Submission to the Canterbury Earthquakes Royal Commission

Training and Organisation of the Engineering Profession

Integrating Professional Engineering Within Emergency Management Planning and Response in New Zealand

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1. Context and Scope of Submission

Very few NZ-based professional engineers had been involved in the early stages of a response to a major metropolitan earthquake involving extensive and widespread damage to property and utility services prior to the 4 September 2010 Darfield Earthquake. Similarly, hardly any NZ-based professional engineers had been confronted with the scale of loss of life, damage to residential and commercial buildings and land that occurred on 22 February.

Arrangements and preparation for the engineering component of responding to such events were under development, more so in some areas than others, with training having been delivered to different degrees.

Notwithstanding the relative lack of operational response experience of NZ-based professional engineers, it is apparent that they have played a vital and valuable role across a range of aspects in the response to the events of the Canterbury Earthquake sequence. In addition to those working in employed and contracted roles, significant numbers of engineers locally and nationally volunteered their time following the September 2010 and February 2011 earthquakes to assist the local authorities with the key task of initial building safety evaluations. Furthermore, many of these engineers then moved straight from an operational response role to undertake key recovery roles.

Much of this involvement was (and in some cases, continues to be) without a clearly defined context or linkage between normal professional engineering roles and civil defence emergency management activities, both pre- and post-disaster.

It is therefore apparent that there needs to be more specific structures and arrangements for professional engineers to be effectively integrated with civil defence and emergency management. The objective of such arrangements is for professional engineers to be appropriately engaged and prepared prior to an event, leading to optimum contribution and performance during a response and the early stages of recovery.

This submission outlines the key features of an integrated set of arrangements that would provide a better linkage between normal (non-emergency) activities and emergency operations. These key features include agency leadership and resourcing, definition of delivery mechanisms, capacity and capability building (training) and ongoing engagement.

The author of this submission currently leads the following engineering groups:

- Department of Building and Housing's Engineering Advisory Group
- NZ Urban Search and Rescue Engineering Group
- National Engineering Lifelines Committee

and has previously been president of the NZ Society for Earthquake Engineering (NZSEE) and leader of the NZSEE Working Group on Building Safety Evaluation.

2. Relationship Between Engineering Functions and Emergency Management

The four phases of emergency management defined in the National Civil Defence Emergency Management (CDEM) Strategy and Plan provide a useful framework for considering the different roles and functions of professional engineers.

These phases are Risk Reduction, Readiness, Response and Recovery, with reference to the following extract from the National CDEM Plan[1]:

- **Reduction** - identifying and analysing long-term risks to human life and property from natural or non-natural hazards; taking steps to eliminate these risks if practicable, and, if not, reducing the magnitude of their impact and the likelihood of their occurring)
- **Readiness** - developing operational systems and capabilities before a civil defence emergency happens, including self-help and response programmes for the general public, and specific programmes for emergency services, lifeline utilities, and other agencies)
- **Response** - actions taken immediately before, during, or directly after a civil defence emergency to save lives and property, and to help communities recover)
- **Recovery** - the co-ordinated efforts and processes used to bring about the immediate, medium-term, and long-term holistic regeneration of a community following a civil defence emergency)

These phases actually represent a continuum. For example, activities undertaken in the recovery phase following a disaster may contribute significantly to risk reduction.

Table 1 gives examples of the main areas in which professional engineering inputs contribute towards meeting CDEM objectives, with emphasis on public safety.

[1] National Civil Defence Emergency Management Plan Order, 2005 *(available from* http://www.civildefence.govt.nz)

Table 1: Relationship between professional engineering activities and CDEM phases

CDEM Phase	Examples of Professional Engineering Functions and Input
Risk Reduction	• Engineering design of new structures and infrastructure systems • The evaluation and improvement of existing structures and infrastructure systems (including Earthquake Prone Buildings) • Research into new methods and technologies
Readiness	• Developing operational systems and capabilities to deliver response and recovery functions • Participation in training
Response	• Rescue – providing technical advice to Urban Search and Rescue (USAR) teams • Building Safety Evaluation Critical facilities - safety evaluation for immediate re-occupancy where possible General structures – rapid evaluation to establish occupancy status • Utility Services and Transportation Lifeline Utility Co-ordination within CDEM operational structures Impact assessment and restoration of basic operations/ access to meet CDEM objectives
Recovery	• Building Safety Evaluation (Detailed for general structures) • Assessment of affected structures and infrastructure systems, specification of repairs and design of new buildings and elements

For the response to a large-scale urban emergency such as the Canterbury earthquakes, different numbers of engineers and relationships are involved for these key activities.

For the specialist task of providing technical support to Urban Search and Rescue (USAR) operations, NZ currently has 10 contracted and 12 support engineers trained as USAR Engineering Specialists. Thirteen of these engineers were deployed following the 4th September 2010 earthquake, and virtually all were deployed as part of the 22nd February 2011 USAR response.

The rapid phase of building safety evaluation typically involves engineers volunteering to assist the affected local authority(s) for periods of up to three days. Totals of 94 and 352 professional engineers were involved as volunteers for the rapid building evaluation process during the state of emergency period following the September 2010 and February 2011 earthquakes respectively. A significant number of additional engineers were involved in doing rapid assessments under commissions for building owners, managers or tenants.

As building safety evaluation activities therefore involve potentially large numbers of engineers, the need for a more systematic and structured set of preparatory and response arrangements is apparent.

Although outside the main scope of the Commission, it is worth noting that some professional engineers are also involved as Lifeline Utility Co-ordinators. This role has designated responsibilities to assist CDEM operations to co-ordinate information from and the activities of lifeline utility organisations in response and recovery. Most of the engineers involved in this role were activated in support of the National Crisis Management Centre and the Canterbury Response Centre following the 22nd February event. These arrangements are still under development, with limited training in place and ongoing engagement and preparation arrangements that are not well defined or resourced.

3. Current Arrangements for the Involvement of Professional Engineers in Response and Recovery Activities

The Guide to the National CDEM Plan[2] prepared by the Ministry of Civil Defence Emergency Management (MCDEM) summarises the functions and lead agency responsibilities with regard to the operational phases of readiness, response and recovery. Relevant responsibilities from the Guide in relation to engineering input are summarised below.

Clause 26 of the National CDEM Plan states that the New Zealand Fire Service (NZFS) is the lead agency for USAR. Clause 26 (1) (c) notes that the USAR capability includes engineers. The planning and development of New Zealand's USAR capability is supported by the multi-agency National USAR Advisory Board, to which the specialist skills strands of medics, canine search and engineers ultimately report to. The organisation and training of NZ's USAR engineers has progressed well since the delivery of initial courses in 2004 as a result of the financial commitment of NZFS and MCDEM.

Section 4 of the Guide to the National CDEM Plan notes that the Department of Building and Housing (DBH) is the lead government agency involved in building safety evaluation following events that impact on buildings. DBH has supported the NZSEE to develop guidelines describing the process and its operational organisation[3]. The status of the arrangements and issues arising are addressed in the NZSEE report to the Canterbury Earthquakes Royal Commission[4]. In overview, the development of the building safety evaluation process in New Zealand has focused only on the immediate building safety assessment with limited preparations in place across local authorities. The limited state of development of these arrangements, including training, is considered to be in large part due to the absence of a legal mandate.

The various components and responsibilities associated with the co-ordination of lifeline utilities during response and recovery are described in Clause 34 of the National CDEM Plan, and elaborated upon in Section 10.2 of the Guide to the National CDEM Plan. The co-ordination across lifeline utility sectors at the national level is the responsibility of MCDEM, and at regional level is the responsibility of civil defence emergency management groups.

Section 4 of the Guide also notes that the Institution of Professional Engineers New Zealand (IPENZ) has the function of maintaining a register of professional engineers who can assist during a civil defence emergency. The establishment of a register had progressed to only a preliminary stage prior to September 2010, and was not able to be operationalised during the response to the initial earthquake. However the significant efforts of IPENZ in

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[2] Guide to the National Civil Defence Emergency Management Plan *(available from* http://www.civildefence.govt.nz)

[3] *Building Safety Evaluation During a State of Emergency: Guidelines for Territorial Authorities, NZSEE August 2009 (available from* http://www.dbh.govt.nz/bofficials-building-safety-evaluation *)*

[4] *Building Safety Evaluation Following the Canterbury Earthquakes*, Submission to the Canterbury Earthquakes Royal Commission, NZSEE, 2011

successfully mobilising and co-ordinating large numbers of professional engineers from around NZ following the two major earthquakes has resulted in the role of IPENZ in such a situation now being much better appreciated by all agencies, in addition to IPENZ better understanding what this activity entails.

New Zealand observations and learnings from major overseas earthquakes has been the principal driver of the arrangements for the engineering response to earthquakes in the areas of USAR, building safety evaluation and lifeline utility co-ordination that were in place prior to the September 2010 Darfield earthquake. NZSEE has co-ordinated reconnaissance/ learning from earthquake missions following all major earthquakes to have occurred since the 1985 Mexico City earthquake. Principal funding for these activities has come from the Earthquake Commission, with additional contribution from the Department of Building and Housing.

In recent times there have also been operational deployments overseas. In September 2009, a total of twelve engineers were deployed on behalf of the NZ Government following both the Samoa earthquake and tsunami and the Padang, Indonesia earthquake. The challenges in rapidly mobilising appropriately experienced and skilled engineers for offshore deployment to these events highlighted the benefits of having an integrated register of engineers for both domestic and international deployment. IPENZ, NZSEE and NZFS (on behalf of the Ministry of Foreign Affairs and Trade) have been subsequently planning such a register.

International deployment is a key component of building New Zealand's domestic engineering response capability, as it helps grow the collective operational experience.

In 2004, a joint task force involving IPENZ, NZSEE, the Association of Consulting Engineers New Zealand (ACENZ) and MCDEM was initiated with the following objectives:

1. To provide an interface between the engineering profession and the national structures for emergency management.
2. To prepare the engineering profession to respond effectively to a major national or regional emergency.

The lack of national structures and systems, coupled with the absence of legislative drivers, has however led to a partially developed set of response arrangements that are not consistent across the various engineering activities. One of the associated outcomes is that the training of engineers for critical response roles such as building safety evaluation has lacked context and resources, and as a consequence, urgency.

This situation of uncertainty at the interface between engineers and emergency management is not unique to New Zealand; a feature article on humanitarian engineering in the December 2011 edition of Civil Engineers Australia leads with the following observation:

> *Engineers play an important role in responding to emergencies, but the pathway for action is not clear*

4. Key Features of Required Arrangements

The arrangements to provide clarity for professional engineers operating in response roles should include the following elements:

- Leadership from agencies that have delivery responsibilities to establish capacity and capability objectives, and provide appropriate resourcing and guidance;
- Delivery mechanisms for response and recovery established, with roles, functions and reporting etc clearly defined, and potential liability issues fully addressed;
- Relevant training in support of the roles and functions available (both initial training and for subsequent development including competency and skills maintenance), and linked with professional engineering Continuing Professional Development; and
- Appropriate engagement on an on-going basis for engineers with operational roles.

These points are elaborated upon in the NZSEE report to the Canterbury Earthquakes Royal Commission in relation to building safety evaluation[5]. Reference is made in that report to the following key components of best practice for the establishment and management of an effective building evaluation programme:

1. Appropriate legal mandate
2. Central government agency providing a focal point, guidance and support for preparedness activities
3. Criteria and process for building re-occupancy established
4. Local authorities appropriately prepared to set up and manage a building evaluation operation
5. Appropriate numbers of trained and warranted building professionals
6. Effective mobilisation arrangements for warranted building professionals (locally and nationally)

The arrangements and structures adopted in California for building safety evaluation provide an illustration of such structures and arrangements. The Californian Safety Assessment Program (SAP) is administered by the state emergency management agency (Cal EMA). Administered by a key full-time official within Cal EMA, this program is supported by a steering committee comprising representatives from the key professional groups (engineers, architects, building control officials) and four state agencies. This committee meets quarterly. The focus is on preparedness and promoting awareness amongst professionals and local authorities, and on response mechanisms.

The operational heart of the program is a comprehensive database of more than 7,000 trained engineers and architects. Official photo identity/ authorisation cards are issued to those undertaking the one-day formal building safety evaluator training course. These cards have a validity period of five years, with a refresher course being required to stay valid for a further five years.

The representative from each of the professional groups is also a SAP Response Co-ordinator, who rings around on a call tree basis to activate resources from unaffected parts of the state when an event occurs. The concept previously proposed by the author of

[5] ibid

having engineering response co-ordinators in Wellington, Auckland and Christchurch has been based on this approach.

For building safety evaluation in New Zealand, DBH has been supported by a Reference Group comprising senior building control officials from Auckland, Wellington, Christchurch, New Plymouth and Gisborne councils, and MCDEM, IPENZ and NZSEE representatives. This addresses some of the key components noted on the previous page, but is limited in its functionality due to the absence of a legal mandate, and does not have formal operational linkages.

5. Training and Continuing Professional Development

The pre-requisite to creating an appropriate training programme is to have the capacity and capability objectives clearly established.

For building safety evaluation, again a useful comparison can be taken from California. The current capacity there is more than 7,000 trained and certified evaluators (including 900 from other states), and about 200 trainers. Their target capacity is between 7,000 and 10,000 evaluators, from a base of 71,000 professional engineers and a population of approximately 37 million people.

From a simple population comparison basis, this could imply that NZ should have of the order of 800 trained and registered building safety evaluators.

Japan also has a large number of professional engineers trained for this operational function.

Broad capability objectives were proposed in 2009 for New Zealand (Figure 4.1 of the NZSEE report to the Royal Commission is reproduced below). The target numbers were however not quantified.

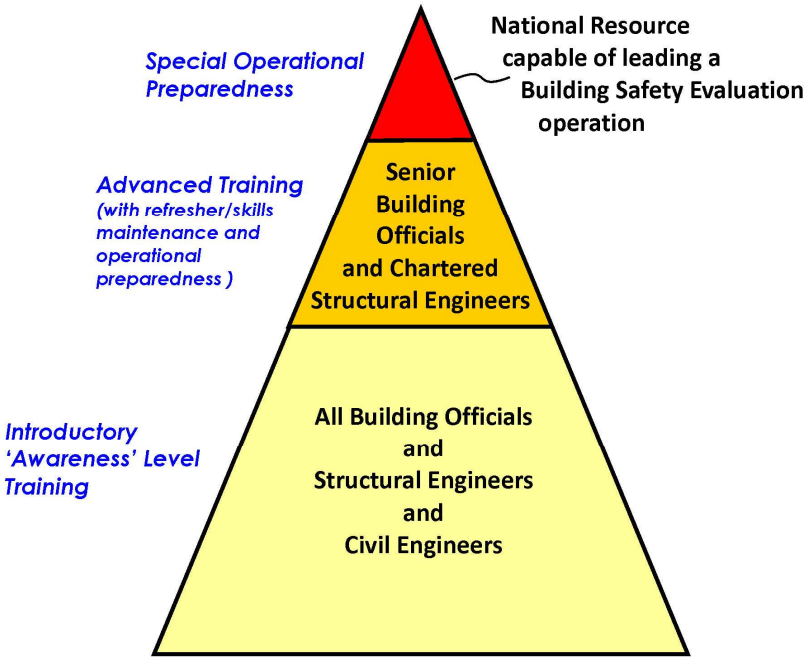

Figure 1: Building Evaluation Resource and Training Capability Objectives[6]

[6] ibid

The two New Zealand building safety evaluation training modules piloted in 2009 drew from the Californian material. These modules cover *Process Management* (aimed at local authority managers of the operation and senior local engineers, with a duration of two to three hours), and *Building Safety Evaluation Procedures* (aimed at all field personnel (ie. engineers and building control personnel; of half day duration).

The training of NZ USAR Engineers has also been derived from US training approaches and material, with some customisation to suit New Zealand. The engineering resource and training capability objectives are based on a similar 'pyramid' to that shown in Figure 1. The two levels of training are *USAR Engineering Awareness*, which is aimed at engineers of any level of experience and discipline, and *USAR Engineering Specialist*, which is aimed at Chartered Professional Civil Engineers who ultimately seek to become operational as part of USAR Task Force teams. For USAR Engineering Specialists, ongoing training is provided in the form of annual two-day workshop for skills maintenance and development, in addition to training with the Task Force teams.

USAR Engineering Specialists are also required to have additional formal rescue training, including USAR Awareness, General Rescue, Co-ordinated Incident Management Systems (Level 2) and First Aid. The latter two courses are considered highly relevant (if not a pre-requisite) for professional engineers seeking to become involved in any emergency response activities.

In summary, there are significant opportunities to more strongly link engineering-related emergency management training with general engineering Continuing Professional Development. However this in turn requires the overall context and framework for engineering response to be properly established, and training delivery suitably resourced.

6. Concluding Observations

1. The response to the Canterbury Earthquake Sequence has represented a significant effort and contribution from the engineering profession. This effort is continuing during the recovery phase. The many learnings from this experience must be reflected in enhanced arrangements going forward.
2. Professional engineers also have a significant influence in the risk reduction phase of emergency management. The events of 22 February 2011 have shown the need to focus on the consequences of hazard events rather than just the likelihood, particularly where public safety is involved.
3. There has been considerable effort at the interface between professional engineers, emergency management and other government agencies over the past decade. This has drawn upon the learnings from major overseas earthquakes and disaster events, and has led to the arrangements that are in place for key functions such as urban search and rescue, building safety evaluation and lifeline utility co-ordination.
4. However the unprecedented nature of the response to the events of 4 September 2010 and 22 February 2011 has highlighted that a more structured approach is required to embed competent engineering more effectively within emergency management. This is particularly the case where large numbers of engineers from a range of locations are involved in a response activity such as building safety evaluation.
5. In order to be able to make an optimum contribution to a disaster response and recovery operation, the engineering profession requires a clearer and more consistent connection with emergency response and emergency management agencies (nationally and regionally). This focal point is fundamental to establishing an appropriate platform for training and general preparedness in non-emergency phases.
6. The establishment of more effective and enduring arrangements for the involvement of professional engineers in the preparation for, response to and recovery from emergency events will require greater commitment from key government agencies to build upon current arrangements.
7. A specific and urgent requirement is to have post-disaster provisions for public safety in relation to buildings included in an amendment to the Building Act.
8. The arrangements to provide clarity for professional engineers operating in response roles should include the following elements:
    - Leadership from agencies that have delivery responsibilities to establish capacity and capability objectives, and provide appropriate resourcing and guidance;
    - Delivery mechanisms for response and recovery established, with roles, functions and reporting etc clearly defined, and potential liability issues fully addressed;
    - Relevant training in support of the roles and functions available (both initial training and for subsequent development including competency and skills maintenance), and linked with professional engineering Continuing Professional Development; and
    - Appropriate engagement on an on-going basis for engineers with operational roles.