



*Submission to the*

**Royal Commission of  
Inquiry into  
Building Failure  
Caused by the  
Canterbury Earthquakes**

16 December 2011

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Dear Sir / Madam

Please find below a general submission to the Canterbury Earthquakes Royal Commission from the Cement and Concrete Association of New Zealand (CCANZ).

## 1. BACKGROUND TO CCANZ

The Cement and Concrete Association of New Zealand (CCANZ) represents a membership in excess of 300 corporates and individuals who collectively account for a significant proportion of the building and construction sector in New Zealand.

The cement and concrete industry annually produces and uses about 1.5 million tonnes of cement in New Zealand, which equates to around 3.75 million cubic metres of concrete for new residential, non-residential and commercial construction. In total, the direct, indirect and induced economic impact of the cement and concrete industry resulted in close to \$7.5 billion of output across the economy in the year to March 2006. This activity supported more than 24,000 jobs and created a value add of about \$2.8 billion – around 2 percent of New Zealand's GDP in 2006.

CCANZ is a member of the New Zealand Construction Industry Council (CIC) and has contributed to the CIC submission, parts of which are echoed here.

## 2. THIS SUBMISSION

This submission presents CCANZ's view on some of the key issues before the Royal Commission. The submission does not provide definitive solutions but rather covers issues the Royal Commission may wish to consider.

This submission also responds to the *Base Isolation and Damage-Resistant Technologies for Improved Seismic Performance of Buildings* report.

### 3. EXECUTIVE SUMMARY

This submission seeks to highlight current disconnects in the building and construction regulatory environment, which have seen distinctions between various documents and organisations become blurred.

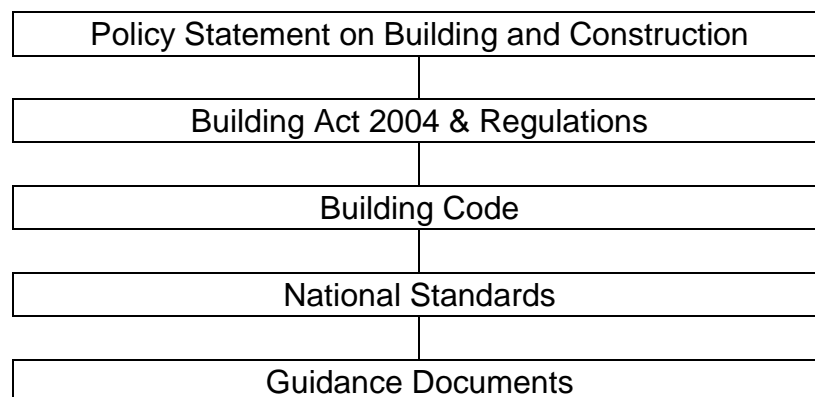
CCANZ is particularly concerned with the current funding mechanism for Standards New Zealand, which is a barrier to the regular review of what is an aging suite of building and construction Standards.

CCANZ fully supports efforts to advance the uptake of damage resistant technologies through Building Code and Standards review, more rigorous educational benchmarking, and increased levels of funding for research endeavours.

### 4. CURRENT REGULATORY SYSTEM

CCANZ supports continuation of the current performance-based regulatory system but believes an unambiguous hierarchy of building and construction policy and compliance documents is required.

Such a hierarchy (see below) should include a policy statement and ensure clarity around how the Building Act 2004, NZ Standards, Building Code and guidance documents relate to one another. This would facilitate greater regularity, confidence and transparency.



In suggesting this hierarchy CCANZ notes the significance of balancing regulator-developed compliance documents and consensus-based industry standards, guidelines and practice notes.

CCANZ also believes that associated with the need for greater clarity in terms of the relationship between documents is the need for greater clarity in terms of the individual roles and responsibilities of the Department of Building and Housing, BRANZ and Standards New Zealand. It is imperative the roles and responsibilities be clearly articulated, along with clearer explanations of the processes of investigation, specification and endorsement of Standards.

## 5. NATIONAL STANDARDS

CCANZ believes it important that the Building Code be supported by an up-to-date set of National Standards, comprising an appropriate mix of international and national Standards.

The present suite of over 650 building and construction Standards referenced in the Building Code and other regulatory documents require review. Uncertainty around Standards New Zealand funding for the renewal and replacement of Standards has led to this less than desirable situation. In response, CCANZ believes a new joint funding mechanism between industry and Government must be established. This would enable the regular review of Standards, as well as signify resolute Government commitment to Standards New Zealand.

Along with other industry organisations, CCANZ proposes a mechanism which delivers joint industry / Government funding for Standards development. This mechanism should be used for funding the whole suite of Standards across the building and construction sector. Industry funds would be matched by funds from the Building Levy - the public or consumer contribution. The resulting pool of funds could then be used for the on-going development and maintenance of building-related Standards.

Such a joint funding mechanism would also ensure a wider representation of interests on the standards committees.

### **NZS 3101:2006 Concrete Structures Standard**

The problems inherent to the current Standards New Zealand funding mechanism are demonstrated in the case of recently recommended changes to NZS 3101.

Annexure 1 of the Canterbury Earthquakes Royal Commission's *Interim Report* proposes that NZS 3101 be reviewed to include information on the magnitudes of elongation and where cracks may be initiated due to elongation. However, the Department of Building and Housing has not committed funding to this important review.

## 6. PERFORMANCE OF CONCRETE

Within the scope of this submission CCANZ believes a summary of concrete's performance during the Canterbury earthquakes is valuable as a means to achieve a clearer understanding of building material attributes.

Although the Darfield earthquake of September 2010 and the Christchurch earthquake of February 2011 placed enormous demands on all types of construction, suitably designed and built concrete structures generally performed well, helping to preserve life and minimise damage.

As stated by the Department of Building and Housing the earth shaking during the Canterbury earthquakes, particularly the 6.3-magnitude quake which struck

Christchurch on 22 February 2011, was more violent than designed for in the Building Code.

These seismic forces placed unprecedented demands on the performance of concrete across many forms of construction. Subsequent discussions have demonstrated that appropriately designed and constructed concrete slab-on-ground and reinforced concrete masonry for residential homes met the seismicity requirements of the Building Code. The vast majority of commercial and multi-storey reinforced concrete buildings also functioned outstandingly.

### **Concrete Slab-On-Ground**

Some residential concrete slabs did suffer damage during the earthquakes, but these were predominantly unreinforced. Although unreinforced slabs were allowed under the Building Code at the time, recent amendments to Clause B1 Structures of the Building Code mean this is no longer the case.

The unreinforced concrete slabs that developed cracks were, in the majority of cases, located in areas previously identified as at risk from liquefaction.

As a foundation for residential properties, cost effective reinforced concrete slabs will continue to offer outstanding durability, along with low maintenance, fire resistance, thermal comfort and an array of surface finishes. However, design and construction must be fit for purpose and fit for the site on which it is being used.

### **Reinforced Concrete Masonry**

During the earthquakes correctly reinforced and constructed concrete masonry met all modern Building Code requirements. There were no reported structural reinforced concrete masonry failures.

It is important to note that concrete masonry, since its introduction into New Zealand during the 1950s, has always been reinforced. Reinforced concrete masonry must also not be confused with unreinforced masonry, predominantly clay brick masonry and natural stone units such as that used to build the severely damaged Christchurch Cathedral.

Concrete block paving and flagstones also performed extremely well. Even where concrete paving was disturbed as a result of the earthquake forces, it is able to be reused following remedial earthwork.

### **Commercial/Multi-Storey Concrete Construction**

As stated by the New Zealand Society for Earthquake Engineering (NZSEE) buildings designed to 'modern' (post-1992) standards performed well and as intended, with little damage. The failure of stairs in the Forsyth Barr building and the tilting of the Grand Chancellor Hotel, were however exceptions.

Modern, properly designed, detailed, and constructed multi-storey reinforced concrete buildings have a proven history of helping to preserve life and minimise

damage during seismic events due to their stiffness, strength, and ductility. CCANZ welcomes the Canterbury Earthquakes Royal Commission's *Interim Report* recommendation to review NZS 3101.

The future of multi-storey concrete construction in Christchurch is further assured as evidenced by Christchurch Women's Hospital and the Southern Cross Hospital's Endoscopy Building, both of which emerged unscathed and available for immediate reoccupation following the earthquakes. These buildings employ 'damage resistance design' in the form of Base Isolation and PREcast Seismic Structural Systems (PRESSS) respectively, a new approach to structural engineering based on concrete technology.

CCANZ thoroughly endorses the appropriate development and adoption of damage resistance structural solutions based on concrete technology, and through a programme of education, information and research will endeavour to assist this process.

## **7. BASE ISOLATION AND DAMAGE-RESISTANT TECHNOLOGIES FOR IMPROVED SEISMIC PERFORMANCE OF BUILDINGS**

CCANZ commends the authors of the *Base Isolation and Damage-Resistant Technologies for Improved Seismic Performance of Buildings* report, and supports its key recommendations within the following areas.

### **Possible Changes to the Buildings Code and NZ Standards**

The report confirms that damage resistant technical solutions are available and have been implemented in real buildings. These successful applications have been facilitated to a great degree by strong interaction between practitioners and researchers through the help of associations such as CCANZ.

To further encourage practitioners CCANZ believes regulatory support needs to be introduced for the design of buildings protected by base isolation and/or damage resistant design procedures. The benefit of which is clearly evident through NZS 3101 Appendix B which gives a design procedure for PRESSS-technology in reinforced concrete structures.

As the report states, it is clear that design procedures and technologies are already feasible, and that in order to have damage resistant systems become the norm a dedicated section for damage resistant design needs to be incorporated into each material design Standard.

### **Educational Needs**

CCANZ support the report's view that it is crucial New Zealand universities maintain and enhance what is already a strong emphasis seismic engineering. The structural engineering profession must be expert in the design of sophisticated modern buildings for earthquake resistance. This can be greatly advanced through introducing the requirement that a Masters degree be the accepted entry point to the engineering profession.

In addition, the establishment of new Masters Degree in earthquake engineering (offered via flexible delivery methods) would provide the opportunity for practising structural engineers to up-skill their knowledge on a course-by-course basis.

Another tactic to address strategic issues within the educational space is the immediate provision by learned societies of short-courses in earthquake engineering for new graduates and practising professional engineers, as well as other professionals in the building industry.

Government commitment to earthquake engineering research and the up-skilling of the structural engineering profession needs to take the form of high levels of long-term investment, the results of which will be evident in lower loss of life and reduced property damage in future earthquakes.

### **Research Needs**

CCANZ concurs with the report's authors in that research must support education if new cost-effective design methods are to be introduced for the construction of new damage resistant buildings.

Investment in people, resources and facilities is required to facilitate ongoing development of the innovative technology with which New Zealand is synonymous, and which has led to many of the damage resistant design strategies such as base isolation and PRESSS.

Key to development within this area is the creation of world class structural testing facilities and the associated computational analysis tools. Such apparatus can be achieved through the modest investment of a few million dollars, and would enable academic researchers to push design boundaries, as well as allow practising structural engineers to model their new designs.

## **8. SUMMARY**

This submission has sought to highlight current disconnects in the building and construction regulatory environment, which have seen distinctions, in terms of direction and purpose, between compliance document, Standards and guidance notes, become poorly defined. To the detriment of the building and construction sector, a similar lack of clarity exists between the roles and responsibilities of organisations such as Department of Building and Housing, BRANZ and Standards New Zealand.

CCANZ is particularly concerned with the current funding mechanism for Standards New Zealand, which is a barrier to the regular review of what is an aging suite of building and construction Standards. As a result, the Standards New Zealand commercially driven business model makes access to Standards difficult for tradespeople.

Issues around the response of structures to seismic forces during the Canterbury earthquakes were predominantly related to design codes, not material. CCANZ fully supports efforts to advance the uptake of damage resistant technologies through Building Code and Standards review, more rigorous educational benchmarking, and increased levels of funding for research

endeavours. In the wake of the Canterbury earthquakes New Zealand engineers are faced with a unique challenge, which doubles as a unique opportunity, to develop and 'own' damage resistant technologies that help to create safer and more resilient building for the betterment of all.

CCANZ's extends its resources to the Canterbury Earthquakes Royal Commission should they be required, and applauds the Commission's efforts and activities.

CCANZ trusts that the above comments and recommendations are appropriate for consideration. Please do not hesitate to contact CCANZ if we can be of any further assistance or if you have any queries or require additional information.

Yours faithfully



Rob Gaimster  
CHIEF EXECUTIVE OFFICER  
Cement & Concrete Association of New Zealand