updated on a prioritised basis. They should be publicly available electronically, and free of charge.

• The review of Standards should be based on agreed priorities and high priority Standards should be reviewed and updated as part of the work programme overseen by the Chief Structural Engineer.

• Standards referenced in the Building Code should

be available online free of charge.

3.5.3 Policy and Regulatory Work Programme The Royal Commission agrees that MBIE should develop, lead and fund a Policy and Regulatory Work

Programme in consultation with IPENZ, NZCIC,

Standards New Zealand, BRANZ, NZGS, NZSEE and

SESOC. The programme would set the objectives for

the regulatory framework for the next 3–5 years, identify the initiatives required to achieve the objectives, the specific work priorities, measures and targets where appropriate, and the agreed responsibility for delivery

for each piece of work within the programme.

Such a programme would provide clarity for the sector by identifying the priorities for the development, review and update of compliance documents and Standards, and would define the status of all compliance documents and guidance material. This would assist sector organisations to determine where they should develop their own specific guidance and when to provide appropriate advice to others, including the regulator.

It would also assist organisations such as BRANZ and universities plan their research programmes so the resulting research is able to assist the development

of compliance documents and Standards.

The work programme should be the responsibility of the Chief Structural Engineer. A key driver of the work programme will be the results from collection and analysis of the information on complex building consents provided by building consent authorities.

Work such as the review and update of Standards cited or referenced in the Building Code included in the programme should be funded by MBIE.

To ensure there is no confusion about roles, responsibilities, priorities and timeframes, a communications plan should be developed by MBIE as a key component of the work programme. The communications plan should identify the most appropriate communication method for each group of industry participants to receive information

about compliance documents and Standards, and any guidance. The status of any such guidance should also be made clear. The effectiveness of the communications plan should be regularly reviewed.

**Recommendations**

173. The Ministry of Business, Innovation and Employment should develop, lead and fund a Policy and Regulatory Work Programme

in consultation with the Institution of Professional Engineers New Zealand, the New Zealand Construction Industry Council,

Standards New Zealand, the Building Research Association of New Zealand, the New Zealand Geotechnical Society, the New Zealand Society for Earthquake Engineering and the Structural Engineering Society New Zealand.

174. The Policy and Regulatory Work Programme should identify the priorities for the development, review and update of compliance documents and Standards, and define the status of compliance documents and guidance material. Work relating to Standards prioritised for update as part of the Policy and Regulatory Work Programme should be funded as part of the work programme.

175. Standards referenced in the Building Code should be available online, free of charge.

176. The Policy and Regulatory Work Programme should be the responsibility of the Chief Structural Engineer.

177. A communications plan should be developed by the Ministry of Business, Innovation

and Employment to communicate the Policy and Regulatory Work Programme and ensure information is effective, and targeted for different participants in the sector. There should be clarity about the

status of information provided to the sector; for example, whether it is a compliance document, Standard or guidance.

**References**

1. Department of Building and Housing (2011). *New Zealand Building Code Handbook* (3rd ed.). Wellington, New Zealand: Author.

2. Department of Building and Housing (2009). *Building Act Review.* Retrieved from [www.dbh.govt.nz/](http://www.dbh.govt.nz/)

buildingactreview

3. Non-residential buildings include hostels, boarding houses, hotels and other short-term accommodation, hospitals, nursing homes, educational buildings, social, cultural and religious buildings, shops, restaurants, taverns, offices, administration buildings, storage buildings, factories and industrial buildings, and farm buildings.

4. Information provided to the Royal Commission by the Ministry of Business, Innovation and Employment in

November 2012.

5. ISO/IEC 17011:2004. *General Requirements for Accreditation Bodies Accrediting Conformity Assessment*

*Bodies,* International Organization for Standardization.

6. A cluster is a regional group of building consent authorities that work together to develop common processes and forms and to share capability, usually under a shared services agreement, such as arranging for a building consent authority with specialist structural engineering staff to process a consent application of a complex building.

7. The Design Features Report describes the intended structural system at a high level. Dr Barry Davidson notes in his submission that it “would describe the proposed structural form, proposed load paths, expected seismic performance etc. It is not intended to have any details such as member sizes supplied at this stage”.

8. AS/NZS 1170.0:2002. *Structural Design Action Part 0 – General Principles,* Standards Australia/Standards

New Zealand.

9. A determination is a binding decision by the chief executive of MBIE and provides a way of solving disputes and questions about the rules that apply to buildings, how buildings are used, building accessibility and health and safety. Most determinations arise from disputes between a building owner and a building consent authority.

Note: Standards New Zealand was previously known as the Standards Association of New Zealand and the Standards

Institute of New Zealand.

**Section 4:**

**Training and education of civil engineers and organisation of the civil engineering profession**

**4.1 Introduction and overview**

The Royal Commission’s Terms of Reference require us to investigate:

…the adequacy of the current legal and best- practice requirements for the design, construction, and maintenance of buildings in central business districts in New Zealand to address the known risk of earthquakes.

This includes, among other things:

…the roles of central government, local government, the building and construction industry, and other elements of the private sector in developing and enforcing legal and best-practice requirements.

We considered that, under these provisions, we should examine current arrangements for the education and training of structural and geotechnical engineers in

New Zealand, the competence standard used by the Institution of Professional Engineers New Zealand (IPENZ) to register engineers, and the occupational regulations that govern the engineering profession. We were also driven to inquire into these matters as a result of evidence that we heard in relation to the failure in

the February 2011 earthquake of individual buildings considered as part of the representative sample of buildings, and in particular the CTV building.

To assist with this part of the Inquiry, the Royal

Commission sought a report1 from IPENZ on:

• the framework governing the provision of civil

engineering education and training in New Zealand;

• the registration process for Chartered Professional Engineers (in the discussion that follows we have referred to persons so registered by the term “CPEng” as that is the approach adopted by IPENZ and the profession generally);

• requirements and obligations arising from

international engineering agreements signed by

or on behalf of the New Zealand Government and the rights and requirements for engineers under these agreements;

• regulatory or quasi-regulatory requirements that govern practising engineers (i.e. the Codes of Ethics that engineers are bound by and the IPENZ complaints and disciplinary mechanisms); and

• the roles of IPENZ and other professional and

learned societies in the civil engineering profession.

Submissions on these and related matters were made by a range of interested parties including engineering consulting firms, individual engineers, IPENZ, Ministry of Business, Innovation and Employment (MBIE), universities, learned societies, and assessors of competence for CPEng registration.

In addition to considering the various written submissions received, the Royal Commission convened a public hearing on 10 September 2012 that took the form of a panel discussion on the topics and issues set out above. As noted, the discussion that follows is also influenced by the evidence we heard about the failure of the CTV building in the February earthquake.

4.1.1 Education

International agreements underpin the nature and content of engineering education in New Zealand. The Royal Commission has heard nothing that

suggests there should be a change in the structure of the Bachelor of Engineering (BE (Hons)) degree. Rather, key matters for further consideration are in post-degree training and continuing education through provision of tailored block courses for those who are working, and mentoring within engineering firms.

4.1.2 Competence

Life safety is and will remain the paramount objective in the design and construction of buildings to resist earthquake motions. This is best achieved by having highly experienced people performing the highest risk activities. In this regard, the Royal Commission has heard proposals and views from interested parties as to the merits, issues and risks of implementing a two- tier certification system that would raise the level of

training and experience required of a structural engineer who certifies engineering design plans for complex structures. We consider there is merit in this concept and recommend the creation of “Recognised Structural Engineer” for these purposes.

We have also reviewed the competence requirements against which engineers are assessed for CPEng registration. Having considered the relevant evidence and submissions, we recommend the introduction of an additional competence measure against which every structural engineer must be assessed – “a good knowledge of the fundamental requirements of

structural design and of the fundamental behaviour of structural elements subjected to seismic actions”.

4.1.3 Codes of ethics

IPENZ members are required to act in accordance with the IPENZ Code of Ethics and CPEngs are bound by

a Code of Ethical Conduct. Both codes are identical in the obligations they impose on the registered engineers. The point of difference is that the IPENZ code is accompanied by guidance to help members determine what they must do in order to comply. The CPEng Code does not provide any guidance or advice

about how to ensure compliance. CPEngs are expected to self-determine the standards of behaviour in order to meet the terms of the Code.

The key matters of interest to the Royal Commission are the clauses governing the requirement not to misrepresent competence (IPENZ clause 4 and CPEng rule 46) and the obligations to report buildings and structures that place the public’s health and safety

at risk (IPENZ clause 11 and CPEng rule 53).

For reasons that we discussed in Volume 6 of this Report, we concluded that the structural engineer who designed the CTV building, Mr Harding, was not competent to do so without supervision by a more experienced engineer. Mr Harding was certified as a Registered Engineer (under the previous Engineers Registration Act 1924), but was not in our view sufficiently experienced to design a six-level office

building with the seismic load resisting system employed in the CTV building. Under the current CPEng framework, engineers are required to work in their designated area of practice under which they have been assessed for registration as CPEng; any engineering activities undertaken outside that area would be a breach of the CPEng Code of Ethical Conduct, which prohibits the misrepresentation of competence. We also heard in the CTV hearing that

the building had been reviewed by structural engineers from Holmes Consulting Group in 1990, who identified a critical structural weakness. In the particular circumstances addressed in Volume 6, we concluded that the reviewing engineers had acted appropriately

by informing the building designers and were justified in not raising the issue they had found with the Christchurch City Council (CCC). However, we consider that reviewing structural engineers should have a

clearly expressed ethical duty to disclose the existence of a critical structural weakness, in a process that protects them from any liability where they have acted in good faith.

4.1.4 Professional and learned societies

The contribution of a small group of volunteers from the engineering profession’s learned societies in guiding and providing a combination of post-degree education and mentoring to structural engineers is both highly valued by the profession and acknowledged by the Royal Commission. We refer to these societies in more detail in section 4.6.

The work undertaken by the societies’ members includes both contributing to formal processes

for reviewing and updating New Zealand Building Standards, and issuing guidance on best-practice for the profession and industry, some of which is paid work but much of which is not. Society members also

contribute technical papers for conference proceedings and provide guidance on best-practice to industry. Processes in which guidance is given are informal, and do not pass through the scrutiny of a regulatory review process: the best-practice advice is not formalised as legal requirements, and therefore may or may not be utilised or taken into account by practitioners.

There are risks in the informal component of this approach. These include whether the necessary expertise will remain available on a voluntary basis to enable the process to continue over time and the

absence of an objective process that tests the content and assesses the consequences of the best-practice guidance by formal regulatory review. Assessment

of consequences would include examining the costs

of the best-practice standards and requirements

to determine value in the context of the risks being managed. In addition, without any formal recognition, the adoption of the recommended best-practice standards and requirements is difficult to monitor and cannot be enforced. This makes it unlikely that they will be consistently applied by practitioners.

**4.2 Legislative framework**

4.2.1 Background

Prior to the enactment of the Chartered Professional Engineers of New Zealand Act 2002 (the CPEng Act) engineers were subject to the Engineers Registration Act 1924. That Act provided for the registration of Registered Engineers who had demonstrated through education and experience that they met the standard

for registration. Requirements of a minimum age and for good character and reputation underpinned registration. There was no explicit competence standard; rather, candidates were registered after they had gained

an engineering qualification at a specific level and suitable experience over a specified period of time, and presented adequately at an assessment interview. Once registered, there were no specific requirements to maintain registration other than the payment of an annual fee.

4.2.2 Chartered Professional Engineers of New Zealand Act 2002

The CPEng Act repealed the Engineers Registration

Act. It:

• states its purpose as being “to establish the title

of chartered professional engineer as a mark of quality”;

• establishes a registration system for chartered professional engineers, and provides for minimum standards that must be met to achieve and maintain registration;

• requires a code of ethics and a complaints and

disciplinary process to apply to CPEngs;

• appoints IPENZ as the Registration Authority, and requires it to make rules as to minimum standards of competence and ethical conduct to be met by CPEngs; and

• establishes the Chartered Professional Engineers Council (CPEC) as the statutory body for overseeing the activities of the Registration Authority. CPEC reviews and approves rules containing the CPEng standards, and hears appeals from the Registration Authority in relation to disciplinary matters.

The Building Act 2004 is the key statute that governs the construction of buildings in New Zealand. It provides for a performance-based building code that is expressed in terms of desired outcomes, rather than prescriptive requirements, as discussed in sections 2.2.3 and 2.2.4 of Volume 4 of this Report. The engineering profession’s standards and performance requirements are driven in

large part by the requirements of the Building Act and the Building Code. These include, for example, performance standards that buildings are expected to meet and guidance as to how those standards can be met, scrutiny in the building consent and inspection process and protection for homeowners through mandatory warranties.

These provisions flow through to the development of standards and best-practice guidance for engineers and training and education programmes for both continuing professional development and competency assessment for CPEng.

Governance arrangements are provided for by the appointment of IPENZ as the Registration Authority and the establishment of CPEC, a statutory body to which IPENZ is accountable for its performance as Registration Authority.

The parts of the CPEng Act that are relevant to this discussion are:

• Part 2 (sections 6–38): establishing and protecting the title of CPEng; registration procedures; development and maintenance of the register by the Registration Authority: the disciplinary

framework for CPEngs and procedures and powers

in relation to disciplinary matters; decision-making functions and procedures of the Registration Authority and Council.

• Part 3 (sections 39–61): establishing CPEC and setting out functions, powers and requirements (including reporting requirements) of CPEC and the Registration Authority.

The key powers and functions of the Registration Authority, set out in section 39 of the CPEng Act, are making, and always having, CPEng rules; undertaking activities associated with registration and maintenance of the register; and conducting a complaints and disciplinary process. Section 40 of the CPEng Act requires that the rules contain minimum standards for:

a) competence in professional engineering for registration; and b) demonstrating current competence in professional engineering for continued registration. It also provides

for rules to be made regarding the frequency at which assessments of current competence must be carried out and for the ethical conduct of CPEngs.

Section 45 of the CPEng Act sets out the key powers and functions of CPEC. These are reporting on the Registration Authority’s performance to the Minister, acting as the first appeals body on matters of both registration and discipline, and reviewing and approving proposed rules containing CPEng standards prepared by the Registration Authority.

CPEng rules 8 and 9 set out the CPEng registration process and information requirements to support an application. IPENZ advises that a graduate engineer will take between four and eight years to meet the competency requirements for CPEng registration.

Provisions pertaining to the register of CPEngs are set out in sections 16–19 of the CPEng Act. In accordance with these sections IPENZ, as the Registration Authority, maintains the CPEng register that records the name

of the CPEng, and information about the status and history of the engineer’s registration, including the date of registration, the period for which the latest

registration certificate was issued and any orders made on disciplinary matters in the previous three years.

Any suspension from registration must also be noted, together with the reason for it. The engineer’s contact details are also provided where this is agreed by

the CPEng. In addition (and in accordance with the power to provide other information under section 18 of the CPEng Act), IPENZ has opted to show in the register the date of the next reassessment of current competence.

The register is available electronically, and can be searched for a specific CPEng or all CPEngs in a specified location. The register is also held in hard copy at IPENZ’s head office.

The CPEng register does not provide information about the skills and expertise, or practice area, of a CPEng, and the CPEng Act does not require that it do so.

At the hearing, IPENZ advised that over the past six years it has been building up practice area information on all registered CPEngs with a view to publishing it

in the CPEng register. It is important that consumers of engineering services have access to sufficient information to make a judgement about the suitability of a particular engineer for work required. We note in this respect that section 16 of the CPEng Act states that one of the purposes of the register is to enable members of the public to “select a suitable engineer from a list of chartered professional engineers”. Inclusion of information about an engineer’s area of practice on the register would be consistent with this purpose. The Royal Commission recommends that IPENZ proceed with this initiative, which it clearly

has power to implement under section 18(1)(d) of the CPEng Act. This enables the Registration Authority to include on the register “any other information that [it] considers necessary or desirable for the purpose of the register”.

4.2.3 Chartered Professional Engineers

Rules of New Zealand (No 2) 2002 (the CPEng rules)

The CPEng rules were made under section 40 of the

CPEng Act and compliance with them is a matter

of legal obligation. IPENZ advises that the rules that contain competence standards have not been changed since being set in 2002. Other rules have been updated several times since inception. The CPEng rules, relevant to this section, are as follows:

• Part 2 (rules 6–42): Registration of CPEngs,

including competence requirements;

• Part 3 (rules 43–53): Code of Ethical Conduct; and

• Part 4 (rules 54–70): Disciplining CPEngs.

Section 41(1) of the CPEng Act states that when preparing a rule containing a CPEng standard, the Registration Authority must: (a) ensure the proposed rule is consistent with the purposes of the CPEng Act; (b) consult with engineers and any persons that it reasonably considers to be representative of other

persons or classes of persons affected by the proposed rule; and (c) take into account international best- practice and New Zealand’s international obligations.

**4.3 The engineering profession**

IPENZ is the most prominent professional body for engineers of all disciplines, and has around 13,000 members who have registered into a number of different classes of membership, as set out below. Membership of IPENZ can be held by non-engineers including students and individuals who have made contributions to engineering from outside the profession.

The civil engineering branch of the engineering profession comprises structural, geotechnical, transportation and mining engineers as well as engineering technologists and engineering technicians.

4.3.1 Classes of engineering professionals The IPENZ register lists all members, the regions where they practise and any other registers they are

on (e.g. CPEng register). Candidates for membership

of IPENZ in the classes of professional, technical or associate member must demonstrate competence

relevant to the class of membership sought. Ongoing membership does not require reassessment of competence – membership lasts for so long as the annual subscription is paid. All members must abide by the IPENZ Code of Ethics. That requires, amongst other things, that members perform engineering activities

only in areas in which they are currently competent.

The competence standard against which professional engineers are assessed to become CPEngs is the same as that to become a professional member of IPENZ, although the CPEng requirements to continue to be a CPEng are more onerous because of periodic reassessments of competence. The majority of the almost 3,000 registered CPEngs are also members of

IPENZ, although there is no legal requirement that they be members of IPENZ.

The members of IPENZ register into one of the following registration classes:

1. Professional Member (MIPENZ) – a person assessed as competent to practise professional engineering as an independent professional capable of designing innovative solutions to complex engineering problems.

2. Fellow (FIPENZ) or Distinguished Fellow (Dist FIPENZ) – a Member who has made a substantial contribution to the development of the engineering profession, its practices or IPENZ itself.

3. Honorary Fellow (Hon FIPENZ) – those who often have backgrounds outside engineering, but have made worthwhile contributions that impact on professional engineering, or IPENZ itself.

4. Technical Member (TIPENZ) – a person assessed as meeting a standard of engineering practice that is sufficient for them to work independently in a range of engineering situations. They were previously known as Engineering Technologists.

5. Associate Member (AIPENZ) – a person assessed as a competent engineering practitioner, based

on strongly developed technical knowledge and practical experience. They are able to perform many standard engineering functions themselves. They were previously known as Engineering Associates.

6. Graduate Members (GIPENZ) – holders of tertiary qualifications in engineering that have been accredited by IPENZ as being of good

internationally-benchmarked quality. They have yet to develop the skills necessary to progress through competence assessment to reach one of the above classes of registration.

7. Companions (Comp IPENZ) – persons whose qualifications are not in engineering but have a position of significant responsibility in which they interact with the engineering profession in

a significant way.

8. Affiliate and Student Members – these members are those studying towards a tertiary qualification in engineering and who seek involvement in a discussion forum with engineers.

Engineers can apply to be registered as CPEng, the quality mark for the practising members of the engineering profession. This requires demonstration of competence against a standard in their practice area (set out in rule 6(2) of the CPEng rules, which we discuss later in this section).

An engineer can seek registration as an International Professional Engineer (IntPE(NZ)), also known as an APEC Engineer. Registration allows engineers to have their professional standing recognised internationally within the APEC region. This provides for the recognition of ‘substantial equivalence’ of professional competence in engineering. A signatory country to

the APEC Engineer agreement may require further assessment of a candidate to be registered on the local professional engineering register, but the extra assessment is to be minimised for those registered under the APEC Engineer agreement.

4.3.2 Civil engineering disciplines

Civil engineering is an engineering discipline that includes the practice fields of structural, geotechnical, transportation and mining engineering. Within each practice field is a smaller, focused area of practice

in which the civil engineer specialises, and it is this area of practice that he or she is assessed against for competency by IPENZ. Examples of such areas of practice include design of bridges, dams and building structures, and design using specific materials.

**4.4 Education and training of engineers**

4.4.1 Washington Accord – international equivalency of engineering degrees

IPENZ, on behalf of the New Zealand Government,

is a signatory to the Washington Accord (the Accord), recognising substantial equivalence of engineering qualifications. Other signatories include the United Kingdom, Ireland, USA, Canada, Australia, Hong Kong, South Africa, Japan, Singapore, Taiwan, Korea, Malaysia and Turkey.

The Accord is an independent agreement for mutual recognition of accredited engineering programmes, benchmarking standards for engineering education and benchmarking accreditation policies and processes. The signatories to the Accord agree that they will “identify and encourage the implementation of best-practice for the academic preparation of

engineers by mutual monitoring, regular communication and sharing of information and invitations to observe accreditation visits and observe meetings of any

boards. Regular monitoring through six-yearly visits is required”. Among other things signatories are required to provide evaluators for reviews of other signatories.

Graduates of accredited programmes in any of the signatory countries are considered to have met the educational requirements for entry to the practice of engineering in any other signatory country. However, to become registered or chartered in a signatory country, that country’s registration requirements must be met.

4.4.2 Education of engineers in New Zealand The Royal Commission has not heard any evidence that suggests there is a fundamental problem in the

way in which the education of engineers is provided.

In addition, we note the international agreements that underpin the prescription of the degrees, which are routinely assessed for compliance. Full participation in this international network is clearly in New Zealand’s best interest.

**4.4.2.1 Accreditation of engineering programmes for membership of professional societies and the Washington Accord**

The Universities of Canterbury and Auckland are the two major providers of professional civil engineering education, both offering four-year honours degrees in engineering, BE(Hons). The engineering programmes offered by both of these universities have been accredited by IPENZ as meeting the requirements of the Accord.

As a result of changes made to the exemplar graduate attributes statement in 2009, signatories to the

Accord are assessing their accreditation standards to determine whether changes are needed to accredited engineering programmes. IPENZ advises that there is disagreement within the engineering community in

New Zealand as to the need for programme lengthening to maintain New Zealand’s international standing in professional engineer education. IPENZ has signalled

a probable increase in length of study required for the accredited BE(Hons) degrees by 0.25 years by 2019.

There are also a number of other universities and education providers, such as Unitec Institute of Technology and Auckland University of Technology, that provide education for engineers in a wide range of disciplines, and for technologists and technicians.

**4.4.2.2 Civil Engineering programmes at the**

**Universities of Canterbury and Auckland**

The Universities of Canterbury and Auckland provide master’s degrees in engineering that focus on more specialised engineering knowledge. The majority of those studying for the master’s degree are recent graduates with a BE(Hons) degree, as well as a small number of practising engineers. The University of Canterbury advises that initiatives are underway to offer a specialised master’s programme in earthquake engineering to be introduced in 2013. As we discuss below, it is clear that over the years the structural and geotechnical engineering content of the BE degree has had to reduce due to the expansion of instruction in other fields of engineering practice. The Royal Commission supports the endeavours of the universities and other academic institutions to provide further scope for those who wish to increase their knowledge and understanding of structural and earthquake engineering, and geotechnical engineering.

The University of Canterbury2 notes that “the role of universities offering professional level engineering qualifications is to ensure that graduating engineers enter the workforce understanding, and able to apply the principles that underpin core subject areas. Furthermore, universities provide graduating engineers with the potential for transferring new techniques

learnt from undergraduate and postgraduate study, into industry”. The University of Auckland3 and the University of Canterbury acknowledge that the formation of a professional engineer is a two-stage process – the engineering degree is the first stage and the second stage is the application of, and building upon, the knowledge gained during the degree through training in industry.

The University of Canterbury provided information to the Royal Commission about the content of its academic programme for structural and geotechnical engineering students wishing to graduate with

Civil Engineering degrees. The first year provides a

foundation in basic sciences and an introduction to applied engineering subjects, which requires students

to achieve an acceptable academic standard in order to progress4. The programme of study in the following two years (known as Professional Years 1 and 2) comprises “a sequence of compulsory courses covering the core

sub-disciplines in civil engineering. These include environmental engineering, hydraulics and hydrology, structural engineering, transportation engineering, geotechnical engineering, surveying, management, design and support courses in mathematics and computation”. In Professional Year 3 (fourth year of study), students can elect to specialise from a menu of elective options with just one compulsory course required, in management.

The University of Canterbury noted that specific education in earthquake engineering does not occur until Professional Year 3 when it comprises up to

50 per cent of the content of structural and

geotechnical courses (all of which are elective in that year).

While not identifying the actual courses provided in its bachelor’s engineering degree, The University of Auckland submission noted much the same structure for its degree.

**4.4.2.3 Structural engineering content in degree**

In the hearing on the education and training of engineers, Professor Buchanan of the University of Canterbury noted that “the structural earthquake engineering content of a bachelor’s degree in civil engineering

at Canterbury and Auckland has slowly shrunk over

the last few decades because there are lots of other important things to put in and if you put something else in you have got to take something else out…”.

An idea proposed was for the creation of a bachelor’s degree exclusively dedicated to structural engineering. That is plainly a matter for the universities to consider. However, at the hearing the panellists from engineering consulting firms noted that it is desirable for graduate engineers to have a broad set of skills.

The University of Canterbury advised the

Royal Commission that following the Canterbury earthquakes, it undertook a review of the education

and training process for engineers involved in the design of large buildings and structures. That review confirmed that “due to the expansion of the body of knowledge

in the many sub-disciplines of civil engineering in the last 50 years the proportion of the undergraduate degree that is dedicated to structural engineering has reduced in recent times”. The University considers that the “structural and geotechnical engineering knowledge of civil engineers entering the profession should be increased in order to supply the engineering profession with better educated personnel who can

design infrastructure appropriate for a seismically active

region such as New Zealand”. The Royal Commission considers that a sound knowledge of the basic principles of structural and geotechnical engineering

is important and agrees with this observation in the University of Canterbury’s submission. We recommend that the Universities of Canterbury and Auckland pursue ways in which it can be achieved.

4.4.3 Training

As noted above, the Universities of Auckland and Canterbury have expressed the view that engineering education is the first step in the formation of a professional engineer; the second is applying and building on the knowledge gained during this degree through training in industry. Others, including the Structural Engineering Society New Zealand (SESOC), have said that on-the-job training by employers is critical.

The Royal Commission is of the opinion that post- graduate training for engineers is an essential factor in developing and maintaining competence. We encourage the ongoing provision of continuing

education through provision of block courses at the tertiary institutions, the tailoring of courses to those who are working, and mentoring within engineering firms. Engineering consultancies should encourage their engineering staff to take membership in the engineering profession’s learned societies and attend seminars. They should provide support for ongoing learning and maintain a structured process for the review and sign-off of work.

SESOC and IPENZ endorse the current methodology that allows engineers to determine their own training needs. SESOC notes further that for structural engineers, those needs are complex and diverse. IPENZ advised the Royal Commission that few CPEngs fail to demonstrate that they have taken reasonable steps in continuing professional development when reassessed for continuing registration. Other submitters expressed support for a prescribed programme of postgraduate training for engineers. The Ministry of Business, Innovation and Employment (MBIE) noted that this

would facilitate engineers undertaking adequate training over a period of some years, rather than having a deficit of further training needs at the time of assessment.

We note that, under the CPEng Rules, the Registration Authority must assess whether an engineer meets the minimum standard for continued registration every

5–6 years. IPENZ advises that it is unaware of any prescribed programmes of training for engineers in other countries.

In order to retain professional membership of IPENZ, an engineer must undertake at least 50 hours per annum

of continuing professional development. This is similar to the requirements for chartered accountants imposed by the New Zealand Institute of Chartered Accountants, who must complete 120 hours over a rolling three-

year period with a minimum of 20 hours in each year. Engineers registered with Engineers Australia must complete 150 hours over a three-year period with at least 50 hours relating to the area of practice, 10 hours of risk management and 15 hours of business and management skills.

Engineers seeking to register or re-register as CPEng must demonstrate competency in their area of practice to IPENZ, and are required to assess their own needs for training courses and further education to assist them to meet the competence assessment in the future. The appropriateness of their further training and

education will be taken into account in the competence assessment process required for registration and continued registration.

4.4.4 Competence

In order to be registered as CPEng, or registered into an IPENZ competence class, an engineer’s competence is assessed by a competence assessment panel against

a set of 12 criteria representing the minimum standard for registration.

**4.4.4.1 Minimum standard for registration**

Under Rule 6(1) of the CPEng Rules, a person must meet “the minimum standard for registration” by demonstrating that he or she “is able to practise competently in his or her practice area to the standard of a reasonable professional engineer”. Rule 6(2) lists

a number of competencies that must be considered in

assessing whether the candidate meets this minimum standard. These require assessment of the extent to which the person is able to:

(a) comprehend, and apply his or her knowledge of, accepted principles underpinning-

(i) widely applied good practice for professional engineering; and

(ii) good practice for professional engineering that is specific to New Zealand; and

(b) define, investigate, and analyse complex engineering problems in accordance with good practice for professional engineering; and

(c) design or develop solutions to complex engineering problems in accordance with good practice for professional engineering; and

(d) exercise sound professional engineering judgement; and

(e) be responsible for making decisions on part or all of one or more complex engineering activities; and

(f) manage part or all of one or more complex engineering activities in accordance with good engineering management practice; and

(g) identify, assess, and manage engineering risk; and

(h) conduct his or her professional engineering activities to an ethical standard at least equivalent to the code of ethical conduct; and

(i) recognise the reasonably foreseeable social, cultural, and environmental effects of professional engineering activities

generally; and

(j) communicate clearly to other engineers and others that he or she is likely to deal with in the course of his or her professional engineering activities; and

(k) maintain the currency of his or her professional engineering knowledge and skills.

The expressions “complex engineering activities” and “complex engineering problems” are defined in rule 7 of the CPEng rules as follows:

• complex engineering activities means engineering activities or projects that have some or all of the following characteristics:

(a) involve the use of diverse resources

(and, for this purpose, resources includes people, money, equipment, materials, and technologies);

(b) require resolution of significant problems arising from interactions between wide- ranging or conflicting technical, engineering, and other issues;

(c) have significant consequences in a range of contexts;

(d) involve the use of new materials, techniques, or processes or the use of existing materials, techniques, or processes in innovative ways;

• complex engineering problems means engineering problems that have some or all of the following characteristics:

(a) involve wide-ranging or conflicting technical, engineering, and other issues;

(b) have no obvious solution and require originality in analysis;

(c) involve infrequently encountered issues; (d) are outside problems encompassed

by standards and codes of practice for

professional engineering;

(e) involve diverse groups of stakeholders with widely varying needs;

(f) have significant consequences in a range of contexts;

(g) cannot be resolved without in-depth engineering knowledge.

Demonstration of competence can include providing evidence of academic and other relevant qualifications, current registration on other professional engineering registers, results from other relevant competency assessments, professional development activities undertaken, work history, statement of self-review,

other information provided in support of the application (e.g. work samples from recent professional engineering activities) and annotations explaining how the information demonstrates that the minimum standard

for registration is met.

**4.4.4.2 Competence assessment process**

Assessment of competence is outcomes-based, requiring a candidate to demonstrate expertise in his or her chosen field of practice, rather than rely

on education and identification of work experiences. In fact, a candidate for CPEng need not have a tertiary qualification although the burden of proof of competence may be onerous in the absence of an engineering degree.

The Royal Commission has been advised by IPENZ

that the process of outcomes-based assessment rather than entrance examination is becoming international best-practice. It is the approach followed in Australia, Ireland, South Africa and the United Kingdom, and

the assessment process in those countries generally mirrors the IPENZ process. It has overtaken the use of entrance exams, although passing an examination remains the requirement for entry to the profession in the United States and Canada.

In 2005, the International Engineering Alliance adopted an exemplar competence profile against which IPENZ procedures were reviewed in 2006 by the APEC Engineer Framework and the Engineers Mobility Forum. The panel of experts found that the IPENZ procedures corresponded to the agreed benchmark standard and, having compared the standard and procedures to those being used in their own jurisdictions, they were satisfied that substantial equivalence was demonstrated.

Another review is imminent (2012/2013).

Evaluation of an application for CPEng registration is made by an assessment panel with a recommendation on the application made to a competency assessment

board. Evaluation procedures are set out in CPEng Rules 10–15. CPEng Rule 75 provides that an assessment panel must consist of two or more assessors who are CPEng (or who have CPEng equivalence), at least one of whom has knowledge or experience relevant to the practice area in which the person is being assessed. The panel undertakes an initial assessment of the application for registration as CPEng, and if it meets the criteria, it is referred to a competency assessment board for full review. CPEng rules 20–26 relate to the assessment processes and information requirements for a CPEng to demonstrate current competency for continued registration.

**4.4.4.3 Discussion**

The Royal Commission is satisfied that the current system for the registration of CPEngs and assessing their ongoing competence is appropriate and represents best-practice in international terms. It provides acceptably for continuing professional development, and the ongoing maintenance of professional competence.

We do not see the need for wholesale change.

Based on information advised to the Royal Commission and from its public hearings, we are not convinced that there are systemic issues across the country with engineers working outside their areas of practice. IPENZ, MBIE and SESOC have commented in submissions there is

no hard evidence that this occurs. SESOC and IPENZ also noted that it is more likely the case that there are engineers performing incompetently within their areas of practice than practising outside of them.

Nevertheless, there are some issues that we wish to record, as a result of our Inquiry into the performance of buildings in the Canterbury earthquakes. We note

from our investigation that the majority of cases of poor performance arose due to either:

• failure to recognise the weakness of the foundation

soils; or

• failure to adequately allow for fundamental aspects

of structural behaviour.

Below we note just a few of the cases where the designers failed to recognise fundamental aspects

of structural behaviour. In some cases, the aspect of fundamental behaviour that caused the problem was not understood by practising designers at the time the design was made, and there was no or little reference to the potential problems in design standards or text books then current.

The most fundamental requirement for structural design is that every load or inertial force must have a valid

load path or load paths between the position where the load acts and the foundation soils. Furthermore, every part and detail of this load path must satisfy the requirements of equilibrium and compatibility.

This very basic requirement was violated in the CTV building, where some of the equilibrium requirements for the transfer of inertial forces between the floors and the structural walls were neglected in the design. In addition, the load paths through the beam-

column joints were not considered. Analysis of these details shows that the strains were incompatible

and consequently the forces required to sustain the imposed actions could not be maintained. This led to rapid degradation of the strength of the details with the formation of wide cracks in the joint zones.

For seismic design, there is a further basic design requirement associated with ductility and capacity design. This requirement is that structural details must not lead to excessive strain concentration in an element, in comparison to the strain capacity of the

material. Structural designers have been slow to identify many aspects of this problem, but the performance of buildings in Christchurch has highlighted it.

Examples of excessive strain concentration due to the detailing that was used were apparent in a number

of lightly reinforced structural walls. The longitudinal reinforcement content in these walls was too low to transfer sufficient tension force across a primary crack to ensure that secondary flexural cracks would form. The consequence of this was that only a single crack opened up with a very limited length where yielding of reinforcement developed on each side of the crack. In a number of cases this led to failure of the reinforcement (PGC, Gallery Apartments (see sections 2 and 6.5.1 of Volume 2). It should be noted that the reinforcement content did satisfy the then current design standards and some revision of this requirement is necessary. Many other examples occurred where elongation of beams led to wide cracks forming in and around floors containing precast units. In some cases this led to

load paths between floors and lateral-force-resisting elements being broken.

The detailing used in the Clarendon Tower building had the design intent of limiting yielding to diagonally reinforced zones in the mid-span region of relatively short beams. This detail amplified plastic hinge rotation in the beams, which led to amplified elongation of

the beams. Extensive cracking of the floors, with detachment of the floors from the beams and damage

to the support zones of the precast floor units, was the result. The detailing in the diagonally reinforced zones of the beams also caused high strain concentrations

in a short length of reinforcement in the region where it was bent down to form the diagonals (see section 6.3.5 of Volume 2).

The Hotel Grand Chancellor was a case where the building had different strengths for seismic displacement to the east and west, which violated one of the basis concepts for the seismic analysis

of buildings. The result was that during the February earthquake the building progressively displaced towards the west, greatly increasing the lateral displacement of the structure. The failure occurred in an inadequately confined and proportioned structural wall. How much the progressive increase in lateral displacement contributed to the collapse cannot be determined (see section 3 of Volume 2).

Our conclusion from the evidence we have considered about building performance in the Canterbury earthquakes is that structural designers of buildings where seismic considerations dominate the structural design requirements need to have a good basic understanding of the fundamental requirements for design, and of the assumptions inherent in seismic analysis. In addition, the designer needs to have a good grasp of the strut and tie approach to design, together with the compatibility and load path requirements for concrete and steel structures.

The current arrangements for assessing and ensuring professional competence are very reliant on competence assessment in practice areas that are defined in wide terms. Further, while the building regulatory system

has a role to play in rejecting inadequate building designs, there are no formal protections in place other than those that arise under the CPEng and IPENZ codes of ethics to ensure structural engineers do not move outside the proper sphere of their professional competence. It is not in fact necessary to be a CPEng, a member of IPENZ (or the holder of an engineering degree) to design a building.

Our Inquiry into the failure of the CTV building has also given rise to concerns about the ability of the regulatory system to function adequately in processing building consents for complex structures. In respect

of some of the identified design defects in the CTV building, we had evidence from experienced structural engineers that it would not have been reasonable to expect the CCC checking engineer to have noted

the problem. This is disquieting in the context of

a regulatory regime in which councils, as building

consent authorities, have the legal duty of ensuring

that building designs approved for construction comply with legal requirements. Although the Building Code

is performance-based, designers continue to place reliance on New Zealand Standards to comply with the objectives and requirements of the Code. The

relevant Standards have become complex documents. At the same time, methods of analysis, during the design phase, of the likely structural performance

of buildings in earthquakes have become more sophisticated, a trend that is likely to continue. In the Royal Commission’s view, placing sole reliance on the building consent authority to ensure that the designs

of complex structures are sound and comply with legal requirements is unwise.

Overall, the evidence that we have heard and considered had led us to the view that there should be greater assurance that complex buildings, whose failure in an earthquake could lead to loss of life, will be adequately designed to minimise that risk. Our proposal for the

role of a Recognised Structural Engineer, addressed in section 4.4.5 below, responds to these concerns.

4.4.5 Competency for complex structures

There was unanimous agreement by panel participants and substantial agreement in submissions provided

to the Royal Commission that: (a) CPEng provides an acceptable entry level qualification to the structural engineering profession; (b) on-the-job learning is critical to developing the skills and expertise of engineers;

and (c) those engineers who engage in the design and analysis of complex structures, or the approval or review of plans of such structures, should be

required to achieve a higher level of qualification to do so. Qualification may be educational or experiential, although most likely it will be a combination.

The Royal Commission agrees with this approach. Buildings whose failure in an earthquake poses a significant risk of loss of life should be designed by the most capable of engineers, in the interests of public safety. We therefore are of the view that the law should provide for “Recognised Structural Engineers” who have acknowledged expertise in structural design, with a specified role in respect of complex structures. A

partial analogy can be made to the mechanism in place, under section 149 of the Building Act 2004, for engineers providing certificates in relation to dam safety assurance programmes. As a pre-requisite, an engineer providing such a certificate must be a “Recognised Engineer”, which is defined as someone having no financial interest in the dam concerned, who is registered under the

CPEng Act, and who has “the prescribed qualifications” and “the prescribed competencies”. Regulation 5 of the Building (Dam Safety) Regulations 2008 contains the prescribed competencies envisaged by the Act. The Royal Commission recommends extending this approach to provide for a Recognised Structural Engineer, with a specified and mandatory role in the design of some buildings.

Such engineers would either design (or supervise the design) of complex structures of the kind we have identified in section 3 of this Volume. They would have prescribed qualifications and prescribed competencies. In our opinion, a CPEng seeking to

become a Recognised Structural Engineer should be able to demonstrate competence through a mixture of higher level education, experience, and training. The prescribed qualifications and competencies

for Recognised Structural Engineers should be a more specific prescription of the qualifications and competencies of the role, suitable for inclusion in

a specific regulation. This set of qualifications and competencies should be developed by MBIE in consultation with CPEC, IPENZ, SESOC and the New Zealand Society for Earthquake Engineering (NZSEE).

This proposal should, if implemented, address some of the concerns raised in submissions and in the hearing on the education and training of engineers. It would:

• ensure that design plans for higher risk structures are certified by an engineer who is competent in the appropriate practice area;

• require assessment of a candidate to become a Recognised Structural Engineer to focus more strongly on earthquake and structural engineering, thereby requiring a greater depth of education.

This could well encourage education providers to

offer appropriate block courses that are targeted at working engineers;

• encourage engineers to undertake appropriate

continuing professional development courses; and

• ensure that the technical skills and relevant principles that underpin sophisticated modern software programmes for building design are well understood.

In section 3 of this Volume, we describe the kinds of buildings in which we consider Recognised Structural Engineer should be involved. We discuss the process by which designs of these buildings, certified by such engineers, should be submitted for approval to a building consent authority.

**Recommendations**

We recommend that:

178. The Institution of Professional Engineers New Zealand (as the Registration Authority) should publish on the Chartered Professional Engineer register information about a Chartered Professional Engineer’s area of practice and any other information that may further inform consumers of engineering services of the competence of individual engineers, under section 18(1)(d) of the Chartered Professional Engineers of

New Zealand Act 2002.

179. There should be ongoing provision of post- graduate continuing education for engineers through the provision of block courses, mentoring within engineering firms and courses suitable for those who are working.

180. The universities of Auckland and Canterbury should pursue ways of increasing the structural and geotechnical knowledge of civil engineers entering the profession.

181. Legislation should provide for Recognised Structural Engineers to be responsible for the certification of the design of complex buildings as described in Recommendations 162–168.

182. The Ministry of Business, Innovation and Employment should develop prescribed qualifications and competencies for “Recognised Structural Engineers” in consultation with the Chartered Professional Engineers Council,

the Institution of Professional Engineers New Zealand, the Structural Engineering Society New Zealand and the New Zealand Society

for Earthquake Engineering. These prescribed qualifications and competencies should be a more specific prescription of the qualifications and competencies of the role, and require more extensive design experience of the

type required for the design of complex structures than that required for a Chartered Professional Engineer. These should be included in an appropriate regulation.

**4.5 Current ethical rules**

Engineers that are registered as either CPEng or IPENZ members are subject to those bodies’ codes of ethics. Engineers that are not registered as either CPEng

or IPENZ members are not covered by the code of ethics or by any other regulatory oversight, including complaints and disciplinary mechanisms.

4.5.1 CPEng Code of Ethical Conduct and IPENZ Code of Ethics

Section 40(1)(c) of the CPEng Act requires the Registration Authority to have rules containing a code of minimum standards of ethical conduct for CPEngs. The current ethical rules are set out in Part 3 of the CPEng Rules (rules 43-53). Included are general obligations to society, general professional obligations,

obligations to employers and clients, and obligations to other engineers.

In order to be registered as a CPEng, an engineer must agree to be bound by the Rules as amended from

time to time (section 8(c) of the CPEng Act). Members of IPENZ are required to observe its Code of Ethics. Both codes provide the same obligations, obliging the engineer to:

(i) take reasonable steps to safeguard health and safety;

(ii) have regard to reasonably foreseeable effects on the environment;

(iii) act with honesty, objectivity, and integrity; (iv) not misrepresent competence;

(v) not misrepresent membership/CPEng status;

(vi) inform others of consequences of not following advice;

(vii) not promise, give, or accept inducements; (viii) not disclose confidential information;

(ix) not misuse confidential information for personal benefit;

(x) disclose conflicts of interest;

(xi) not review other engineers’ work without taking reasonable steps to inform them and investigate.

The IPENZ Code is accompanied by specific guidance from IPENZ that describes what engineers need to do to meet the particular clause of the Code. The CPEng Code does not contain such guidance.

The Royal Commission has not been persuaded that there is a problem or material weakness in the codes of ethics for CPEngs and for IPENZ members. We are comforted that both codes are identical. It is not clear why guidance is provided for the clauses

of the IPENZ Code, but not for the CPEng Code. The Royal Commission acknowledges that a code should not spell out specific actions to be taken,

but nevertheless clarification to remove any ambiguity is appropriate. In this regard, arising out of the evidence that it has heard during the Inquiry, the

Royal Commission considers it desirable that attention be given to the following matters:

• the test for taking action should be well understood

by engineers – i.e. ensuring public health and safety;

• it should be understood that each clause in the codes of ethics stands alone and no one clause can override another. In the case of a perceived

conflict between two or more clauses, the question

as to which clause should carry most weight in

the circumstances presented should be a carefully considered matter of judgement; and

• reporting obligations of engineers when a structure

has been identified that presents a risk to health and safety. There should be clarity as to the point at which an obligation of a reviewing engineer to

report is extinguished, and where the accountability for addressing the matter and rectifying any weaknesses rests.

4.5.2 Complaints and disciplinary mechanisms Any person can lay a complaint with IPENZ as the Registration Authority alleging that a CPEng or an

IPENZ member has breached either or both codes

of ethics. IPENZ can undertake an investigation of a

CPEng or IPENZ member on its own motion.

Sections 20–38 of the CPEng Act prescribe the

process for complaints and discipline, and the practice for the making of complaints, their investigation and determination by IPENZ as the Registration Authority, and rights of appeal to CPEC. Grounds for making disciplinary orders against CPEngs are set out in section 21 of the CPEng Act. The statutory provisions are supplemented by more detailed provisions in the CPEng rules. Under section 21 of the CPEng Act, a disciplinary order may be made if the Registration Authority is satisfied that a Chartered Professional Engineer:

(a) has been convicted, whether before or after he or she became registered, by any court

in New Zealand or elsewhere of any offence punishable by imprisonment for a term of

6 months or more if, in the Authority’s opinion, the commission of the offence reflects adversely on the person’s fitness to practise engineering; or

(b) has breached the code of ethics contained in the rules; or

(c) has performed engineering services in a negligent or incompetent manner; or

(d) has, for the purpose of obtaining registration or a registration certificate (either for himself or herself or for any other person),—

(i) either orally or in writing, made any declaration or representation knowing

it to be false or misleading in a material particular; or

(ii) produced to the Authority or made use of any document knowing it to contain a declaration or representation referred to in subparagraph (i); or

(iii) produced to the Authority or made use of any document knowing that it was not genuine.

IPENZ rule 11 provides the complaints and disciplinary mechanism for its members. It largely replicates the CPEng mechanism for filing complaints, their hearing and determination. Complaints may be made against an IPENZ member for the following reasons:

• incompetence (a pattern of unsatisfactory work);

• negligence (insufficient care in a particular

instance); or

• unethical practice (in breach of the IPENZ Code of Ethics and other codes of ethics administered by IPENZ (e.g. CPEng Code of Ethical Conduct).

Disciplinary penalties (set out in section 22 of the CPEng Act) include: removal of registration, and prohibition of application for re-registration before the expiry of a specified period; suspension of registration for a period of no longer than 12 months or until the person meets specified conditions relating to the registration; censure; and a fine not exceeding $5,000. The disciplinary order made is notified in the register. The Registration Authority must also notify the order and the reasons for it to the Registrar of Licensed Building Practitioners appointed under the Building Act

2004 and may publicly notify the order in any other way that it thinks fit (section 22(5)).

IPENZ has advised that over the past three years there have been 25–30 complaints made against engineers of which 15–20 relate to CPEngs and around 10 are about IPENZ members. This represents a significant increase over a total of around 11 complaints in each of 2004

and 2005. Since 2003 there have been 14 disciplinary committee hearings (of both IPENZ and CPEng cases), of which nine resulted in disciplinary orders.

4.5.3 Codes of ethics – reporting potentially unsafe structures

Rule 43 of the CPEng Code and clause 1 of the IPENZ Code require an engineer to take reasonable steps to safeguard the health and safety of people, in the course of his or her engineering activities. In the course of reviewing an existing building, a CPEng or an IPENZ member would need to consider the obligations imposed by rule 53 of the CPEng Code and clause 11

of the IPENZ Code. These provide an obligation on engineers not to review other engineers’ work without taking reasonable steps to inform them and investigate.

In the course of our Inquiry into the failure of the CTV building we have had to consider the question of what should happen after a reviewing engineer has

discovered a critical structural weakness in a building. We have discussed in section 2.4 of Volume 6 the circumstances in which Mr Hare of Holmes Consulting Group discovered a critical structural weakness in the CTV building in 1990. This was reported to Alan Reay Consultants Ltd (ARCL), but not to “an authority”, because it appeared that ARCL intended to act on the advice received.

Mr Trevor Robertson (CPEng, IntPE, FIPENZ), a Senior

Principal of Sinclair Knight Merz, working in the role of Principal Structural Engineer, was called to give expert evidence on issues relevant to the ethical conduct and reporting obligations owed by engineers in such circumstances. Mr Robertson has over 40 years’ experience as a structural engineer, and has twice

been appointed by IPENZ as a member of ethical complaints investigating committees. We accept

that Mr Robertson has expertise in the field of ethical standards for engineers.

He emphasised that the responsibility for the structural integrity of a building, consistent with the codes and engineering knowledge at the time of the building’s design, lies with the designer. It was his evidence

that if a reviewing engineer determines the design to be non-compliant with the codes under which it was designed, and particularly where this non-compliance may be critical to, or at least compromise, the building’s

integrity, then the reviewing engineer should report

this to his or her client and advise the original designer

(if known and still practising) about the discovery and its implications. The reviewing engineer should then satisfy him or herself that the designer accepts responsibility for attending to the matter.

If the designer does not take responsibility, then clause 6 (in Part 3) of the IPENZ Code and rule 48

of the CPEng Code oblige the reviewing engineer to make the person not accepting that advice aware of the possible consequences of that action. The text does not indicate that the reviewing engineer should go any further. However, Mr Robertson said that, in such circumstances, the reviewing engineer may then choose to report the matter to “an authority”.

In the Royal Commission’s view, further action should be taken if it appears that the original designer will not act on the reviewing engineer’s advice. To facilitate this, we recommend that the reviewing engineer be required to advise both the territorial authority and IPENZ of the review findings if the reviewing engineer identifies the building to be a risk to health and safety, regardless

of whether the initial design engineer accepts the responsibility for rectifying it. The regulatory authorities and IPENZ could then be expected to pursue appropriate responses and rectification of the matter with the initial designer of the building, or take other action, in the interests of public health and safety.

4.5.6 Review of plans

Building consent authorities are in possession of much potentially useful information about the performance of engineers in preparing building design documentation in support of consent applications.

In section 3 of this Volume, we have recommended that MBIE be able to require consent applications for complex structures to be provided to it by building consent authorities. Review of these plans might indicate whether there is a need for additional guidance or compliance document updates, and assist the identification of training and education needs.

**Recommendations**

We recommend that:

183. The Institution of Professional Engineers New Zealand should provide clarification of its codes of ethics, in respect of the following matters:

a the test for taking action should be well understood by engineers – i.e. ensuring public health and safety;

b each clause in the codes of ethics stands alone and no one clause can override another. In the case of a perceived

conflict between two or more clauses, the question as to which clause should carry most weight in the circumstances presented should be a carefully considered matter of judgement; and

c reporting obligations of engineers when a structure has been identified that presents a risk to health and safety. There should be clarity as to the point at which an obligation of a reviewing engineer to report is extinguished, and where the accountability for addressing the matter and rectifying any weaknesses rests.

184. Part 3, clause 6 of the Institution of Professional Engineers New Zealand Code of Ethics and Rule 48 of the Chartered

Professional Engineers Rules of New Zealand

(No 2) 2002 should be amended to provide for an obligation to advise the relevant territorial authority and the Institution of Professional Engineers New Zealand in circumstances where a structural weakness has been discovered that gives rise to a risk to health and safety.

**4.6 Professional and learned societies in civil engineering**

4.6.1 Functions of learned societies

A particular feature of the engineering profession is the existence of learned societies dedicated to particular fields of engineering practice. Membership

of the individual societies largely consists of engineers practising within the society’s particular field. Many engineers are multi-disciplinary and are therefore members of more than one society.

These learned societies include the Structural Engineering Society New Zealand (SESOC), New Zealand Society for Earthquake Engineering (NZSEE), New Zealand Concrete Society (NZCS), New Zealand Geotechnical Society (NZGS), New Zealand Timber Design Society, Cement and Concrete Association

of New Zealand (CCANZ), the Heavy Engineering

Research Association (HERA) and others.

The learned societies often play key roles for their particular specialty by facilitating communication of new research through publishing journals, sponsoring academic works and holding regular conferences. The societies are also active in preparing and publishing advice and guidance, often called “practice notes” for their members, but which they make publicly available on their websites.

4.6.2 Functions of professional societies

The engineering profession’s professional society is IPENZ, with services targeting the entire engineering profession including civil, mechanical, electrical, and chemical engineering. IPENZ has around 13,000 members, including CPEngs, engineering students, technicians and technologists, and business people who are not engineers but have made worthwhile

contributions that impact on the engineering profession.

IPENZ’s role includes maintaining a database of members, providing guidance and practice notes on engineering best-practice, and providing career development support, employment brokerage and

activities that support the standing of the engineering profession in the community. IPENZ is also the Registration Authority for the CPEng quality mark and undertakes activities in support of that function. IPENZ audits the quality and scope of university degrees and accredits them for the purposes of the Washington Accord, as well as for membership of IPENZ itself.

4.6.3 Contribution to identifying best-practice in engineering

The learned societies make a considerable contribution to the development of standards that define engineering requirements. Throughout the course of its Inquiry, the Royal Commission has been reminded of the significant amount of voluntary time and effort provided by the leaders of the societies on an ongoing basis. This

has been valuable to the longer-term integrity of the construction sector in New Zealand, and the country owes them a debt of gratitude.

The learned societies often contribute formally through participation in working groups to inform the development or review of New Zealand Standards. The societies are active in identifying the need for particular Standards

to be updated or for new Standards or guidance to be created, and often take it upon themselves to do so through the voluntary efforts of their members. The output from this work may later be submitted to Standards New Zealand or MBIE. However, in many cases it is not progressed in that quarter, and instead becomes informal best-practice guidance (for example, practice notes) to the profession that may be applied at the practitioner’s discretion. The informal updating of best-practice guidance is valuable, but not without risk.

4.6.4 Risks

The absence of a regulatory process means there is no review and oversight of the informal best-practice guidance except by the members themselves. Guidance is not mandated for uptake across the industry as a whole, but rather adoption becomes a discretionary matter for each engineer or firm. There is

no monitoring of compliance with informal best-practice guidance and so it is not known to what extent it is

being followed.

As a result there is likely to be inconsistent application across the industry, especially if the associated incremental costs are sizeable. These costs are borne by the consumer and flow through to the national economy. In the absence of a formal regulatory process, they are neither assessed for reasonableness in the context of the risk being managed, nor are they applied evenly. Indeed, if the additional costs are sizeable, consumers may seek out practitioners who will not implement the new practices or follow the guidelines.

In addition, we note that an informal process of voluntary contributors may not include standard contractual processes such as identifying and managing conflicts of interest that members may hold through their private interests in the construction industry.

It is not clear whether the current model that relies on voluntary contribution from society members is sustainable. In the hearing on the organisation of the engineering profession, the Royal Commission was advised by society executives that it was becoming considerably more difficult to enlist well qualified voluntary contributors to support their initiatives. In the meantime, despite the risks involved, we consider that the societies should continue to advance engineering knowledge and practice as they have done in the past.

As discussed in section 3, the Royal Commission recommends that MBIE develops a policy and regulatory work programme to identify priorities and clarify roles. The Ministry should make contact with and be aware of the views held by the engineering profession’s learned societies as to where best-practice guidance is required, and the appropriate process for achieving it, including the need to codify any parts of the advice in the form of regulations or standards and whether the issues should be led by the regulator, or left to the societies.

4.6.5 Coordination between engineers and other construction industry practitioners

The professional and learned societies play an

important role in facilitating information sharing, debate, and problem resolution across the various disciplines within the engineering profession. Of particular

interest to the Royal Commission is the need for more collaboration between structural and geotechnical engineers. The societies also endeavour at times

to bring engineers together with other intersecting professions within the construction industry (for example, constructors, manufacturers and architects).

The Royal Commission notes submissions by MBIE, CCANZ and NZCS that in their view there is a reasonable level of constructive engagement between the different branches of engineering. However, there is scope for more collaboration between architects and engineers. The Royal Commission recommends that MBIE, IPENZ and the New Zealand Registered Architects Board (NZRAB) actively encourage more interaction between engineers and architects.

The Royal Commission has received an interim report provided by a working group to the NZRAB. The working group was commissioned by the NZRAB to report, among other things, on lessons able to be learned from the Canterbury earthquakes. While the NZRAB has,

at the time of writing this section, yet to consider the recommendations in the interim report, we consider a number of the recommendations are consistent with evidence heard, or advice provided in submissions during our Inquiry. These include:

• emphasis being placed on structural engineers and architects working together closely at an early stage of design and clients being made aware of the benefits of early engagement of a structural engineer;

• ensuring architects and structural engineers are jointly

involved in seismic design features of structures;

• reviewing the structural engineering content of both tertiary degrees in architecture and in competencies required for initial registration as an architect;

• reviewing the provision of “core practice development to ensure the issues identified following the Christchurch earthquakes are addressed for all architects wishing to apply for continuance of

their registration”.

The importance of early engagement between architects and structural engineers was also noted by Mr David Sheppard, National President of the New Zealand Institute of Architects, at the Royal Commission’s hearing on the organisation of the engineering profession.

In section 3 of this Volume, we have recommended the development of a Structural Design Features Report, which is required to be signed by an appropriately qualified engineer prior to the submission of a building consent application. This will help ensure the early engagement of structural engineers in the design

of structures. However, we also consider that the professional societies for the respective professions should work to ensure greater collaboration between the two professions. MBIE, as the regulator, clearly has an interest in New Zealand having well-designed buildings and should support this engagement.

**Recommendation**

We recommend that:

185. The Institution of Professional Engineers New Zealand, the New Zealand Institute of Architects, and the New Zealand Registered Architects Board, supported by the Ministry of Business, Innovation and Employment, should work together to ensure greater collaboration and information sharing between architects and structural engineers.

**References**

1. Institution of Professional Engineers New Zealand Incorporated. (2011). *Standards and Regulation for Building*

*Construction in New Zealand.* Christchurch, New Zealand: Canterbury Earthquakes Royal Commission.

2. Letter from Dr Shayne Gooch, Dean of Engineering and Forestry, University of Canterbury to

Justice Mark Cooper, Commission Chairperson, Canterbury Earthquakes Royal Commission, 2 August 2011.

3. Letter from Professor Michael C R Davies FRSE, Dean, The University of Auckland to Justice Mark Cooper,

Commission Chairperson, Canterbury Earthquakes Royal Commission, 1 August 2011.

4. The University of Canterbury advised that of approximately 800 students enrolled in the first year of the

BE(Hons) degree, about 450 meet the criteria each year to progress to professional years (letter dated

3 August 2011).

**Section 5:**

**Canterbury Regional Council and Christchurch City Council – management of earthquake risk**

**5.1 Approach under the Terms of**

**Reference**

The Terms of Reference for the Inquiry require the Royal Commission to consider the nature of the land associated with the representative sample of buildings in the Christchurch Central Business District (CBD). The Terms of Reference also require consideration of the adequacy of the current legal and best-practice

requirements for the design, construction and maintenance of buildings in central business districts in New Zealand, to address the known risk of earthquakes. A matter specifically raised, in paragraph (d)(iv), is the role of local government in developing and enforcing legal and best-practice requirements.

We have reported on the results of that aspect of our Inquiry in earlier Volumes of our Report. We note in particular that in section 4 of Volume 1, we concluded that liquefaction and the loss of strength of surface soils as a consequence of the February earthquake had adverse effects on the foundations of buildings

in the Christchurch CBD (see section 4.9 of Volume 1). Further, in Volume 2, we identified liquefaction as having contributed to the damage sustained by particular buildings, namely the Christchurch

Town Hall (discussed in section 6.1.3 of Volume 2); Craigs Investment House at 90 Armagh Street

(section 6.3.1); the Victoria Square apartment building at 100 Armagh Street (section 6.4.1); and the IRD building at 224 Cashel Street (section 6.5.3).

In Volume 1, we made a number of recommendations designed to ensure a greater understanding and knowledge about ground conditions, so as to ensure better foundation performance not only in the Christchurch CBD, but in CBDs in other New Zealand cities (Recommendations 3–9 in Volume 1, section 1). We also made recommendations in relation to foundation design where there is a risk of liquefaction or significant soil softening in an earthquake

(Recommendations 10–13), foundation design generally (Recommendations 14–20 and 25–31) and ground improvement (Recommendations 21–24). These

recommendations all reflect the existence of, and assume, urban land zonings that permit development of substantial buildings in New Zealand’s cities.

Existing urban zones are the consequence of the processes and procedures followed under the Resource Management Act 1991 (RMA) and, before

its enactment, the various Town and Country Planning Acts. The Royal Commission’s Terms of Reference generally have a focus on building performance and consequently, we have not thought it appropriate

to inquire in great detail about the decision-making process that has led to the existing zoning patterns in Christchurch, which set the scene for the widespread damage experienced as a consequence of liquefaction and lateral spreading in the eastern suburbs of Christchurch. Nor have we done anything other

than note the fact that land that might be subject to liquefaction was developed in the Christchurch CBD in exercise of development rights conferred many years previously.

As already noted, the Terms of Reference have a focus on building performance. We observe however that by paragraph (e), the Royal Commission is empowered to inquire into “any other matters arising out of, or relating to, the foregoing that come to the Commission’s notice in the course of its inquiries and that it considers

it should investigate”. We considered it would be inappropriate to ignore entirely the fact there has been unnecessary damage and costs sustained as a result of the development of land subject to a risk of liquefaction without duly considering that risk. Apart from anything else, an understanding of how that has been possible under the existing regulatory system might enable

better outcomes in the future. We are required by the Terms of Reference to make recommendations on any measures necessary or desirable to prevent or

minimise the failure of buildings in New Zealand due to earthquakes likely to occur during their lifetime. These aspects of the Terms of Reference are not restricted to the consequences of the Canterbury earthquakes, and they require us to consider buildings in central business districts throughout the country.

As a result of our Inquiry into these matters we conclude that there should be better provision for the acknowledgment of earthquake and liquefaction risk in the various planning instruments that are made under the RMA. One way of minimising failure of buildings in the future is to ensure that the land on which they are developed is suitable for the purpose. Having said that, we need to emphasise that it is not possible to predict with any certainty when an earthquake will occur and,

in reality, the public and private investment in the country’s cities is such that it is not realistic to redirect development away from the existing central business districts. However, when zoning for new development areas is contemplated, we consider that it would be appropriate for the risks of liquefaction and lateral spreading to be taken into account.

**5.2 Introduction**

As part of our Inquiry into the Canterbury earthquakes, the Royal Commission has examined whether

the Canterbury Regional Council (CRC) and the Christchurch City Council (CCC) took appropriate actions to meet their responsibilities and obligations under the RMA to manage earthquake risk. Two issues were of particular interest to the Royal Commission.

The first was whether the CRC and the CCC sufficiently considered earthquake risk (including the risks of liquefaction and lateral spreading) by using available information when they made decisions about the

zoning of land. The second was whether information about earthquake risk was provided to the public in a meaningful way.

In late 2011, the Royal Commission asked resource management policy consultant, Mr Gerard Willis to advise us about the manner in which earthquake risk had been dealt with in the relevant planning documents of the CRC and CCC. He was the author of a report1

(by Enfocus Ltd) “Management of Earthquake Risk by

Canterbury Regional Council and Christchurch City Council – Obligations and Responses under the RMA” that was provided to the Royal Commission in November

2011. It was published on the Royal Commission’s website and submissions from the public were invited. Submissions were received from the CCC and CRC,

as well as the Ministry of Business, Innovation and Employment (MBIE) and from one individual. The content of this section is based on Mr Willis’ advice, our consideration of the submissions received and the knowledge we have gained over the course of our investigation.

We set out the following key observations:

• Mr Willis considers that there was a lack of clarity about the division of responsibility between the CRC and CCC for managing earthquake risk and about their policies for earthquake risk mitigation. However, this did not have a material impact on the quality of hazard planning for the Canterbury region over the past decade.

• In its planning documents, the CRC considered its role to be that of information provider and it was active in commissioning research and disseminating information. Controlling land use for the mitigation

of earthquake hazard, among other things, was a

function that was devolved to the CCC. The CRC did however retain a role in the control of land use where the impact of the activity or land use had an effect on water quality.

• Technical information received over time by the local authorities relevant to the assessment of earthquake and liquefaction risks was often not consistent, but had since 2005 indicated a low risk of material damage resulting from an earthquake.

• The CRC and CCC did not have a good understanding of the consequences of an earthquake, but sought to inform themselves by commissioning reports and advice, on the risk and the management of it. However, they seldom

used information held in making decisions on land

zoning, land development and/or subdivision and building consent applications.

• Most urban zonings were confirmed well before

information was available on earthquake risk in the Canterbury region (i.e. prior to 1977), although development of many parts did not occur until after that time. It is problematic to revisit zoning decisions when development rights have subsequently been acquired.

• It is difficult to decline applications for subdivision

consent when they are in accordance with the use for which the land was zoned. At the time of subdivision consent, earthquake risks should be addressed through consents being conditional upon either land remediation or the adoption of specific construction techniques.

• Geotechnical reports should be required where earthquake risk is identified. This requires local authorities to better understand earthquake risks and consequences affecting both the region and specific development proposals.

In its submission to the Royal Commission, the CCC advised it had made a number of changes to its practices to better manage earthquake-related risks in the future. These are intended to place a greater emphasis on understanding risk in various parts of Christchurch, and on seeking and understanding geotechnical information associated with proposed plan changes and land use and subdivision consent applications. The CRC’s submission to the Royal Commission confirmed its intention to continue to adopt a collaborative and partnership-focused approach in which information relating to natural hazards and environmental issues is obtained and made available for territorial authorities and other relevant organisations.

In mid-2011, the Ministry for the Environment published the “Canterbury Fact Finding Project” report, jointly prepared by Hill Young Cooper and the Resource Management Group Ltd2. The project looked at the extent to which information on liquefaction and lateral spreading hazards was known, available and factored into planning and development processes in the period from 1977 to the present. We have considered it in the course of our investigation of these matters.

**5.3 The Resource Management**

**Act 1991**

The requirements and obligations for regional and territorial authorities in the management of natural hazards are set out in the RMA. Section 2 of the RMA defines natural hazard as meaning “any atmospheric or earth or water related occurrence (including earthquake…) the action of which adversely affects

or may adversely affect human life, property, or other aspects of the environment”. We consider that the reference to earthquake would include liquefaction, but the latter is covered in any event as an “earth

or water related occurrence that adversely affects property”. The key obligations for regional councils and territorial authorities are:

• regional councils have the functions of: establishing,

implementing and reviewing objectives, policies and methods to achieve integrated management of the natural and physical resources of the region

(section 30(1)(a)); preparing objectives and policies in relation to any actual or potential effects of the use, development and protection of land which

are of regional significance (section 30(1)(b)); and the control of the use of land for the purpose of the avoidance or mitigation of natural hazards (section 30(1)(c)(iv));

• territorial authorities have the function of the control of any actual or potential effects of the use, development or protection of land, including for the purpose of the avoidance or mitigation of natural hazards (section 31(1)(b));

• the Regional Policy Statement (RPS) must state, among other things, the local authority (which could be the regional council, or a territorial authority) responsible for specifying the objectives, policies and methods for the control of the use of land to avoid or mitigate natural hazards (section 62(1)(i));

• both regional councils and territorial authorities must keep records of natural hazards to the extent that they consider appropriate for the effective discharge of their functions (section 35(5)(j));

• a territorial authority may refuse to grant a subdivision consent, or may grant a consent subject to conditions, if it considers that the land in question is likely to be subject to material damage by certain natural hazards (section 106).

The RMA obligations of the CRC, including the demarcation of responsibilities between itself and the CCC, are recorded in its RPS for Canterbury. Regional councils across New Zealand published their first Regional Policy Statements in 1998, with the next generation of Statements publicly notified in 2011,

and in the case of Canterbury, not yet fully operative. The functions of territorial authorities are recorded in their district plans. For Christchurch, the district plan relevant to our Inquiry is the 2005 Christchurch City Plan (the City Plan).

The Enfocus Ltd report characterises and comments on the initial RPS (1998) documents publicly notified around the country as reflecting “the early stages of RMA implementation and the bedding in of regional council and territorial authority relationships”. With respect to the Canterbury RPS (1998) and the City Plan (2005), Mr Willis observed that:

• the Canterbury RPS focused on hazards generally, with no discussion of managing or mitigating earthquake risk as a specific natural hazard. However, the shortcomings of the Canterbury RPS (1998) do seem to have been acknowledged by the Proposed RPS for Canterbury, which was publicly notified in June 2011. The latter includes a broader suite of policies that provide guidance and direction to those exercising control over land use and explicitly addresses earthquake risk (policy 11.3.3 – Earthquake faults, chapter 11 of the proposed RPS, entitled “Natural Hazards”);

• the absence of clear specification of policies relating to earthquake risk mitigation and division of responsibility between the CRC and CCC did not of themselves have a material effect on the quality of hazard planning in the region over the past decade, or lead to any failure in the mitigation of earthquake risk; and

• the CRC and CCC recognised earthquake risk, understood their functions and were broadly carrying out those functions.

Sections 6 and 7 of the RMA relate to managing the use, development, and protection of natural and physical resources, and identify matters of national importance and other matters that should be recognised when exercising RMA functions and powers. The Minister for the Environment has appointed an independent technical advisory group to review these sections including whether they can be improved to give greater attention to managing natural hazards, noting the RMA issues arising from the Canterbury earthquakes.

So far as we are aware, the report3 from the technical advisory group has not, at the time of writing,

been formally considered by the Government. However, we consider that there is a clear case for ensuring that regional and district plans are framed having appropriate regard to the potential effects

of earthquakes and liquefaction (and other natural hazards), and the function of processing resource and subdivision consents should also be performed in a way that recognises that risk. The Royal Commission recommends that changes should be made to the principles in sections 6 and 7 of the RMA to bring the management of natural hazards into the list of things

that should be considered when councils are exercising functions under the RMA.

**5.4 Regional and district planning**

5.4.1 CRC: Canterbury Regional Policy

Statement (1998)4

An RPS sets out objectives, policies and methods to address a region’s resource management issues. One of its goals is to achieve integrated management of the region’s resources. As noted earlier, one of its key

requirements is to identify the division of RMA functions between the regional council and the territorial authorities. In the absence of specification, the regional council is responsible.

Under the RPS (1998), the CRC saw its regulatory role

as limited to:

• control of land use in circumstances where the impact of the activity or land use results in effects such as on water quality; and

• processing resource consent applications within its regional council functions (i.e. to control the taking, use, damming or diversion of water, the discharge

of contaminants, etc.).

It was also noted in the Enfocus Ltd report that according to the RPS (1998) and a letter to the

Royal Commission dated 31 August 20115, the CRC

saw its role in earthquake risk mitigation as mainly that of an information provider. In accordance with this role, the CRC was active in commissioning research for the identification and assessment of natural hazards in Canterbury and information dissemination.

All remaining earthquake risk mitigation obligations (e.g. control of any actual or potential effects of the use, development or protection of land, including for the purpose of the avoidance or mitigation of natural hazards) were expected to be met by the CCC although this demarcation of responsibility was not clearly articulated in either the RPS (1998) or the 2005 City Plan.

A key question is whether it was prudent for the CRC

to remove itself from taking any role in the control of the use of land, even when the primary responsibility is held by the CCC and notwithstanding the RMA provides for it to do so legitimately (see section 30(1)(c) of the RMA). This is a matter for the CRC, and not one on which

the Royal Commission has formed any view. It should be noted that a regional council is not prevented from acting, irrespective of whether it has passed primary responsibility to the territorial authority. Mr Willis

notes that best-practice hazards planning guidance (“Planning for the Development of Land on or Close to Active Faults”, 2003, issued by the Ministry for the Environment6) is for a regional council to continue to

have a role in terms of providing policy guidance as to where and how risk ought to be avoided or mitigated, and in advocating that policy in district plan preparation and individual resource consent applications. We observe that it is plain from our consideration of the seismicity of Canterbury that the risk is one that should be considered and understood at the regional level, and we consider that regional councils should take a lead role in this respect. In Auckland, the Auckland Council should ensure that it has the appropriate understanding of the seismicity of the area it administers.

5.4.2 Christchurch City Plan7

The 2005 City Plan recognised the CCC’s obligations to control land use for the purpose of avoiding or mitigating natural hazards and to consider declining land subdivision applications where it considered land is likely to be subject to a natural hazard. It recognises earthquake risk but does so at a high level and does little to provide for ways and means of managing it. The focus of the City Plan is information provision

and an expectation that earthquake risk issues will be addressed by controlling building construction through the requirements of the Building Act 2004.

The City Plan does not identify liquefaction zones, nor does it include a requirement for a risk assessment

or set out risk standards, although there is a policy that refers to limiting development in areas of “moderate to high risk”. Mr Willis was not aware of any other district plans that contain such information although he comments that this does not mean that the risk assessment has not been undertaken. One reason for its omission in Christchurch may be to do with the high variability of soils so that precise and definitive information on liquefaction risk may require geotechnical investigation on each individual property in a zone.

**5.5 Technical information**

5.5.1 Advice sought

The CRC and CCC have sought advice and have been provided with information relating to earthquake risk

on numerous occasions since 1995. In its submission to the Royal Commission, the CRC identifies some 26 reports that it commissioned relating to earthquake hazard and risk investigations in the Canterbury region. We note the following key reports:

• Geology of the Christchurch Urban Area,

GNS Science 1992. (It is unclear what led to the provision of this report).

• Earthquake Hazard and Risk Assessment:

Probabilistic Seismic Hazard Assessment,

GNS Science 1999 (revised 2007), commissioned by the CRC.

• A report commissioned by the CRC in 2004

from Beca Carter Hollings and Ferner Ltd, which provided specific advice on the liquefaction risk in Christchurch. A peer review of the Beca report was commissioned by the CCC from URS New Zealand to determine whether it could be used as a basis

for information to be placed on Land Information

Memoranda (LIMs) for the purposes of notifying the public of earthquake risk. However, the peer review highlighted the many caveats and qualifications noted in the Beca report and the limited information on which the liquefaction maps in the report had been prepared. This led to an approach to the provision of data on LIMs that referred to the indicative nature of the liquefaction zones. This would signal the need for a detailed geotechnical site investigation at the time of significant new development.

• In 2005 the CRC commissioned Opus International Consultants Ltd (Opus) to develop an earthquake risk assessment methodology in order to assist the quantification of the risk of an event or range of possible events. The model was not fully developed and was overtaken by a government-funded

GNS Science and NIWA project to develop a

national risk assessment model (Riskscape) that covered much of what was intended for the Opus model. Christchurch was chosen as a pilot for

the project. We understand from Mr Willis that Riskscape is still under development although an early version is available.

• Estimated Damage and Casualties from

Earthquakes affecting Christchurch, GNS Science

2005, commissioned by CCC.

5.5.2 Earthquake and liquefaction risk assessments

Meaningful advice on earthquake risk was not available until the early to mid-1990s. Mr Willis comments that much of the advice received over time by the CRC

and CCC was not entirely consistent but would have created a picture of relatively low liquefaction risk. A letter from GNS Science to the CCC in 20038 advised that, among other things, the majority of houses in Christchurch would not be affected by liquefaction, even during the strongest shaking (MM8)9 likely to

be experienced.

At the public hearing on territorial authorities’ earthquake-prone policies on 14 November 2011, the Royal Commission heard from Mr Peter Mitchell, General Manager of Regulation and Democracy

Services at the CCC. Mr Mitchell has been employed

by the CCC for 28 years. Counsel assisting the

Royal Commission explored with Mr Mitchell the extent to which information about earthquake risk had been conveyed to the Council. In particular, reference was made to a report prepared by members of the Group managed by Mr Mitchell on the subject of “Earthquake- prone Buildings Policy, Dangerous Buildings and Insanitary Buildings Policies”, that was on the agenda for the Council’s meeting of 15 December 2005. That report had a section headed “Earthquake Risk For Christchurch City” in which reference was made to

a GNS Science report of 200310. Counsel explored

a number of statements in the GNS Report with

Mr Mitchell, as follows (the statements in this report are in quotation marks).

• “Early studies of the seismic hazards affecting Christchurch indicated a relatively high seismic hazard level, only marginally lower than that of Wellington”. Counsel asked Mr Mitchell if that had been the view within the Council about the earthquake risk in Christchurch at that time.

Mr Mitchell said he did not think that Councillors

had been advised of that observation of GNS Science. His evidence was that the clearly acknowledged risk to the City was from the Alpine fault” although he noted that the smaller fault

lines on the Canterbury side of the Southern Alps could be triggered. But he did not consider the CCC viewed the risk as “marginally lower than Wellington”, despite the reference in the report.

• “More recent studies, however, indicate a lower level of hazard that is more in keeping with the location and activity of all earthquake sources (i.e. both close-in distributed seismicity sources and known fault sources). The recent results are

also more consistent with the historical record than

the earlier ones, and have been used as the basis of our study. During its 160-year recorded history Christchurch has not experienced MM8 shaking, and only occasionally have spot intensities of MM7 been observed”. Mr Mitchell expressed the view, which he thought would have been shared by other members of staff, that the seismic risk in

Christchurch was “at the lower end of the scale” but that earthquakes could happen based on the past history of earthquakes in the region.

In addition, counsel referred Mr Mitchell to a subsequent GNS Science report11, dated May 2005, in which the following was said:

This indicates that Christchurch lies in an intermediate seismicity zone, some distance from

a zone of high activity. However, known earthquake sources, in particular the Ashley, Springbank and Pegasus fault zones, are present within the region and are large enough and close enough to cause significant damage throughout the city.

Counsel assisting asked Mr Mitchell if that was a view that the CCC would have held and been aware of for some time. He answered “no, not before receipt of that advice at that time”. He noted this advice underpinned the CCC’s earthquake-prone buildings policy adopted in 2006 (we discuss the CCC’s earthquake-prone buildings policies in section 4.2 of Volume 4).

Notwithstanding the advice received, the CCC appeared to have taken a view that the risk of material damage resulting from an earthquake was low. The passive earthquake-prone buildings policy that was adopted in 2006 did not contain timeframes for the upgrading of the City’s earthquake-prone buildings.

Mr Mitchell’s evidence contributes to the view formed

by the Royal Commission that while some local authorities were active in commissioning advice on seismic risk, they were less attentive to applying it in a meaningful way in decision making. It is not clear why the CCC would adopt earthquake-prone buildings policies that were passive in nature given the level of risk in Christchurch as described by GNS Science advice, referred to above. One reason may have been the ambiguity in terms such as “intermediate seismicity” and lack of understanding of the consequences of an earthquake less than the reportedly occasional magnitude 7 events. However, it was, in the Royal Commission’s view, incumbent upon the CCC to take measures to understand the

information to inform its policies.

Mr Willis notes in the Enfocus Ltd report that planning and decision making was based on the more recent GNS Science advice, and one consequence was that the risk to domestic buildings was not considered

sufficient to warrant geotechnical reports being required as a rule.

**5.6 Earthquake risk management**

We discuss in this section the means by which the CRC and CCC undertook earthquake risk management in planning and decision making, with respect to:

• land zoning;

• land development and/or subdivision (i.e. when actions are taken relying upon on earlier zoning decisions); and

• building consent applications and in particular the inclusion of geotechnical information and the imposition of construction and/or soil remediation conditions on applicants as a condition of consent.

Mr Willis reviewed the nature and extent of information sought, received and disseminated to the public on earthquake risk by the CRC and CCC and the degree to which the information was used to advocate for earthquake risk mitigation.

As noted earlier, the CRC had largely placed responsibility for the control of the use of land for

the purpose of the avoidance or mitigation of natural hazards with the CCC. Mr Willis expresses the view in the Enfocus Ltd report that the CRC has performed well in the collection of information relating to earthquake risk, identification and assessment of earthquake risk and the dissemination of information on earthquake

risk to the public. His report notes that the councils had endeavoured to inform themselves through the commissioning of risk assessment models in the mid-2000s (e.g. the Opus model and Beca report).

He comments that “Canterbury’s experience with risk assessment appears at least as well advanced as other major centres in New Zealand…”.

However, it appears that the CRC has seldom used the information in its possession on earthquake risk to either inform decision making or to advocate for earthquake risk management in planning processes.

It has considered liquefaction and lateral spread risks to be issues for territorial authorities to address at the time of subdivision and development. For example,

for the then Proposed Change 28 to the City Plan

(this was a private plan change publicly notified on

22 November 2008 relating to land at Ferrymead12 that was subsequently approved in October 2009), the CRC’s submission did not raise concerns about liquefaction risk, which has proved to have been an important issue.

Proposed Change 113 to the RPS was for the extension of the urban limits to make available additional land for greenfields urban development. It was notified in July

2007, revoked in 2011 and instead incorporated as Chapter 12A of the RPS authorised by the Canterbury Earthquake Recovery Act 2011. It was based on Proposed Change 1 but updated as a result of the Canterbury earthquakes. Section 12A took effect from

17 October 2011. The CRC did not raise the issue of earthquake risk in the planning process, on the basis that this was a matter for territorial authorities to

manage when processing subdivision and development consents. In its appeal to the Environment Court14 against the Pegasus Bay development (Waimakariri District), liquefaction risk was raised, but as a matter secondary to the main issues of transportation and growth management.

Neither has the CCC been active in using information it has sought to inform decision making, by triggering the need for applicants to provide earthquake risk information as part of their plans, and if necessary to take remedial action on the land, or otherwise mitigate the risk.

As noted earlier, the CCC sought a peer review of the Beca report (that had been commissioned by the CRC) on liquefaction risk as it was considering

placing notice of the risk on LIM reports for individual properties. As a result of the limitations of the Beca report, the information on LIM reports communicated only the indicative nature of liquefaction zones, rather than a more detailed articulation of the risk.

**5.7 Zoning**

The “Canterbury Fact Finding Project” report recorded that most urban zonings (at least within that report’s study area)15 were confirmed well before (i.e. pre-

1977) information of substance became available on earthquake hazard risk in the region (in the 1990s). However, notwithstanding zoning decisions taken before 1977, development of many parts did not occur until after that time, often not until the mid-1980s and in some cases in the 2000s. Therefore intervention

to ensure earthquake risk was managed might have occurred at the time development and/or subdivision plans were submitted for consent.

The following key issues associated with zoning decisions taken by the local authorities were raised in the Enfocus Ltd report:

• the CRC does not prohibit areas being developed due to risk of liquefaction and lateral spreading; rather, it takes the view that land can be remediated, and construction methods can be used in many cases that will enable land development to occur. The Enfocus Ltd report questions that approach, suggesting it may be more appropriate to prohibit development of such areas if other areas not susceptible to the risk can be substituted. The CRC however notes that “liquefaction is but one factor amongst several that must inform strategic planning for urban growth…”. The CRC further notes that development of a site subject to liquefaction

risk requires that risk to be mitigated in order for subdivision land development to proceed, which is a matter for a territorial authority to address;

• where zoning decisions were made prior to substantial information about earthquake risk being available in Canterbury (before the early to mid-1990s), it was very difficult for local authorities to use

zoning to manage natural hazards. To do so, they

would need to revisit zoning decisions, which could adversely affect those holding development rights; and

• in more recent times, but prior to the Canterbury earthquakes, the risk of earthquakes and their consequences have seldom been taken into account by CCC in zoning decisions either by requiring the risk to be addressed as a matter of course or by imposing conditions for managing the risk prior to development. Proposed Change 1 to the RPS (1998) for the expansion of the urban limits to make additional land available for greenfields urban development took into account the natural hazards of flooding and sea level rise, but not liquefaction risk. However, there have been exceptions, notably for Plan Change 28 relating to zoning at Ferrymead. In that case, the risk of liquefaction and lateral spreading was assessed at the CCC’s request,

with the result that all business-zone development is to be set 50 metres back from the bank of the Heathcote River.

**5.8 Subdivision consents**

The “Canterbury Fact Finding Project” report states that there was no evidence of the use of section 106 of the RMA (refusing subdivision if the land is likely

to be subject to material damage) or its predecessor, section 274 of the Local Government Act 1974, to deny subdivision consent. Neither was there any evidence

of active consideration of liquefaction and lateral spreading risk in this context. Mr Willis endorsed the reviewers’ comment that “the planning reality is that once land is zoned for a specific use it is very difficult for a council to refuse a subdivision that enables that use to establish”.

The CRC has advised the Royal Commission of its view that natural hazard risk is a matter for territorial authorities to consider at the point of subdivision

and development. This was supported by MBIE in its submission to the Royal Commission. However, the City Plan, at least in the case of the eastern suburbs, indicated reliance on building construction standards under the Building Act 2004 to manage earthquake risk, rather than on the RMA consenting processes. MBIE considers that “the Building Act should only be relied on for the building related aspects of managing earthquake risk and to ensure that building work does not cause the land to become a natural hazard (as defined in the Building Act)”.

Regardless of the lack of flexibility resulting from earlier zoning or subdivision and development decisions, it remained incumbent on the CCC to ensure that any earthquake risk associated with the land subject to development and/or subdivision plans was considered, and where necessary managed and/or mitigated. Where appropriate, applicants should have been required to undertake geotechnical investigations or other hazard assessment and if, as a result of those inquiries, risk

was found to be present, mitigation actions should have been identified and monitored.

**5.9 Geotechnical investigations and consenting requirements**

Since the 2005 GNS advice to the CCC indicated low risk of liquefaction and lateral spreading to domestic buildings, the CCC decided that residential dwellings would not require changes in foundation engineering requirements and consequently there was no need to have a geotechnical survey. Evidence suggests that the CCC has seldom imposed conditions requiring site remediation or stabilisation prior to consents for developments or subdivisions being approved.

Advice from Mr Ian McCahon, geotechnical engineer, during the Royal Commission’s hearing on soils and foundations was that the CCC would normally seek

a geotechnical report for the consenting of a major structure in central Christchurch.

Mr Willis advised that it is not clear within CCC processes as to what triggers CCC consent officers to require geotechnical and/or hazard assessments and information although he notes that a different approach has been taken since 22 February 2011. The CCC advised in its submission to the Royal Commission

that it is giving increased attention to the need for geotechnical investigations to accompany consent applications and is requiring them for subdivision consent applications. In addition, it is imposing conditions, such as requiring specific foundation design, where appropriate. We also note that, as discussed in Volume 1, the CCC commissioned Tonkin

& Taylor Ltd to carry out a substantial study of the subsurface conditions in the Christchurch CBD16.

**5.10 Future measures**

In its submission to the Royal Commission, the CCC

advised that:

• the City Plan is being reviewed to ensure that it gives effect to the RPS, as well as reviewing its objectives, policies and rules regarding earthquake risks;

• it is using the detailed information regarding possible risk areas that has been made available since the Canterbury earthquakes to commission,

or require, geotechnical assessment for plan change

requests and land use consent applications when this is considered necessary;

• the Canterbury Earthquake Recovery Authority’s

liquefaction maps are being used to identify

risk levels across various zones of Christchurch to determine whether a hazard is likely (for the purposes of the CCC being in a position to decline a subdivision application under section 106 of the RMA where that is considered the appropriate response). The CCC advises that all applications for subdivision consents will now be required to

be accompanied by a geotechnical report and that the content of reports must be consistent with MBIE guidelines for geotechnical investigation and assessment of subdivisions; and

• internal guidance to CCC officers has been developed regarding the assessment of section 106 matters, which should result in a consistency of approach taken on resource consent applications.

We record our view that these are appropriate procedures for the CCC to adopt.

The CRC also provided a submission in which it noted its intent to continue to work collaboratively with the territorial authorities and other key partner organisations with respect to the development and sourcing of information relating to natural hazards

and environmental information. The CRC notes that it has “carried out a whole range of investigative work to assist in the mitigation of the risks of earthquakes across the Canterbury region” and that “most of

these investigations were undertaken in collaboration with the relevant territorial authorities to ensure that the information collected would be useful to them in carrying out their legislative responsibilities”.

The CRC considers that there would be merit in creating “a far stronger and clearer legislative definition and framework” for the roles of regional and territorial authorities in land use control issues.

**5.11 Conclusions**

The Royal Commission draws the following conclusions:

• the process by which land was initially zoned for urban development by the CRC, followed by subdivision and/or development that was granted consent by the CCC, was sufficient to meet legislative requirements historically applicable. However, the weaknesses in the process were the lack of compelling earthquake risk advice prior to the early to mid-1990s when land was zoned by the

CRC, and the lack of action from the CCC to require developers to investigate the geotechnical risks associated with their development plans;

• the importance of information gathering on natural hazards affecting a region is not limited to its collection and use to assess risk, but also to understanding the consequences of the risk materialising and identifying risk mitigation and management strategies for implementation where appropriate;

• where information on natural hazards and their consequences is unclear, local authorities should seek further clarification to satisfy themselves that they are sufficiently aware of the hazards to enable effective planning;

• The RMA should be amended, and processes under it adopted, to ensure that the risks posed by earthquakes are appropriately considered in decisions about zoning and land use; and

• Regional councils and territorial authorities should

ensure that they are adequately informed about the seismicity of their regions and districts. Since seismicity should be considered and understood at a regional level, regional councils should take a lead role in this respect, and provide policy guidance

as to where and how liquefaction risk ought to be avoided and mitigated. In Auckland, the Auckland Council should perform these functions, as it has regional responsibilities following the abolition of the Auckland Regional Council.

**Recommendations**

We recommend that:

186. Sections 6 and 7 of the Resource Management Act 1991 should be amended to ensure that regional and district plans (including the zoning of new areas for urban development) are prepared on a basis

that acknowledges the potential effects of earthquakes and liquefaction, and to ensure that those risks are considered in the processing of resource and subdivision consents under the Act.

187. Regional councils and territorial authorities should ensure that they are adequately informed about the seismicity of their regions and districts. Since seismicity should be considered and understood at a regional

level, regional councils should take a lead role in this respect, and provide policy guidance

as to where and how liquefaction risk ought to be avoided or mitigated. In Auckland,

the Auckland Council should perform these functions.

188. Applicants for resource and subdivision consents should be required to undertake such geotechnical investigations as may be appropriate to identify the potential

for liquefaction risk, lateral spreading or other soil conditions that may contribute to building failure in a significant earthquake. Where appropriate, resource and subdivision consents should be subject to conditions requiring land improvement to mitigate these risks.

189. The Ministry for the Environment should give consideration to the development of guidance for regional councils and territorial authorities in relation to the matters referred to in Recommendations 186–188.

**References**

1. Enfocus Ltd (November 2011). *Management of Earthquake Risk by Canterbury Regional Council and*

*Christchurch City Council.* Christchurch, New Zealand: Canterbury Earthquakes Royal Commission.

2. Hill Young Cooper and Resource Management Group Ltd. (August 2011). *Canterbury Fact Finding Project*.

Retrieved from <http://www.mfe.govt.nz/issues/Canterbury-earthquakes/fact-finding-full-report.pdf>

3. Technical Advisory Group. (February 2012). *Report of the Minister for the Environment’s Resource Management Act 1991 Principles Technical Advisory Group*. Retrieved from <http://www.mfe.govt.nz/publications/rma/tag-> rma-section6-7/tag-rma-section6-7.pdf

4. Canterbury Regional Policy Statements. The 1998 RPS and the notified 2011 RPS can be found at Environment

Canterbury’s website <http://ecan.govt.nz/our-responsibilities/regional-plans/rps/Pages/Default.aspx>

5. Letter from Environment Canterbury to the Canterbury Earthquakes Royal Commission, 31 August 2011.

6. Ministry for the Environment (2003). *Planning for the Development of Land on or Close to Active Faults.*

Retrieved from <http://www.mfe.govt.nz/publications/rma/planning-development-active-faults-dec04/html/>

7. The Christchurch City Plan can be found at [http://www.cityplan.ccc.govt.nz/NXT/gateway.](http://www.cityplan.ccc.govt.nz/NXT/gateway) dll?f=templates&fn=default.htm

8. Letter from GNS Science to Building Control Manager, Christchurch City Council, 14 July 2003.

9. MM refers to Modified Mercalli Intensity scale which is a measure of how ground shaking from an earthquake

is perceived by people and how it affects the built environment at a particular location. In any given earthquake, the Mercalli Intensity will depend on the location of the observer and will usually be greatest nearer to the earthquake’s hypocentre. This information is complementary to “static” magnitude estimations (ML, MW, Me)

that describe the energy released at the earthquake source rather than the ground shaking experienced in

surrounding areas. These terms are explained in Volume 1, of our report at section 2.6.1.

10. Cousins, J. (2003). *Earthquake, volcano and tsunami risks to property of Christchurch City Council*. Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences.

11. Cousins, J. (2005). *Estimated damage and casualties from earthquakes affecting Christchurch*. (Client Report

2005/2007). Report prepared for the Christchurch City Council. Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences.

12. City Plan Change 28 was a private plan change relating to around 29.9 hectares of land known as

‘Kennaway Park’ at Ferrymead. Information can be found at <http://resources.ccc.govt.nz/files/CityPlan->OperativePlanChange28.pdf

13. Information about Proposed Change 1 to the RPS for the development of greater Christchurch can be found at [http://ecan.govt.nz/our-responsibilities/regional-plans/rps/Pages/proposed-change-no-1.aspx.](http://ecan.govt.nz/our-responsibilities/regional-plans/rps/Pages/proposed-change-no-1.aspx)

14. As advised verbally by the CRC to Mr Willis in the course of the review.

15. The study area consisted of the residential component of the eastern suburbs of Christchurch and Brooklands, Kaiapoi, and Kairaki/The Pines.

16. Tonkin & Taylor Limited (2011). *Christchurch Central Geological Interpretative Report*. Christchurch, New Zealand: Christchurch City Council.

**Appendix 1:**

**New Zealand Society for Earthquake**

**Engineering Guidelines**

Guidelines for carrying out structural assessments of the seismic resistance of existing building stock can be broadly defined in two categories, involving increasing levels of thoroughness and accuracy.

|  |  |
| --- | --- |
| **Building assessments in preparing for future earthquakes** | **Building assessments post-earthquake** |
| Initial Evaluation  Procedure | Overall Damage Survey or Initial assessment |
| Desktop study | Rapid Assessments  (Levels 1 and 2) |
| Detailed  Assessment | Detailed Engineering  Evaluation |

Confusion can arise in the types of structural assessments being used. There are many similarities and some overlap in these types of assessments.

**1. Building assessments in preparing for future earthquakes**

It is important to have agreed procedures for evaluating the seismic resistance of existing building stock. Their purpose is to determine the susceptibility of buildings

to damage from earthquakes and to devise and implement structural improvements that will bring all buildings up to or above a predetermined minimum level. Evaluation of an existing structure requires not only knowledge of the current design standards but also additional experience of the potential limitations that older buildings have. These include material properties, methods of construction, potential

weakness in form, and judgement on the significance of observed damage. The result of this evaluation is often expressed as a percentage of the standard required for a new building.

In 2006, the New Zealand Society for Earthquake Engineering released guidelines for assessing whether a building is potentially earthquake-prone to assist local authorities to prepare for future earthquakes. These guidelines are *Assessment and improvement of the structural performance of buildings in earthquakes: including Corregendum No 1.*

**2. Building assessments post-earthquake**

In the immediate aftermath of a major earthquake, the Overall Damage Survey and rapid assessments are used as a basic sifting method for identifying the worst of the immediate hazards. For rapid assessments,

evaluators do a quick visual assessment of the type and extent of a building’s structural damage, and on that basis can post a green (inspected), yellow (restricted use), or red (unsafe) placard. The percentage new building standard is **not** calculated in this process.

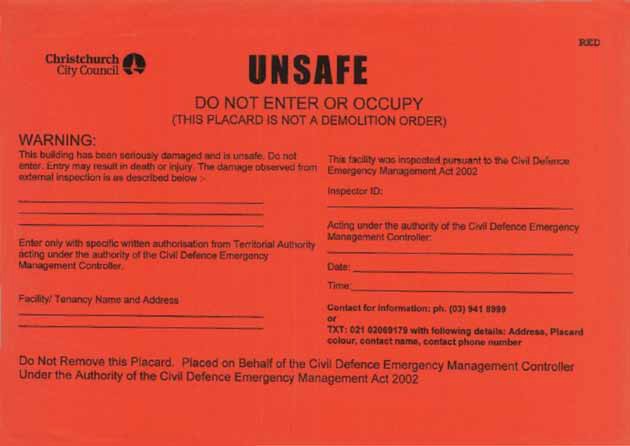
The Detailed Engineering Evaluation is a similar assessment to a Detailed Assessment, with the difference being that there is an assessment on the effects of the damage caused by the recent

earthquakes. A percentage new building standard may be calculated in this process.

In 2009, the New Zealand Society for Earthquake Engineering released the latest version of its guidelines for building safety evaluations. These guidelines are *Building Safety Evaluation During a State of Emergency: Guidelines for Territorial Authorities.*

**Appendix 2:**

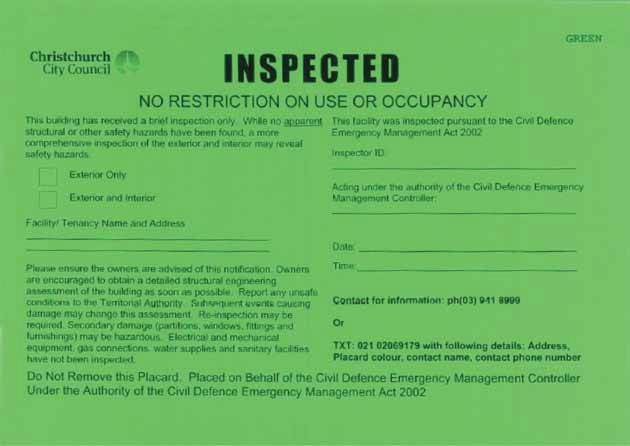
**The Christchurch City Council placards**



**Figure 17: The red placard used in Christchurch after the Canterbury earthquakes (source: Christchurch City Council)**



**Figure 18: The yellow placard used in Christchurch after the Canterbury earthquakes (source: Christchurch City Council)**



**Figure 19: The green placard used in Christchurch after the Canterbury earthquakes (source: Christchurch City Council)**

**Appendix 3:**

**The CPEng Certification Form**

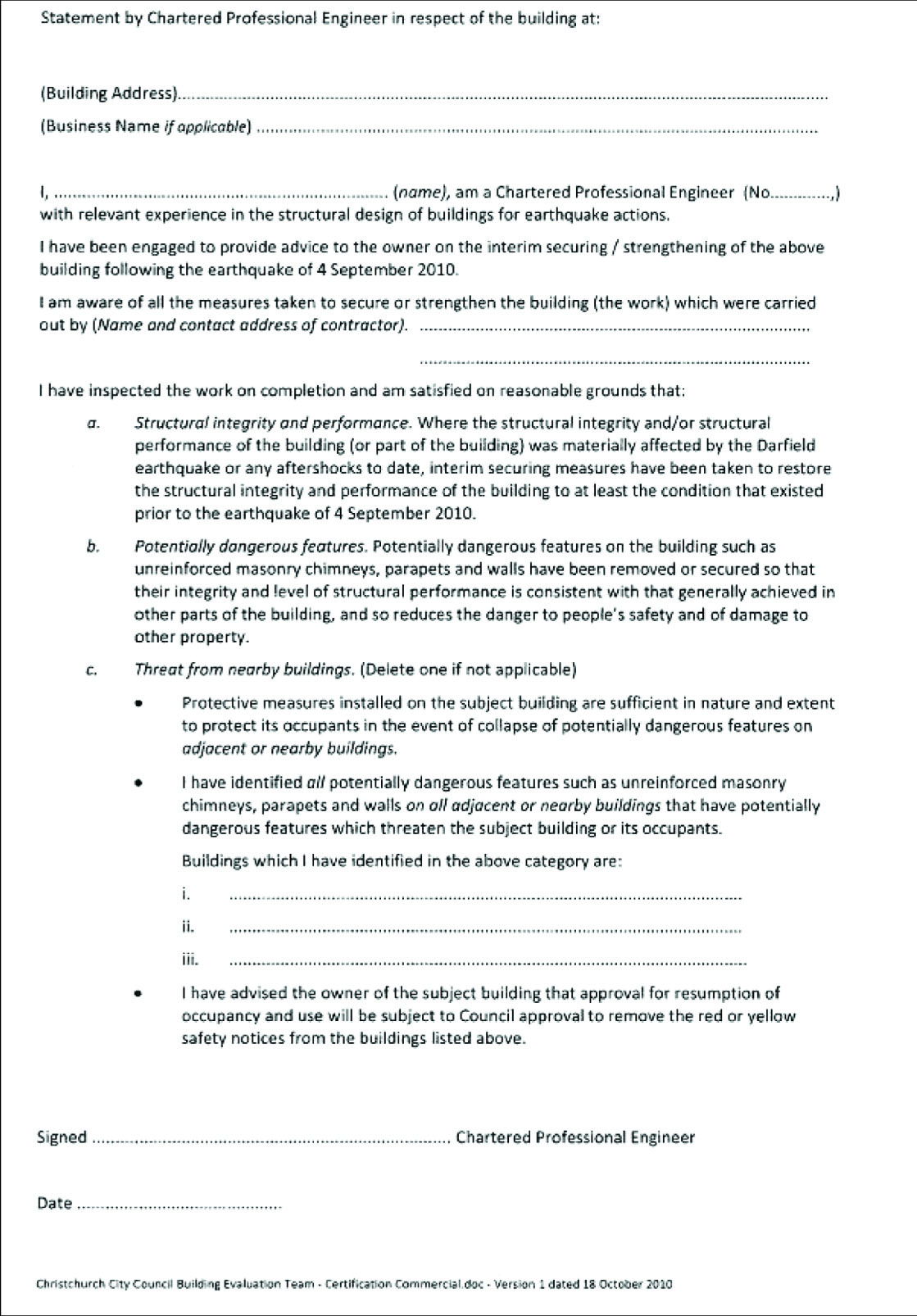


Figure 20:The CPEng Certification Fonn {soun:e:Christchun:h City Council,2011)

**Appendix 4: Section 124 notice**

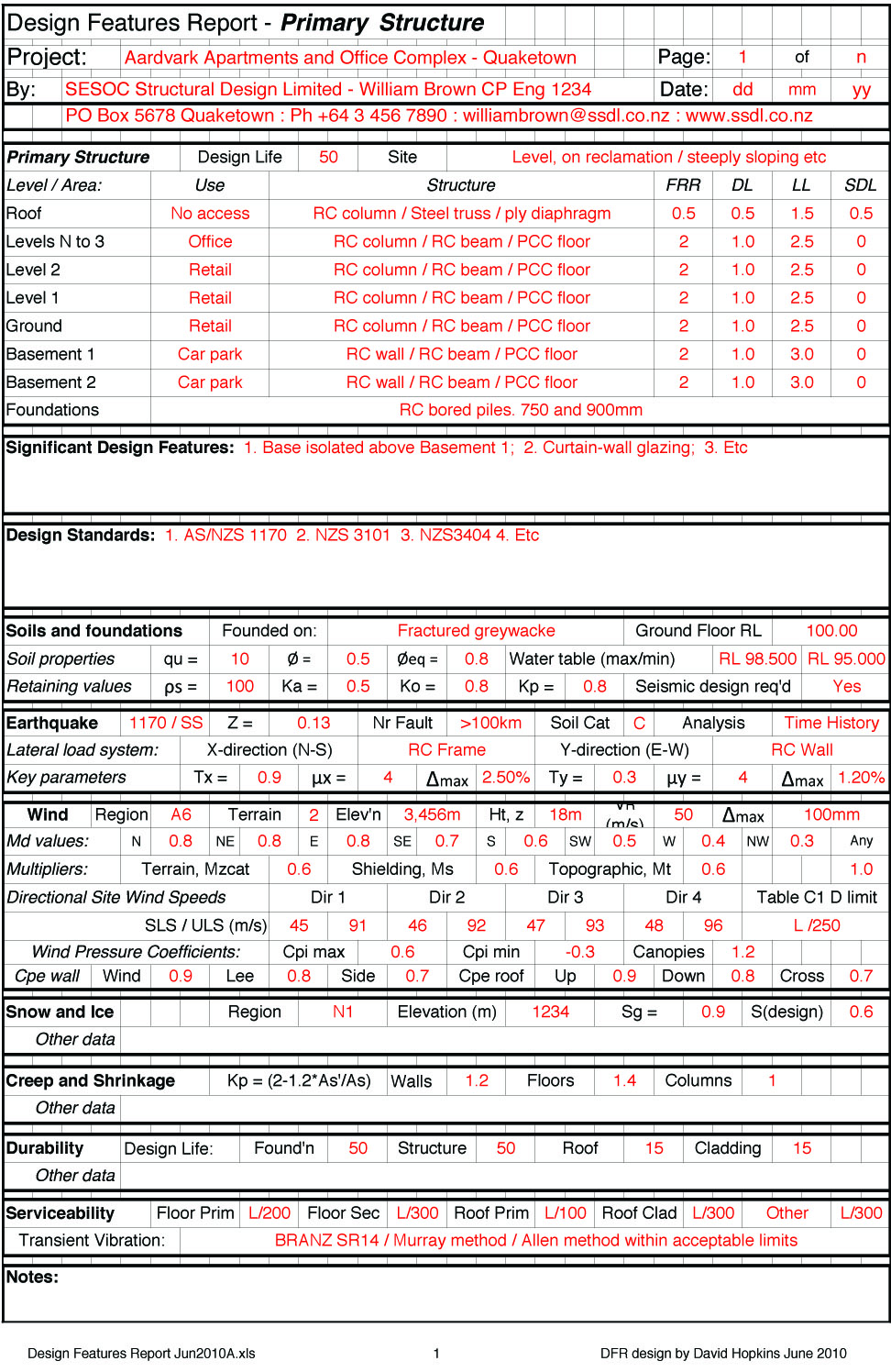


**Figure 21: The section 124 notice used in Christchurch after the September earthquake**

**(source: Christchurch City Council)**

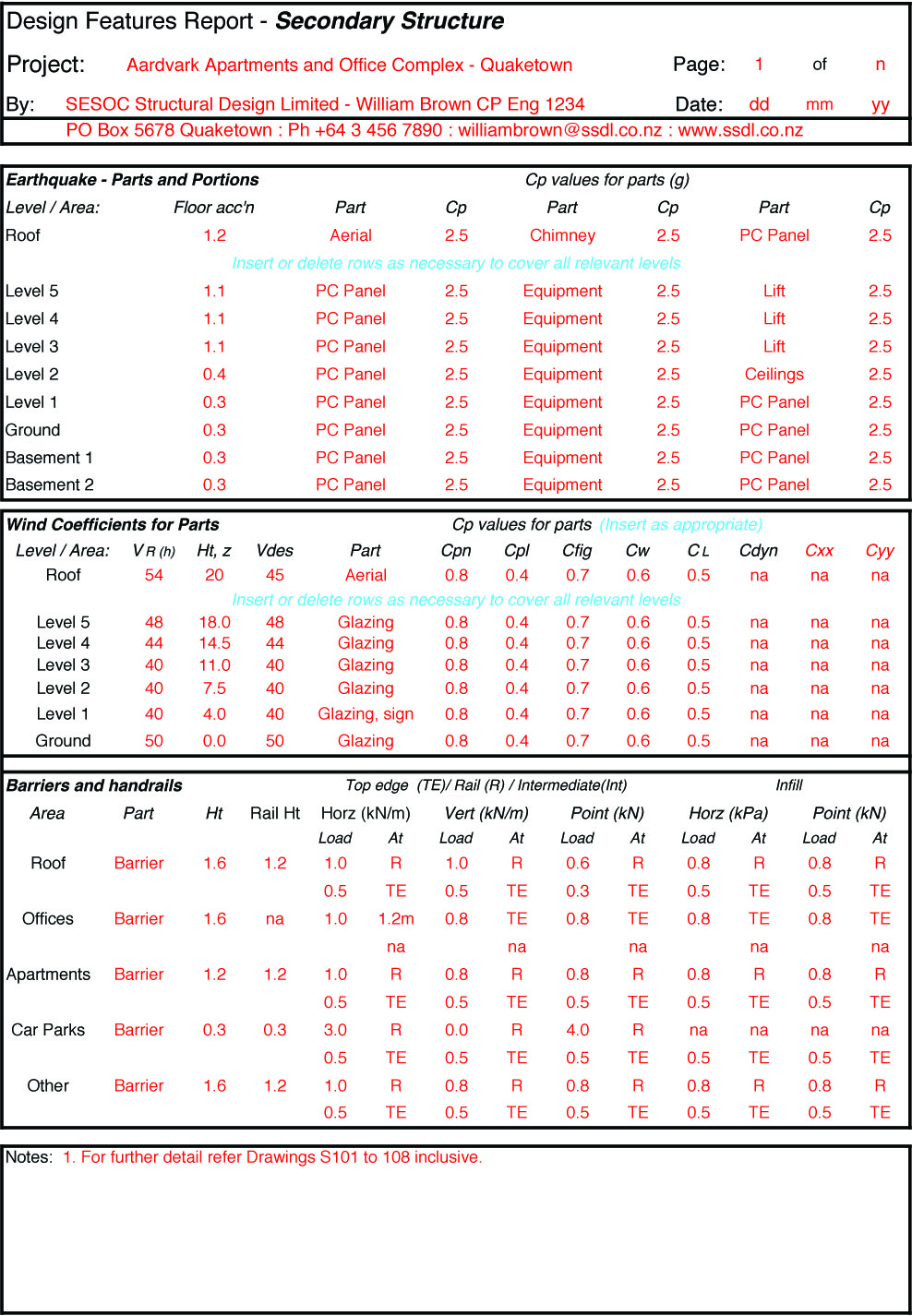
**Appendix 5:**

**Design features report example**



**Figure 22: Example of a Design Features Report (source: Dr David C Hopkins, submission to the Canterbury**

**Earthquakes Royal Commission, August 2012)**



**Figure 22 continued: Example of a Design Features Report**