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Editorial: Disaster Reconnaissance Missions: Is a Hybrid Approach the Way Forward?

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Editorial on the Research Topic

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INTRODUCTION

When a catastrophic natural hazard event occurs, it causes human casualties, damage to buildings and infrastructure, and affects livelihoods, society, and the wider economy. Much of the damage caused by natural disasters is visible only for a short time, because search and rescue, demolition and rebuilding often start within a few days. It is therefore important that damage assessments start rapidly after an event.

For the earthquake community, the need for speedy but systematic post-earthquake investigations has led to the formation of several international earthquake reconnaissance teams whose aim is to be available for rapid deployment after an earthquake. They are composed of earthquake specialists from different disciplines, and generally include team members from the affected countries. Each team conducts a survey whose exact scope depends on the scale and type of damage. But the study generally includes investigations of the seismological and geological aspects of the event, the damage to buildings and to infrastructure, and the way in which relief and rescue have been conducted. On return, the team typically communicates their findings through technical meetings and produces a report which is commonly made available on openly accessible websites.

The Learning from Earthquakes programme of the California-based Earthquake Engineering Research Institute (EERI[1]) has the most experience in such field reconnaissance missions and has conducted more than 150 investigations since it began after the 1971 San Fernando, California earthquake. In the United Kingdom, the Earthquake Engineering Field Investigation Team (EEFIT[2]) is a joint venture between industry and universities and has conducted more than 30 investigations since its formation in 1982 following the Irpinia (Italy) earthquake of 1980. Similar organisations exist in several other countries (Spence, 2014). The cross-cultivation of these findings across different historical events have been fundamental in improving our science. The cumulative findings of the missions have been instrumental in formulating research programmes worldwide, which have studied aspects of the physical damage, response, and recovery from multiple events. These research

[1]https://www.eeri.org/.

[2]https://www.istructe.org/get-involved/supported-organisations/eefit/.

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programmes in turn have led to steady improvements of national and international codes of practice for building, as well as assisting in understanding the vulnerability of different types of affected facilities and in developing ways to enhance earthquake safety internationally (Spence and So, 2021).

Disasters that occurred in 2020 and 2021 during the COVID-19 pandemic challenged the disaster risk resilience community to come up with alternative ways of achieving the objectives of a reconnaissance activity. With international travel being disrupted, teams were unable to physically go to the disaster-stricken areas for a field study of damage to buildings and infrastructure.

This situation was attempted to be overcome through **hybrid missions**. These combined remotely coordinated fieldwork and assessment of alternative data sources for deployment for a remote investigation, as detailed in what follows.

PARTNERING UP WITH LOCAL COMMUNITIES TO CARRY OUT THE FIELDWORK UNDER THE COORDINATION OF THE REMOTE TEAM

Instead of travelling to the disaster-stricken areas, the reconnaissance teams needed to recruit and train locals to carry out the fieldwork. These typically included professional engineers, engineering students and the general public who volunteered to take part in the damage assessment exercise, leading to a strong community engagement process–an important facilitator of humancentric approaches in post-disaster studies (Zhao et al., 2022). This arrangement required preparation of extensive training materials, both on damage grades manifesting in various construction systems and on the data collection tools (Aktaş et al., 2021). The field data were then secondary-assessed by the remote team to check and eliminate misclassification errors. Experience so far has demonstrated a good level of alignment between outcomes of field- and remote-assessment exercises (Aktas et al., 2022a; 2022b) suggesting that this data collection modality is viable in the future given sufficient training is available to the participants.

Further, as the travel pressure and the associated costs are lifted, compared to conventional reconnaissance activities larger teams were formed. This led to more multi-/cross-disciplinary groups and more students and early career researchers participating in them than previously. The EEFIT mission team to the 30 October 2020 Aegean Sea Earthquake comprised 27 members, around half of whom were students and early career researchers (Aktas et al., 2022a). Therefore, the missions were successfully used as a capacity building platform. Large field crews helped cover a wider geographic area in a shorter time than in conventional reconnaissance models, leading to more comprehensive datasets that can be used for fragility analyses (Aktas et al., 2022b) and for a better assessment of building stocks under consideration for code compliance (Malcioglu et al., 2022). StEER had a field crew of more than 50 participants from the local communities to assess the damage of 12,600 + properties within the western half of the southern peninsula affected by the earthquake (Kijewski-Correa et al., 2022), which would have been impossible by a small professional reconnaissance team.

Therefore, this new model of data collection helped strengthen links and allowed capacity sharing with the local stakeholders, including communities, universities, national institutions responsible for disaster risk resilience and risk reduction, experts and practicing engineers, who brought better access to relevant authorities and communities owed to knowledge of local language(s). Familiarity with the local building stocks, practices and context was another crucial benefit.

ALTERNATIVE DATA SOURCES FOR A REMOTE DAMAGE ASSESSMENT

Paired up with locally recruited field crews to collect data *in-situ*, the remote teams worked on identifying alternative sources of information to assess the viability of an entirely remote model for future disaster reconnaissance activities. The investigated sources of information included personal and institutional databases (national institutions responsible for disaster risk reduction and recovery), photography archives, social media (in particular Twitter, and Facebook), online video sharing platforms (e.g. Youtube), printed and web-based media, CCTV footages and drone recordings (So et al., 2020). While social media and crowdsourcing platforms were found useful for sentiment and topic analyses (e.g. Contreras et al., 2022), the potential of these to act as a viable source of information in future reconnaissance work for damage assessment was deemed to be dependent on the context and objectives of the mission. Often cases, the damage bias in these remote data sources was higher than most missions intended, and therefore an overall understanding of damage within the affected areas was difficult to capture (Aktas et al., 2022a; 2022b). How to make social media platforms and other data sources more useful to completely remote reconnaissance efforts remains for now an open question that calls for attention from citizen science, public engagement and engineering.

Importantly, remotely coordinated data collection activities highlighted the importance of more advanced data collection and management platforms. EEFIT's adopted LfE Mobile App (So et al., 2020; Aktaş et al., 2021; Aktas et al., 2022a) and StEER's Fulcrum (Whitworth et al., 2022) used different interfaces and workflows that allowed efficient collection and easy auditing of the data, while minimising data losses and intense post-mission digitisation and post-processing efforts that the conventional paper-based data collection methods are prone to. In near future, we expect the efforts towards flexible systems that will eventually find wider use within the relevant research community will be furthered for effective compilation of data needed in line with the specific aims and objectives of a given mission, as well as for viewing, auditing, managing and mapping them.

THE LAST WORD

As a conclusion, hybrid approaches to disaster reconnaissance can be used to better engage local stakeholders into the disaster

risk reduction and management processes, such that the post-disaster observations can be used to build a dialogue rather than be a one-way data gathering exercise. Reflecting on successes of the Earthquakes without Frontiers project, Jackson stresses the need for the international community to empower in-country scientists with collaboration and endorsements of their methods and work. These efforts have led to improved public safety policy, and a shift in the political understanding of managing earthquake risk. New building codes have been developed, and many more been retrofitted, resulting in safer and more resilient buildings (Jackson, 2021).

The importance of learning from disasters, recording the consequences in detail, so that key findings are identified and passed on, both for the benefit of the affected country in its attempt to improve preparation for subsequent events, and for the international community, has not changed. However, our recent experience has brought to light the need to carefully assess how we can share resources, reduce repetition of efforts, and build capacities, as an international community. Perhaps one positive of the COVID-19 pandemic is that it has brought the world closer together through remote technology and platforms and challenged our present modes of work and travel.

Hybrid missions can contribute to the overall decarbonisation of the built environment sector by minimising international travel. While there are many open research questions needed to be answered to improve remote reconnaissance practices, we expect to see these strategies implemented more widely in the future, not only under pandemic-related or other pressures, but also generally. We hope this special issue helps highlight benefits and potential future uses of hybrid missions.

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All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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