Reflections on the Newcastle earthquake: the next 35 years

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Abstract

Earthquakes remain a rare yet constant risk to communities around the world. In Australia, these have the potential for significant consequences such as the Newcastle earthquake in 1989, the Meckering earthquake in 1968 and the Adelaide earthquake in 1954, which was the most destructive earthquake recorded in Australian history until the Newcastle event. This year marks the 35th anniversary of the Newcastle earthquake and the 70th anniversary of the Adelaide earthquake. It provides an opportunity to reflect on the systems and processes available to emergency managers for prevention, preparedness, response and recovery from emergency events.

Introduction

On 28 December 1989, a 5.6 on the Richter Scale (now equivalent to a Moment Magnitude 5.3 as currently used across Australia) earthquake struck Newcastle, New South Wales. The city area of Newcastle was the centre of the earthquake and 13 people were killed, many were injured and 30,000 buildings within the city area were damaged (Newcastle (N.S.W.) Renewal Co-ordination Unit 1994). The earthquake was felt as far away as Batemans Bay to the south, Dubbo and Armidale in the northwest of the state with some reports coming from Melbourne (Coroners Court of New South Wales 1990, p.1). The earthquake was the first in Australia with a damage bill of $1 billion (1994) dollars (Newcastle (N.S.W.) Renewal Co-ordination Unit 1994, p.2).

The coronial inquest that followed made 3 recommendations and several observations (Coroners Court of New South Wales 1990). Recommendations included changes to the Australian Earthquake Loading Code AS 1170.4, a review of engineering and architecture training courses and formalisation of a procedure to have engineers attend emergency sites to provide advice on building structures. Observations included discussion on the importance of leadership, equipment that should be used, failures of telephone and radio equipment and communication in general and the use of engineers at the scene (Coroners Court of New South Wales 1990, pp.22–23).

Since that time, what keeps earthquake scientists and emergency management personnel alert is not knowing where and when the next big earthquake might occur. Many of us are unaware of these concerns and what it could mean for the homes we live in, the infrastructure we rely on for our way of life and consequences to society and the economy.

Risk

Past disaster events provide insights and lessons for the future. The Insurance Council of Australia commissioned an analysis of these past catastrophes to allow more direct comparison of the impact these events had on the community. The analysis adjusted for inflation and normalised the costs to present-day and found that the 1989 Newcastle earthquake is ranked the third most costly insurance catastrophe when normalised to present-day property numbers, values and building codes. The costliest is Cyclone Tracy in Darwin in 1994, followed by the hail storms in Sydney in 1999 (Insurance Council of Australia 2023, pp.8–9).

Since the Newcastle earthquake, there have been major advances in the emergency management sector. Development and improvements in the consideration of risk, through publications such as the Risk Management Standard (drafted in 2004 and updated) (International Organisation for Standardisation 2011) underpins the thinking applied for emergency management personnel. The application of risk to

emergency management is documented in national policies such as the *National Strategy for Disaster Resilience* (Attorney-General's Department 2013) and is supported with other strategies such as the *National Disaster Risk Reduction Framework* (Commonwealth of Australia 2018). These now frame the way risk and resilience are considered in Australia. Supporting these national policies are other materials such as those found on the Knowledge Hub website of the Australian Institute for Disaster Resilience. The Knowledge Hub contains historical information, a glossary of common terminology and a range of best-practice doctrinal handbooks that are freely available. These may promote best practice, whole-of-community and multi-jurisdictional management of emergency events prevention, preparedness, response and recovery.

Prevention

Building codes play a crucial role in community safety and are one of the prevention measures available to reduce risk. But Australia has a large legacy building stock developed prior to the current building standards. It took the Newcastle earthquake event for the earthquake loading standard to be established and to assure life safety (given this is a key objective of the National Construction Code (Australian Building Codes Board 2022)). Life safety is the key principle for emergency management, however, emergency management encompasses the critical recovery component, which is usually protracted and costly.

Prior to the Royal Commission into the National Natural Disaster Arrangements, a global initiative led by the International Code Council was established to improve the resilience of buildings and communities from weather-related hazards. This initiative was a collaboration between the code development organisations of Australia, Canada, New Zealand and the United States working towards shared outcomes (Australian Building Codes Board 2020). As part of this effort, the Australian Building Codes Board sought stakeholder views and opinions on the challenges and opportunities to enhance resilience in the building codes and standards (Australian Building Codes Board 2021). The findings were that stakeholders acknowledged the need to investigate how building codes and standards can reduce vulnerability risks to current and future building stock. This need was recognised during the royal commission and resulted in its Recommendation 19.4:

> *The Australian Building Codes Board, working with other bodies as appropriate, should: (1) assess the extent to which AS 3959:2018 Construction of buildings in bushfire-prone areas, and other relevant building standards, are effective in reducing risk from natural hazards to lives and property, and (2) conduct an evaluation as to whether the National Construction Code should be amended to specifically include, as an objective of the code, making buildings more resilient to natural hazards.*
> (Binskin et al. 2020, p.43)

To address this recommendation, government building ministers agreed in June 2024 to add climate resilience as an objective of the National Construction Code to withstand extreme weather events (Department of Industry Science and Resources 2024). What is not clear is the effect this new objective will provide for earthquake resilience. Until the outcome is implemented into the code, it is unknown if this objective will apply to all construction code standards. If so, what does this mean for earthquake loading and future earthquake resilience of all buildings?

Preparedness

The emergency management sector remains challenged to raise awareness of low-probability hazards such as earthquake especially when faced with situations created by higher-frequency hazard events. We also know that resilience gains can be undone with an event in a major town or city where there is concentrated infrastructure like roads, rail, power, water and communications infrastructure potentially damaged. What would mean for the broader economy?

The earthquake science and engineering community know the uncertainties in earthquake hazards and accommodating this uncertainty in construction. Dealing with uncertainty is part and parcel for the emergency management sector, however, these uncertainties are not well understood by the community. There remains large unknowns about the maximum earthquake that could occur in Australian and we don't know all the secrets that the landscape holds.

The National Seismic Hazard Assessment (updated in 2023) (Geoscience Australia 2024b) defines the expected level of ground shaking for defined return periods to inform building codes and emergency management. Among the outputs from this assessment is the Earthquake Scenario Selector Tool that contains credible earthquake scenarios for defined locations around Australia and that can be used for exercising, risk assessments and planning. The National Seismic Hazard Assessment is updated as new research and data becomes available and is typically updated to coincide with updates to the earthquake loading code.

Response and recovery

Emergency management agencies are increasingly working together to deliver consistency in their operations. The primary incident management systems used across Australia are the Australasian Interagency Incident Management System (AIIMS) (AFAC 2017) used by fire and emergency services and the Incident Command and Control System Plus (ICCS+) used by police agencies (Australia New Zealand Policing Advisory Agency 2022). These 2 management systems have more in common than ever before and the integration is constantly improving. Recent developments have increased the application of recovery considerations into the overall management of

emergencies with new units of competency developed for recovery practitioners (Commonwealth of Australia 2020).

There has also been specific parallel work to develop Australia's Urban Search and Rescue (USAR) capabilities. Two states now maintain internationally certified teams and other jurisdictions maintain smaller capabilities that can work together across borders (National Emergency Management Agency 2024). To develop Australia's USAR capabilities, Australia hosted the Asia Pacific Earthquake Response Exercise in August 2023 in collaboration with the United Nations International Search and Rescue Advisory Group (International Search and Rescue Advisory Group 2023).

Since the Newcastle earthquake, there has been continued investment and evolution in the monitoring and alerting of earthquakes with the establishment of the National Earthquake Alert Centre (NEAC) and many new products provide usable information to support response and recovery operations. Modern alerting uses the moment magnitude scale, replacing the Richter Scale. NEAC products such as the Felt Grids and ShakeMaps published through Earthquakes@GA provides valuable situational awareness about where the greatest earthquake ground shaking is predicted and where people have reported the effects (Geoscience Australia 2024a).

Opportunities

The emergency management community has advanced considerably since the 1989 Newcastle earthquake. Professionalisation of the emergency management field, including the people known as emergency managers is advancing (Dippy 2020, 2022). Emergency management is moving toward a full-time role for more and more practitioners. A greater collaborative effort is becoming evident as improvements in standards such as those relating risk have created a framework to support national progress towards resilient communities. However, unlike tsunami and tropical cyclone, there is no national forum to unify efforts in earthquake risk management. We need national leadership to acknowledge earthquake risk and convene a national forum under the auspices of the Australia-New Zealand Emergency Management Council (ANZEMC) governance arrangements to drive continuous improvement in emergency management for earthquake risk.

Such a forum could advocate for and support efforts to strengthen the seismic network that could reduce vulnerabilities and provide a better definition of earthquake hazard. The forum would support better knowledge sharing of earthquake projects and provide a chance to leverage efforts for broader national benefit. The forum could collectively seek to address the challenge of community perception of earthquakes. For example, the forum could develop ways to improve community awareness of earthquakes and of knowing what to do in an earthquake regardless of whether people are at home, work or are elsewhere. The forum could consider using the United States led annual Great ShakeOut exercise platform to raise awareness of earthquakes to practice what to do in an earthquake (Federal Emergency Management Agency 2023). There is already participation in such exercise from institutions in Australia (less than 100 in 2023) and that participation should grow in the future. In 2023, over 700,000 participants were registered from New Zealand institutions for its Great ShakeOut exercise.

There are a host of research and data gaps that are well known to the scientific and engineering community. A national forum could bridge the knowledge gaps through unified effort and support.

What does the future hold

The future holds a range of new and emerging processes and technologies that will enhance community resilience. The ongoing professionalisation of emergency management will lead to better educated and trained emergency managers who are able to influence policy and practice in an evidence-informed manner. The professionalisation of emergency management will provide greater research and practically validated lessons from which to train the artificial intelligence tools that are being developed. The use of artificial intelligence requires that research provides the source research validated information from which to train that artificial intelligence. Artificial intelligence may then provide an opportunity to identify and prevent emergency events.

Advances in remote sensing technologies such as low earth orbit satellites will provide a means to learn more about the world in which we live and communicate that knowledge in a timely and efficient manner. These processes and technologies support the technical and human responses to emergency events as we seek to prevent emergencies, prepare for, respond to and recover from future events. We can't prevent everything, but the aim must be to reduce the negative effects for communities.

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