The role of engineers and scientists in reducing the impact of urban disasters

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ABSTRACT: Increasing risk associated with the impacts of natural and technological hazards has led to concerns about New Zealand's capability to manage significant emergencies, particularly in urban areas. This has resulted in the development of thinking into a new approach to emergency management. This is a comprehensive risk management approach incorporating Reduction (mitigation), Readiness, Response and Recovery activities in a coordinated manner, by all involved stakeholders. As key stakeholders, the involvement of scientists and engineers in each of the 4 R areas is of critical importance.

Engineers and scientists have a long history of involvement in understanding the impacts of hazards through planning, design standards assessment and strengthening of at risk structures and regional Lifeline Groups. They have been active in post-earthquake reconnaissance in bringing back the lessons learnt to New Zealand. There is, however, a need to become more involved in establishing relationships prior to events, so that post-earthquake response can be improved. In response, engineers are critical in a number of areas, including evaluation of buildings and infrastructure and Urban Search and Rescue in the case of structural collapse. Emergency managers will be seeking to engage with engineers more in these areas.

1 INTRODUCTION

New Zealander's must cope with the challenges posed by significant natural hazards, plus deal with increasing exposure to technological and other man-made hazards exacerbated by demographic changes and infrastructure pressure. While our most common natural hazard is flooding, the most dangerous hazard is earthquake and the most under-rated threat is volcanic eruption. Our population is ethnically diverse, ageing and geographically concentrated with 85% in town/city areas that in some areas, suffer from rapid growth and pressure on inadequate, ageing infrastructure.

As a nation, our ability to deal with disasters has been variable and has not been tested by an event of national significance in recent decades. As a result of long-standing serious concerns about our capability to manage significant emergencies, the lack of cross agency planning, and the gaps in our mitigation and preparedness activities, a number of reviews recommended a new approach. Traditional civil defence focused on response (i.e. waiting for a disaster to happen) rather than planning and acting to reduce risks and improve the potential for recovery. Civil defence has typically been a peripheral, part-time activity fragmented between 86 local government authorities and assorted emergency services and other agencies, leading to duplication and lack of effective coordination and integration. Civil defence has been perceived by the public as "Dad's Army" and having a few candles and bottled water. On the other hand, there are compelling public and government expectations that those of us involved in

emergency management have it all in place and that significant support will be provided to communities in emergencies. We cannot, unfortunately, say that this is the case.

This paper summarises the new directions in Civil Defence and Emergency Management, and discusses the important role that engineers and scientists have in reducing urban disasters.

2 NEW DIRECTIONS IN CIVIL DEFENCE AND EMERGENCY MANAGEMENT

New Zealand has decided that it must improve the ability of its emergency management sector to adapt to changing circumstances, to learn from overseas experience and to better co-ordinate our limited resources. A shared vision has been developed, one of a

'***Resilient New Zealand'***

- a capable society, understanding and managing hazards

The strategy to achieve resilience is through a comprehensive, integrated, all-hazards approach to risk management. Comprehensive means addressing the "4Rs" of risk **reduction, readiness, response** and **recovery**, and integrated means through the cooperation and coordination of affected sectors and agencies.

Major steps towards improving New Zealand's resilience include:

- Strengthening *relationships* between the professions and agencies involved in emergency management;
- Promoting *behaviour* that embraces risk, asset and emergency management planning and activity; and
- Raising awareness of *legislation* underlying relationships and behaviour; in particular the proposed Civil Defence Emergency Management (CDEM) Act.

The Bill is intended to:

- Ensure New Zealand has the appropriate structures and expertise to manage disasters at the local and national level
- Ensure NZ implements a risk management approach to hazards across the board
- Ensure NZ communities actively seek to reduce the risks they are exposed to as well as being prepared to respond effectively to events when they happen
- Provide the framework for greater co-operation and co-ordination on emergency management amongst local government, national government, and emergency services
- Reduce the risk of adverse economic and social impacts from emergencies.

At the heart of the proposed Act are CDEM Groups – grouping together the currently disparate 86 local government authorities, working together with Police, Fire, Ambulance and Health services and Lifeline Utilities in 12 CDEM Groups based upon existing regional council boundaries. The responsibilities of Groups are to: promote understanding and acceptance of responsibilities and roles, build effective working relationships and address the gaps, overlaps and inefficiencies in CDEM planning and capability. They are required to produce a CDEM Group Plan encompassing a strategic approach to hazard analysis, reduction and mitigation activities as well as planning for responding to and recovering from emergencies.

Engineers and scientists are key stakeholders

Engineers and scientists are a key stakeholder and have relationships with all the other stakeholders involved in emergency management. As such, they need to be involved in all 4 Rs.

3 REDUCTION/MITIGATION

This involves knowing what **hazards** are likely to occur and what **impacts** they will have on the built environment. Scientists and researchers will be brought together with engineers so that, over time, reduction in risk can occur through planning, legislation, building modifications and new building structural techniques and standards. Traditionally, engineers have had most impact in the area of Reduction by, for example, developing design standards for new buildings and also for assessing and strengthening pre-modern code earthquake prone buildings. Engineers and scientists are also an integral part of Lifeline Utility groups. Engineering expertise in the design and operation of assets lends itself most naturally and effectively to the new emphasis in emergency management of a risk management approach and as such, engineers' skills and expertise will be keenly sought.

4 READINESS

Not all hazards and impacts can be eliminated. With engineers and scientists working with local government planners and others to understand the level and likelihood of risk in the built environment, it is possible to plan and prioritise for response in advance. Engineers, seismologists and geologists have been involved in a substantial number of reconnaissance expeditions to international disasters looking at the effects of earthquakes and other disasters and make a major contribution with respect to identifying and communicating the lessons learnt.

In this area, it is proposed to establish Priority Response Agreements, whereby, through the establishment of relationships prior to events, buildings and structures can be rapidly assessed for occupancy and operability post-disaster, according to their level of risk and importance in the immediate and short-term period following the disaster. This is critical in order to manage the emergency, protect lives and assist in decision-making about evacuation and return to buildings associated with critical facilities.

It is also proposed that a post-earthquake register of engineers – skill sets, location and contact details – be established for the various tasks. (Refer Brunsdon, D. "The Response of Professional Engineers to a Major Earthquake: *Priority Response Agreements and a Register of Engineers"*.)

5 RESPONSE

Engineers are immediately required for evaluation of critical facilities and utilities and for building safety evaluations (refer the presentation by Denzil Duncan, MCDEM on the 2001 Seattle Earthquake). While some authorities in New Zealand have commenced putting processes recommended by NZSEE (NZSEE, 1998) in place, it is inconsistent around the country, lacking a national focus. The requirement is for immediate advice regarding the structural integrity of buildings for the safety of emergency service responders, followed by decisions around the evacuation of, and return to buildings by building occupiers and owners. Engineers are also looked to by emergency service providers for advice about alternate power & water supplies in buildings and building safety systems. NZ Fire Service engineers provide advice about fire risks and the impact of fires in buildings.

Engineers are also critically important as part of the multi-agency Urban Search and Rescue teams which will be deployed following any structural collapse. A project, jointly led by the Ministry of Civil Defence and Emergency Management and the New Zealand Fire Service has been underway for the last 12 months to develop a capacity for rescue following structural collapse. In case you are unaware, such a capability in New Zealand is sadly lacking. Other than the emergency services being able to rescue a few individuals from damaged structures, our capability has been really non-existent to manage anything more significant. We have had limited knowledge of what will be required, a complete lack of common standards and training,

inadequate equipment and few designated personnel. We have started to address this by a number of initiatives, including:

- The establishment of a national multi-agency USAR Steering Committee
- The adoption of international training and operating standards
- The development of our own training packages at Category 1(USAR Awareness and general rescue) and Category 2(specialist USAR Task Force skills and competencies)
- The re-establishment of the lower North Island team which had been languishing for some years and the beginning establishment of a South Island team
- The building of relationships with international organizations and teams
- Developing a greater understanding of the activities, roles and responsibilities included in urban search and rescue

Through this work it became obvious that engineers, along with paramedics, mine rescue personnel and other specialist groups must have a direct relationship with the USAR general and specialist teams of personnel. The Steering Committee conducted the first specialist USAR Category 2 training program of the project in Palmerston North October last year, during which time the importance and value of engineer participation and skills were soundly demonstated.

Engineers are needed to identify structural collapse patterns for various building types, perform structural triage and work with the team on methods of shoring. Most importantly, the engineer is there as an integral member of the team to protect the lives of other team members and the public. Engineers are therefore required as part of the Advance Planning team of the USAR Taskforce, available for 24 x 7 deployment. Work is needed to formalize selection of interested and appropriately skilled engineers, availability, transport, mobilization. The training of engineers to perform these tasks is important and work is being done to develop an approach to such training. (Refer McGuigan, D.M., Deam, B.L., & Bull, D.K. "*Urban Search and Rescue and the Role of the Engineer"*).

The Steering Committee intends developing 3 national specialist Task Forces, based in Auckland, Palmerston North and Christchurch. The objective is to have at least 2 specifically trained structural engineers attached to each of the three national USAR Task Forces. 2 engineers attended the Palmerston North training and their experiences and impressions are included in the afore-mentioned paper.

6 RECOVERY

In the medium term, building inspections will continue to be required for rebuilding and insurance purposes, as well as engineering advice re the demolition of buildings and disposal of contaminated building material. Most communities have not begun to address these issues.

7 CONCLUSION

For many years, the public of New Zealand, their political representatives and even the emergency management sector have been complacent in their assumption that everything was in place to deal with emergencies. This has certainly been the case for small scale, localized events that Police, Fire. Ambulance and Civil Defence deal with regularly. It has been an erroneous assumption for any regional or national event. Reviews of this country's capability have revealed a worrying reality. Critical analysis of planning and exercises shows that readiness and response is not coordinated between the professions and agencies involved and that there are significant gaps in our preparedness. The role of scientists is important in research, understanding of hazards and their impacts and a risk management approach to

mitigation. The role of engineers is equally important in each of the 4 R areas as described above. It has to be said that while a few individuals and agencies have started to engage on these issues, over all scientists and engineers are not being effectively involved in the emergency management sector where they have a vital contribution to make.

The presentations look at what is being, and can be, done about that. The challenge for all of us, emergency managers and engineers, is to take equal responsibility for making it happen.

REFERENCES

New Zealand Society for Earthquake Engineering, *Post-earthquake Building Safety Evaluation Procedures*, January 1998

New Zealand Society for Earthquake Engineering, *The Response of Professional Engineers to a Major Earthquake: Priority Response Agreements and a Register of Engineers,* January 2002