

## **BUILDING MANAGEMENT IN EMERGENCIES: AN UPDATE ON NEW ZEALAND ARRANGEMENTS**

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### **Abstract**

Following the Canterbury Earthquake Sequence, New Zealand arrangements for post-earthquake building evaluation were significantly revised and further developed. This has involved extensions to engineering processes, including procedures for rapid geotechnical assessment of land instability affecting buildings, and the inclusion of flood events. More significantly, provisions for building management in emergencies have now been included in the National Civil Defence Emergency Plan for the first time.

The impacts of the M7.8 Hurunui/ Kaikoura earthquake of 14 November 2016 on multi-storey buildings in Wellington has added another chapter to this evolution, with the introduction of legislation to require owners of buildings to provide certain information to the local authority in situations where a declaration of a state of emergency has not been made. An additional technical process, Targeted Damage Evaluation, was also created.

National guidance for local authorities and engineers on the management of processes to be followed in emergencies has recently been released, consolidating the experiences and learnings of the past decade. This paper summarises recent developments in New Zealand, the current arrangements and tools for engineers, relationships with building instrumentation, and their connection with community resilience.

### **1. Background**

A process for post-earthquake building evaluation was first developed for a New Zealand situation following the 1989 Loma Prieta earthquake. It had been prepared essentially on a volunteer basis, with the New Zealand Society for Earthquake Engineering, NZSEE, publishing Guidelines in 1998 using the 1989 version of ATC-20 as the basis. The first time that implementation occurred in New Zealand was in 2007 following the Gisborne earthquake. Since then there has been an evolution in understanding, mandate and practice with enhancements occurring progressively with event experience. In contrast to the relative seismic quiescence of the previous 50 years, the past decade has seen a significant increase in activity in New Zealand, a period that has included the Canterbury earthquake sequence, Seddon, Cook Strait and Kaikoura earthquakes. The post-earthquake building evaluation system has therefore been tested on a number of occasions and, indeed, the importance of having an effective and efficient system has been better realised by the public and national and community leaders. Progressive enhancements have increasingly taken a whole of system approach, not just being concerned about the immediate response but how the initial response can assist with recovery and the processes needed during this next phase.

Following Gisborne, the then Department of Building and Housing supported NZSEE in developing the 2009 Guidelines (NZSEE 2009) that outlined the overall process but concentrated more on the rapid assessment process during response. The guidelines were endorsed by the Ministry for Civil Defence and Emergency Management, MCDEM, and launched by the NZ Government Minister for Civil Defence, giving the process more official recognition. The working group who developed the Guidelines subsequently drafted amendments following the NZ Aid support mission to Padang, West Sumatra in October 2009 and drew upon learnings from the 2009 L'Aquila earthquake in Italy. This update was not finalised prior to the September 2010 Darfield earthquake. The scale of the Darfield and then the February 2011 Christchurch earthquakes seriously tested building evaluation processes and many lessons

were gained (Hare and Galloway 2011, Galloway and Hare 2012). A review of post-earthquake building evaluation became a focus of the Canterbury Earthquakes Royal Commission, CERC.

Subsequently, the November 2016 Kaikoura earthquake brought new challenges and developments.

## **2. Canterbury Earthquakes and the Royal Commission**

Much has been written about the participation and contribution of engineers and impact on the profession resulting from the Canterbury earthquakes (Brunsdon et al 2013, Stannard 2016, Hare and Campbell 2018). More than 500 engineers participated in rapid building evaluation processes, and many more were in some way connected with the rebuild (NZSEE 2012, Hare et al 2014, Galloway et al 2014).

The CERC heard evidence during public hearings in September 2012 on building management after earthquakes and considered international practices. They concluded that while improvements were necessary, the current approach was appropriate, stating that *“overall, New Zealand was very well served by the engineers, building control officials, and other civil defence workers who participated in the building safety evaluation operations in Canterbury, most of whom were volunteers who worked to ensure the safety of the wider Christchurch community in very difficult circumstances.”* A total of 51 recommendations for improvement were made (Recommendations 111 to 161, CERC, 2012), all of which were accepted by the Government (MBIE 2017). Issues covered included:

- Legislative mandate – should legislation specifically refer to building management following emergencies rather than relying on existing powers in CDEM Act, how can the transition to recovery under Building Act be improved, and whether powers should apply outside of a ‘state of emergency’?
- Purpose – confusion as to whether the paramount purpose was public safety or recovery and economic activity
- Consistency of assessments – requirements for adequate and trained resources
- Assessment basis – should rapid assessments consider residual capacity of the building rather than only be damaged-based, given aftershock risk?
- Detailed assessments – following rapid assessments there was no agreed detailed engineering assessment process, resulting in variable levels of investigation following the initial placarding
- Public communication – green placards were confused with being safe rather than meaning no damage was observed but follow up still required, and placard wording was not in plain English
- Integration of geotechnical and structural assessments
- Recording and accessing building information
- Protocols for cordoning and demolition

## **3. Civil Defence and Emergency Management Context**

Building management in emergencies has to date been planned and carried out under the Civil Defence Emergency Management (CDEM) framework given legislative effect through the CDEM Act 2002 and the National CDEM Plan Order 2015 (MCDEM 2015). This framework aims to encourage communities to be self-reliant, manage risk, and for local and national civil defence agencies and personnel co-ordinated to prepare for and respond to emergencies, considering the four Rs: Risk Reduction (Prevention), Readiness (Preparedness), Response and Recovery.

**3.1 Roles within CDEM Framework.** Many agencies have defined roles under this legislation. To enable regional co-ordination and co-operation, regional councils unite with the territorial authorities within each region to establish a CDEM Group. The regional council chairperson and mayors represent each council on the CDEM Group. Each CDEM Group establishes a Co-ordinating Executive Group (CEG), that includes the chief executive of each council and representatives from the emergency services.

The CDEM Group manages hazards, provides resources, and provides for emergency response and recovery. The CEG advises the CDEM Group and implements CDEM Group decisions.

Local authorities are required to function during and after an emergency to the fullest possible extent, even though this may be at a reduced level, and plan and provide for civil defence emergency management within their district.

Emergency services include the New Zealand Police, Fire and Emergency New Zealand, and health services. They participate in the development of the National Strategy and CDEM Plans, and have a representative on each CDEM Group CEG.

Lifeline utilities include transport infrastructure providers (road, sea and air), community water supply, sewerage and drainage systems, energy generation and distribution networks, and telecommunications network providers. They are also required to ensure their operations are able to function during and after an emergency to the fullest possible extent, even though this may be at a reduced level, and to provide technical advice as requested.

The role of central government complements the roles and duties of local government, communities and individuals. Government and its agencies provide guidance, promote community values and create action through leading by example. They are also required to be able to function to the fullest possible extent, even though this may be at a reduced level, during and after an emergency, perform agreed functions under any CDEM Plan, participate in the development of the National Strategy and CDEM Plans at both the national and regional levels, and provide technical advice on CDEM issues (MCDEM 2002).

**3.2 National CDEM Plan 2015.** Building work in New Zealand is managed under the Building Act 2004 but this has not addressed post-earthquake situations. For the first time in legislation, the 2015 National Civil Defence Emergency Management Plan (Schedule to the CDEM Plan Order 2015) made provision for Building Management within a CDEM context. Prior to this time the Civil Defence Controller had powers under the CDEM Act to implement rapid assessments during a declared “state of emergency”. The lack of specific mandate affected government priorities, resourcing and a lack of clarity when transitioning to business as usual once the “state of emergency” was over.

The National CDEM Plan assigns responsibilities to the Ministry for Business, Innovation and Employment, MBIE, the national building regulator, to:

- plan for the national co-ordination of building management in an emergency
- co-ordinate training and qualification of building assessors
- maintain the rapid building-assessment processes, maintain arrangements for mobilising and demobilising trained rapid building assessors and detailed-engineering evaluators
- maintain sufficient capability of assessors nationally to enable timely support to CDEM Groups when local capabilities are exceeded.

During response and recovery MBIE will:

- provide national co-ordination of building management support to a CDEM Group when requested by the Director or the National Controller
- lead rapid building assessment functions in a state of national emergency
- advise and report on operational building management needs and options to the Director or the National Controller
- provide building management policy advice to the Government as requested
- lead the securing and management of compromised building sites for forensic investigations

- advise the Government, during recovery after an emergency, on the requirements for facilitating the efficient and effective recovery of building stock and functions.

Territorial Authorities develop and maintain arrangements, in accordance with national guidelines and procedures, for assessments, evaluations, and steps to be undertaken for managing risks to and uncertainties as to the safety of buildings in response to and recovery from an emergency.

During response and recovery the territorial authority will, as necessary:

- lead rapid building assessments
- take steps to manage the safety of people in and near a building, by, as appropriate, cordoning, stabilising, barricading, demolition, or requiring the mandatory evacuation of a building or the area around a building
- preserve and restore lifeline utility services in the affected area that they are responsible for.

**3.3 CDEM Act Changes Following Kaikoura Earthquake.** The National CDEM Plan has provided much greater clarity about the roles of the various agencies. However, these responsibilities had not been fully understood and operationalised by agencies before the Kaikoura earthquake occurred on 14 November 2016, resulting in considerable confusion on the ground. Other challenges and issues arose. A ‘state of emergency’ was not declared in Wellington, preventing a rapid assessment operation from occurring and initially preventing Wellington City from requiring building owners to provide them with safety information. This was addressed by fast tracking legislative changes to the CDEM Act, introducing ‘transition periods’ providing similar powers to require information from building owners as during a state of emergency. A transition period was subsequently declared by Wellington City and a number of buildings were required to have ‘targeted assessments’ undertaken (Brunsdon et al 2017, WCC 2017).

**3.4 Building Amendment Bill 2018.** Public consultation on the Building Amendment Bill currently before parliamentary select committee is the latest step in fully recognising the importance of building management after an emergency. If passed by Parliament in its current state to become part of the Building Act 2004, it will assist with a number of issues that have arisen with previous events. It clarifies the purpose with the paramount consideration being protection of human life and safety. It provides powers to territorial authorities to manage buildings during an emergency, including placing notices, evacuating and restricting entry, cordoning, demolition (heritage building demolition requires Ministerial approval), requiring information from building owners, such as detailed engineering assessments for them to remove or reduce risks. With Ministerial approval it can occur outside of a declared ‘state of emergency’ or ‘transition period’. It requires that powers are used proportionately, recognising personal and property rights.

As the administrator of the Building Act and also the steward of the building regulatory system, MBIE will become squarely responsible for the effective and efficient implementation and functioning of processes required. While the adequate resourcing, training, mobilising, and supporting of territorial authorities in the event of an emergency by experienced experts is not specifically mentioned in the Act, it will clearly be essential. Now that building management after an emergency is likely to be included in the functions of the MBIE Chief Executive defined in the Building Act, it will enable the building levy to be used to fund necessary resourcing. The Bill provides for MBIE to prepare and issue a methodology for preparation of post-event assessments and approve the form of notices, directions, signs and assessments and to issue guidance. It also provides liability protection for authorised people undertaking building management after an emergency, a contentious area that has only been satisfied in the past by restricting assessor involvement to occasions when a state of emergency has been declared so that the CDEM Act liability exemption applies.

The Bill also provides MBIE and the Minister with specific powers to investigate building failures, another opportunity to learn more about building performance and improve future practice, a key element

of risk reduction. To date, building failure investigations – Southland Stadium (snow storm), Christchurch CBD buildings (Canterbury earthquakes) and Statistics House (Kaikoura earthquake) – have been undertaken under general monitoring powers with the co-operation of the building owner.

#### **4. Learning from Events – Addressing the Process Gaps**

Evolving and improving practice has occurred progressively with each emergency event requiring building emergency management implementation. Gisborne was a test case relying on local building officials, the USAR Task Force and engineers who volunteered to assist the few local engineers. This led to the development of the 2009 guidelines by NZSEE providing more formal rapid assessment and resource mobilising processes. The aid mission to Padang, West Sumatra, resulted in improved forms, data capture and reporting, and provided core leadership experience for managing the 4 September 2010 Darfield earthquake. The indicator building process was initiated during the response to Darfield, a valuable development that has now been included into American practice. Many further developments occurred during the response to the devastating Christchurch earthquake on 22 February. These included:

- Operation Suburb – to provide confidence to homeowners approximately 70,000 homes were assessed by building officials with engineering and welfare support
- Operation Shop – providing priority assessment for essential facilities supporting the community
- Critical Buildings Team – the establishment of a specialist team assessing, stabilising or demolishing approximately 45 critically damaged high rise buildings in the Christchurch CBD
- Cordon management, and the use of containers as barricades
- Integrating assessments done for private building owners into the Christchurch City Council process.
- Geotechnical assessment of Port Hills – geotechnical engineers and engineering geologists assessing land damage in Port Hills
- Supporting the CDEM ‘shelter in place’ philosophy – providing portable sanitary facilities in suburbs to enable people to stay in their homes even though sewerage was damaged and unavailable
- Mobilising and demobilising significant numbers of engineers and building officials
- Regular Technical Clearing House meetings, which continued throughout the recovery phase
- Building forensic investigations

As most engineers had not been trained in assessment procedures when the Darfield earthquake occurred, building assessments were quite variable, some overly conservative with some red placards being posted for broken windows, and others unconservative, ignoring dangerous parapets. A comprehensive training programme was necessary. The CERC recommended the three-tier training programme proposed by the NZSEE (NZSEE 2012) and this was accepted by the Government. To date approximately 500 engineers and building officials have been through the Tier 2 training. Further on-line resources have been developed for refresher and awareness training. Earthquake, flooding and geotechnical Field Guides have also been developed for assessors (MBIE 2015, 2017).

The placards have been reworded in plain English and a decision was made, following CERC recommendations, to change the green placard to white, contrary to international practice (MBIE 2015).

It was intended that Detailed Engineering Evaluations, DEE, (now being termed Detailed Damage Evaluations, DDE, to clearly distinguish it from detailed seismic assessments being undertaken prior to an earthquake) by building owners should occur following rapid assessments. MBIE’s Engineering Advisory Group developed and published a draft two stage process (qualitative and, as necessary, quantitative) (EAG 2012), which was mandated for many Christchurch commercial buildings by CERA. It proved resource intensive and the large number of buildings to assess meant there were considerable delays. An Interim Use Evaluation process was developed to get buildings back into operation in the meantime (MBIE 2012). The DDE process remains a work in progress. The residual capacity of buildings that have experienced strong shaking and post elastic deformation resulted in insurance disputes and delays.

Significant research and international collaboration is continuing to better understand residual capacity constraints and provide guidance to assessing engineers (Elwood et al 2016, Sarrafzadeh et al 2017).

A more targeted follow-up assessment approach was adopted in Wellington following the 2016 Kaikoura earthquake. The shaking characteristics more severely affected medium rise buildings (4 to 15 storey, 1.5-2 second period) on soft ground (Brunsdon et al. 2017). Precast concrete flooring systems were known to be vulnerable. A targeted damage evaluation (TDE) procedure was therefore developed by leading researchers and practitioners to support the Wellington City Council requirement that the owners of 72 buildings undertake a more detailed inspection. The results demonstrated its value by identifying damage unseen during the initial response whilst optimising the use of scarce engineering resources.

Land instability in the Port Hills in Christchurch affected many residential properties during the Canterbury earthquakes (Macfarlane and Yetton 2013). It was even more widespread during the 2016 Kaikoura earthquake with some 80,000 landslips identified, affecting mainly rural houses many in remote locations in North Canterbury and Marlborough regions. These events have highlighted the need for better integration of geotechnical and structural assessments. A Geotechnical Rapid Assessment Field Guide has since been developed (MBIE 2017).

## **5. Understanding the Scope of Building Management in Emergencies**

A more comprehensive process guidance for territorial authorities on building management in an emergency has recently been published (MBIE 2018). As well as reflecting the developments in rapid building assessments since the predecessor 2009 NZSEE version, this new guidance more clearly portrays the scope of building management in emergencies, the elements of which can be summarised as:

1. Understanding the extent of the emergency and the nature of its impact on buildings within the affected community.
2. Then, if appropriate, carry out a rapid building assessment operation within an identified area where there is cause for concern for public safety in or around buildings.
3. The management of public safety issues both inside and outside any rapid building assessment operational area. This includes working with owners on repairs and barricades, or urgent demolition where key public access routes are affected.
4. Managing the issues caused by the emergency to enable the community to recover to business as usual. This includes: providing timely information to the public; managing, updating and the eventual removal of building placards, cordons and barricades; seeking more detailed assessments from owners where appropriate; and monitoring urgent repair work.

## **6. Current Capability and Future Challenges**

While significantly more resources are now available than prior to the Canterbury earthquakes, gaps remain. Even though New Zealand has experienced a number of significant earthquakes in recent years causing loss of life, damage and serious disruption, it remains a challenge to continue getting decision maker attention and prioritisation for improving the management of buildings following emergency. Organisations undergo considerable churn and already the central building regulator, MBIE, has virtually no one who was involved during the Canterbury response. The Tier 1 group of experienced practitioners is aimed to address this, but it remains to be implemented. Smaller territorial authorities are similarly affected by capability which can impact on decision making. It was clearly evident that some of the local authorities affected by the Kaikoura earthquake did not understand processes or their responsibilities, and so training in the 2018 MBIE guidance is clearly needed. The key geotechnical question remaining unresolved is how early red placards posted on buildings because of fears about landslides can be removed when further analysis and consideration indicates that access restriction is not required.

The residual capacity assessment of reinforced concrete buildings remains a challenge. Research being undertaken by QuakeCore in New Zealand, along with international collaboration, and further consideration of the empirical approach used in Japan aims to provide answers.

Increasingly building are being instrumented. Devices are cheaper and more readily available that provide accelerations and displacements for building manager decisions. However, there is no agreed protocol as to how this data should be gathered and used by decision makers during the early stages of a response.

Processes for electronically recording field data via apps were trialled in the Kaikoura earthquake and the 2017 Bay of Plenty floods, resulting in much more rapid production of plots of damaged buildings and associated information summaries. More efficient data collection and transfer holds the key to effective rapid building assessment, and is an area of current focus.

Building management following emergency processes have been primarily developed for earthquakes. To date, there has been little documented experience when using the current New Zealand processes for flooding, and this is another area where attention is needed with some urgency.

## **7. Conclusions**

Successive earthquake events in New Zealand and internationally continue to highlight the importance of having effective arrangements in place for the management of buildings in the response to and recovery from earthquakes. These arrangements need to include the following elements:

1. Legislation and plans that enable a clear interface between building and emergency management aspects
2. Operational arrangements across Readiness (Preparedness), Response and Recovery that engage engineers and emergency managers
3. Resource capacity and capability to deliver on these arrangements. This includes leaders to prepare for and co-ordinate operations, and suitable numbers of trained and experienced engineers and building officers to provide necessary technical inputs

In New Zealand there is now a clearer understanding about the scope of building management in emergencies, and how in particular it is much broader than just rapid building assessments and placarding of buildings. There are also promising developments with respect to electronic field applications of standard national forms, and the linking of geotechnical and structural rapid assessments.

The training and development of those that have the knowledge and experience to lead building management operations is a crucial element of the overall national capability, and one that now requires greater attention. An associated need is for the establishment of specific standing arrangements between metropolitan territorial authorities and engineers to enable early process leadership and maximising the use of information from instrumented buildings.

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