International Seminar

on

Development of a Resilient Smart Network System against Natural Disaster

Natural Hazard Disaster Risk Management in New Zealand

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Natural Hazards Commission Toka Tū Ake (NHC)

New Zealand is at significant risk from natural hazards. As a country with a small economy, legacy land use planning issues and risk exacerbators such as population growth, increased demand for housing and climate change, it's important we have a collaborative, coordinated and effective disaster risk management system.

Natural hazard disaster risk management is governed by multiple pieces of legislation, focusing on risk reduction at the community and personal levels. Different laws, strategies, programs, and agencies are involved, to ensure we understand and manage our risks. These include regulatory tools such as land-use planning, building requirements, emergency management, local governance. Over the past 15 years, this system has been, unfortunately, well tested, by large, medium and small-scale events.

This presentation will discuss the governance of natural hazard risk in New Zealand, focusing on lessons learned and adaptations made. A focus will be on the importance of science and information to understand significant risks, plan to reduce them, and be ready to respond and recover from any remaining residual risk. This includes local government efforts to build resilient communities, and sector collaboration to address gaps and issues in managing disaster risk, such as legal concerns, knowledge gaps, and climate adaptation and retreat.

In addition, we will discuss the unique and important role of first loss disaster risk insurance in New Zealand and how we remain one of the highest insured countries (against natural hazard risk) in the world. Additionally, how the scheme uses natural hazard research, and experts in risk reduction to advocate for improved natural hazard risk management and protect the insurance scheme.

Towards a national understanding of flood disasters in New Zealand

Dr. Ryan Paulik

The National Institute of Water and Atmospheric Research (NIWA)

Flooding is New Zealand's most frequent natural hazard and one of its costliest. Two-thirds of the population live in flood-prone areas, and climate change is expected to increase both the severity and impact of flooding. Despite this threat, New Zealand lacks a national understanding of fluvial and pluvial flood hazards and their risks to people and assets. To address this knowledge gap, a new framework for national-scale flood hazard mapping and risk analysis has been developed. The modular framework uses open-source software for workflow scheduling, input data generation, hydrodynamic modelling, and risk analysis. The model workflow divides New Zealand into 'model domains', with domain-specific design storms, digital elevation models, river flow, and tidal models forming the hydrodynamic model inputs for generating flood inundation maps and evaluating risk to people and assets. This presentation outlines key components of the modelling framework, shares preliminary results on New Zealand's national flood hazard and risk, and highlights opportunities for future improvement and transferability.

Community service-centred hazard risk management and risk tolerance

Dr. Charlotte Brown

ResOrgs – Resilience & Risk Experts

Effective risk management decision making must be informed by both a sound understanding of the impacts of a disaster and our tolerance to those impacts. Historically, hazard and loss modelling in New Zealand has focussed on direct impacts, and risk reduction decisions (such as asset design standards and land use planning thresholds) are based on, often arbitrary, annual exceedance probabilities that have no clear connection to the likely impacts of disruption.

New Zealand research and practice is actively working to bridge this gap to develop community service-centred risk management tools and methods that can drive more effective risk management aligned to our national risk tolerance. This presentation will summarise the research and modelling that is improving our understanding of disaster impacts from a community-service perspective. The presentation will begin with the latest research on preparedness, response and recovery perceptions and behaviours. Next, we will summarise key developments in our shift from asset to service loss modelling. This includes modelling residential and industry impacts of disruptive events; infrastructure interdependency modelling; infrastructure recovery modelling; transport system, evacuation and freight modelling. We will also showcase MERIT, a socio-economic impact modelling tool designed for shock events.

Lastly, we will explore advances in how we are embedding risk tolerance in risk management decisions. This includes progressing toward a national risk tolerance framework and the establishment of infrastructure performance standards. As part of this we will share approaches and examples of how to engage communities on their risk tolerance perspectives, including the Resilient Building Project, Let's Talk About Risk project, AF8 programme, and digital tools for engaging communities on preparedness.

National Seismic Hazard Model and Impacts on Building Design in New Zealand

Prof. Ken Elwood

Ministry of Business Innovation and Employment (MBIE)

New Zealand is one of the most seismically active countries in the world, with recent history of significant and unique fault rupture and earthquake impacts. These impacts have shaped the ongoing evolution of seismic risk understanding and its implications for how New Zealand designs, assesses, and manages buildings.

This presentation will provide an overview of the recently updated New Zealand National Seismic Hazard Model (NSHM) and its influence on building performance expectations under the Building Act 2004. The latest NSHM incorporates advanced geophysical modelling and updated seismicity data, significantly reshaping the hazard landscape. These changes are already informing updates to building design standards, moving toward a more risk-based, performance-oriented framework. Further impacting this, are societal expectations and how New Zealanders are excepting more from their buildings – including cheaper costs and faster recovery after an event. This is shifting and influencing new builds and the management of existing buildings. This presents unique challenges: implementing earthquake-prone building policies, addressing public safety, navigating uncertainty, and managing costs amid evolving standards.

As science and modelling evolves, so must policies and practices to ensuring a safe, more resilient built environment for all New Zealanders. This is why the New Zealand engineering community are working to identify and address challenges and opportunities, including risk tolerance, innovative retrofit strategies, and ensuring regulatory frameworks remain responsive, evidence-based, and future-focused.

City-scale disaster simulation and resilience assessment:

From physics-based method to AI method

Prof. Xinzheng Lu

"Resilience" has emerged as a prominent focal point for building and urban disaster prevention. As a result, it's critical to use physics-based models to investigate the mechanisms of urban disaster and resilience evolution, as well as to continue developing AI-driven urban disaster simulation and resilience assessment methods.

This presentation will first introduce the nonlinear time history analysis at the building and city scales against earthquake disasters. The lecturer will then present a physics-based multi-hazard simulation framework based on the city information model (CIM) to assess the resilience of the community in the face of multiple hazards (i.e., earthquake, fire, wind, and COVID-19 disasters). Because the developed physics-based models do not rely entirely on historical disaster data, they can be applied to a wide range of communities. The database, which is powered by CIM, standardizes the data format required by simulations for various hazards and scales, improving simulation efficiency.

Furthermore, the potential of AI in providing a competitive advantage over traditional disaster simulation methods is investigated. AI-driven urban disaster simulation and assessment methods, in particular, are being developed to facilitate intelligent data acquisition, model establishment, vibration identification, and damage prediction. The proposed AI models can significantly improve modeling and computing efficiencies by learning and illustrating characteristics of the disaster evolution process.