frontiers | Frontiers in Built Environment

TYPE Editorial
PUBLISHED 06 September 2022
DOI 10.3389/fbuil.2022.1005562



OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Earthquake Engineering, a section of the journal Frontiers in Built Environment

RECEIVED 28 July 2022
ACCEPTED 11 August 2022
PUBLISHED 06 September 2022

CITATION
Monteiro R, De Luca F, Galasso C and De Risi R (2022), Editorial: Natural-hazard risk assessment in developing countries.
*Front. Built Environ.* 8:1005562.
doi: 10.3389/fbuil.2022.1005562



# Editorial: Natural-hazard risk assessment in developing countries

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KEYWORDS

**natural hazards, built environment, large-scale assessment, risk, developing countries**

Editorial on the Research Topic
Natural-hazard risk assessment in developing countries

## Introduction

Developing countries are disproportionately affected by natural hazards and lack of coping capacities. This combination sets back progress on poverty alleviation and slows long-term development, contributing the aggravation of the many obstacles already faced by these countries and their communities. Probabilistic risk assessment models are increasingly popular tools for estimating potential human and economic loss due to natural hazards. Within such a context, risk modeling for developing countries presents specific challenges in terms of quantity and quality of the available input data at all components of risk: hazard, exposure, and vulnerability. As such, widening the types of hazards and ensuring that models are contextualized to the local needs of these countries is also crucial and may require innovative or, some times, simplified, yet sound, approaches that tackle the well-known deficiencies in this context. Some of the above-mentioned challenges include: 1) characterization of hazard or multi-hazard models, with a view to risk analysis of existing structures and infrastructure; 2) innovative data collection methods, for creation of quantitative exposure models at different scales, including approaches to overcome limited or poor data; 3) impacts on vulnerable structures and critical infrastructure, including the development of advanced physical vulnerability models to incorporate damage from single or multiple hazards to networks; 4) mitigation measures for natural-hazard risk, including optimization of retrofitting campaigns; 5) loss estimates to single and/or multi-hazards.

With the above in mind, this Research Topic brought together researchers from different fields of probabilistic risk assessment, who presented their work with emphasis

on applications with high scientific and practical interest for developing countries, with a particular focus on the physical vulnerability of existing buildings and infrastructure. The published contributions deal essentially with individual natural hazards, but at different spatial scales (from a single asset to portfolios of spatially-distributed buildings). The presented research studies described in detail and demonstrated how specific challenges (availability of geotechnical data to assist risk assessment; use of GIS data and artificial intelligence for risk modelling; use of nonlinear analysis methods in regional assessment of large numbers of structures) of the targeted developing countries in Asia have been addressed and how the outcomes contributed to a better understanding or an increased level of their resilience.

The present Research Topic therefore contributes to the aforementioned goals by gathering a diverse set of recent studies, which provide original papers addressing the current challenges related to natural-hazard risk assessment in developing countries. A total of three papers authored by 11 different experts of the field integrate the present issue, encompassing the objectives described above. The topics addressed in the papers are from several fields across risk assessment including: estimation of seismic building damage using geographical information system-based (GIS) data processed with artificial intelligence algorithms; the use of cone penetration test results as insights for soil characterization and data completeness in the Kathmandu Valley region, in Nepal; and the calibration of a simplified method for seismic risk assessment of esxisting buildings, on a regional basis.

## Papers in the collection

The first paper of the collection (Hansapinyo et al.) develops a new approach using an artificial intelligence system called adaptive neuro-fuzzy inference system (ANFIS) model to predict the damage of buildings at urban scale considering input uncertainties. It does so by performing seismic damage evaluation of buildings using a simplified method of static assessment (the capacity spectrum method—CSM) to obtain a large set of training data from a combination of three main parameters (earthquake magnitude, distance and structural type). The proposed model was then validated through analyses of spatial seismic building damage under five possible earthquakes in Chiang Mai Municipality, Thailand. The study showed how the proposed ANFIS model can predict the seismic building damage reasonably well compared with the CSM and create damage scenarios for earthquake-prone areas where little seismic data is available, such as developing countries.

The second paper of the collection (Gilder et al.) is focused on the use of static piezocone penetration tests (CPTu) data acquired in the Kathmandu Valley sediments, a region often hit by strong earthquakes. By making use of established CPTu interpretation procedures, the study can contriburte to the assessment of the soil *in situ* properties. The method employed predominantly SPT data and limited shear wave velocity measurements to assess the variability and seismic response of soil deposits underlying Kathmandu. The article successfully provided additional data to existing international databases; new shear-wave velocity measurements; and initial estimates of the cyclic resistance ratio (CRR) at the sites visited. It also set the basis for future liquefaction assessment needs, due to the presence of saturated silts in the valley.

The third and last paper of the collection (Cross et al.) calibrated a spectral-based analytical method, namely, FAST, for Nepalese RC-infilled buildings. This represents an important outcome as the FAST method has been initially conceived for Southern European RC buildings with hollow clay brick infills, which are different from the Nepalese contruction techniques. The calibration is achieved by reviewing code prescriptions and construction practices for RC masonry infills in Nepal and updating the FAST method, also using advanced Bayesian updating procedures. The method was then verified both for a single school building and a number of builings within the Kathmandu Metropolitan City (in the vicinity of Tribhuvan International Airport) obtained from photographic documentation. The authors demonstrated the conservative nature of the method and its higher accuracy at capturing low-level damage, making it suitable for large-scale preliminary assessment of vulnerability for prioritisation purposes.

The editorial team acknolwdges the significant contributions of the papers to the research and development in the various topics addressed and hope that the readers will find them relevant and inspiring for future research endeavours in the field of natural hazard risk assessment in developing countries.

## Author contributions

RM, FL, CG, and RR conceived and edited the Research Topic and have all provided a substantial, direct and intellectual contribution to the work, while approving it for publication.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note