Humanitarian Civil Engineering

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Practical solutions for an interdisciplinary approach

Edited by

Georgia Kremmyda

University of Warwick

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Preface

Humanitarian engineering is the integration of engineering with sciences, social sciences and arts to design, develop or improve tools, approaches, technology and educational practice needed to promote the well-being of populations facing grand challenges. In current times, where various humanitarian crises are happening, such as natural and human-made disasters, energy and sustainability challenges, fast-growing-population cities, pollution and climate change, we find that civil engineers have a pivotal role to play, enabling our society to progress towards sustainable human development.

From water supply to renewable energy provision, from efficient transport systems to digital infrastructure, from constructing resilient cities to the provision of sanitation facilities, engineering knowledge and application underpin the responses needed by us all to pursue a sustainable future. Because the issues of humanitarianism are not just civil engineering problems, there is need to engage with other professions and stakeholders to embrace and exploit combinational expertise, and to introduce approaches and practices that enable sustainable and safe applications.

As demonstrated through the various United Nations (UN) dialogues, notably the Hyogo Framework for Action 2005–2015, the Sendai Framework for Disaster Risk Reduction 2015–2030 and the UN Sustainable Development Goals 2030), there is (a) recognition that building resilience against humanitarian challenges is central to effective global action; (b) lots on explicit and implicit discussion about resilience and transformative change; (c) increased recognition of the importance of humanitarian intervention; (d) a need for promoting developments across different disciplines and sectors to have a global humanitarian impact; (e) and a focus on the advancement of education, learning and training for skills.

Objectives of the book

This book makes the case for the pivotal role of civil engineers in tackling global humanitarian challenges. Enabling the safety of life and property against humanitarian challenges is the highest call of the civil engineering profession. Nevertheless, it cannot be done by civil engineers alone; it requires partnership and collaboration. It requires the introduction of humanitarian engineering for a holistic synthesis to develop sustainable solutions that integrate social, environmental, cultural and economic systems.

Humanitarian engineering can be used as the catalyst for the change that the world needs, crossing knowledge boundaries (within academic disciplines, governments, government internal functions, companies and sectors, and the boundaries between these domains), with interdisciplinary approaches and practices that enable sustainable, safe applications from water supply to renewable energy provision, from efficient transport systems to digital infrastructure, from constructing resilient and safe cities to the provision of sanitation facilities.

The book aligns humanitarian engineering with civil engineering practices, and adds on the work already being done in the developed and developing world, with a focus to serve effectively and responsibly, and primarily, the most vulnerable and unsupported communities in the world. The book aims to identify best practices that are tangible, practical and relevant to ensure safe engineering against global challenges. The book, through a series of case studies, combines concepts and tools traditionally used by practitioners and development agencies with civil engineering practices, project management and systems thinking. When blended, these concepts, frameworks, practices and lessons learnt offer civil engineers better methods to manage the difficulties inherent in community development projects. The level of competence needed from civil engineers to respond to humanitarian needs is also discussed in a context of unique and difficult to measure skillsets.

This book shows the passion of the authors and editor in the application of civil engineering in humanitarian settings. It highlights the most select literature and provides meaningful professional experiences. The book showcases the pivotal role of civil engineering in the solution of global humanitarian challenges, enabling our societies to progress towards a safer future. The book intends to be a coherent and accessible document summarising the knowledge available in humanitarian engineering. It is believed that the book represents a unique and timely compendium on this topic. The book is addressed primarily to engineers – professionals and university students – interested in global challenges and development projects, whether they reside in developed or developing countries. Development workers and practitioners may also find parts of this book useful, especially if they are interested in the technical aspects of humanitarian engineering and sustainable development.

Georgia Kremmyda

About the editor

Georgia Kremmyda

Georgia is a professor, the director of studies in civil and environmental engineering and the deputy head of teaching at the School of Engineering, University of Warwick.

Georgia completed her undergraduate, postgraduate taught and doctoral studies at the National Technical University of Athens, Greece. Before joining Warwick University in 2015 and for a period of 15 years, Georgia shared her time between carrying out leading engineering roles in industry and delivering teaching and research in academia. Her teaching and research interests are oriented but not limited to the design of earthquake-resilient structures, sustainable cities, infrastructure for emergencies and the delivery of interdisciplinary, problem-based education, especially in resource-constrained environments.

Within her academic role, Georgia is leading initiatives related to the development of innovative programmes that are promoting equitable access to education, in science and engineering. Georgia leads the Warwick University humanitarian engineering programme and co-leads the Warwick Global Research Priority in Sustainable Cities, both aligned to the United Nations Sustainable Development Agenda 2030. On an international level, Georgia has been elected as Vice President (Conferences) of the International Network of Women Engineers and Scientists for 2021–2023. Within Warwick University, she is the deputy chair of the Institutional Athena SWAN Self-Assessment Team, leading the subgroup working on ‘Organisation and culture for inclusivity, diversity and equality’ and ‘Support to trans people’. She is also the chair of the STEM Education and Student Experience workstream within the framework of the Warwick STEM Grand Challenge.

About the contributors

This book would not have been possible without the incredible and dedicated efforts and contributions of its many authors, who provided us with articles reflecting their knowledge and long-standing experience in the humanitarian and engineering sectors.

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Joseph Ashmore leads the Shelter and Settlements team in the International Organization for Migration (IOM) Department of Operations and Emergencies. The team supports programming that assists between 4 and 6 million people annually. Joseph has over 18 years practical experience with 15 humanitarian organisations in humanitarian shelter and settlements programming. He has also led on Shelter Projects for the development of a range of global consensus-based guidance documents on reconstruction, shelter provision, settlement planning, gender-based violence (GBV) risk reduction and strategic settlement issues.

Simon Bird

Simon Bird is a Chartered Engineer with varied experience of mainstream civil engineering, research, rural development and disaster relief. He is passionate about applying engineering skills in humanitarian settings, and has mentored young engineers and helped with RedR hands-on training. Presently he works part time as a tunnel engineer for Mott MacDonald and also as infrastructure advisor for Medair, a Swiss-based non-governmental organisation (NGO). His most recent assignments for them have been in Lebanon – in providing shelter for Syrian refugees and repair of apartments damaged by the Beirut explosion.

Gustavo Cortés

Gustavo Cortés has a PhD in structural engineering and is a professional engineer (PE) in Texas, USA, and a member of the Swiss Society of Engineers and Architects (SIA). In addition to his experience in the private sector, Gustavo was an associate professor at LeTourneau University in Texas. Presently, he works as the senior shelter and infrastructure advisor for Medair, advising country programmes in Africa, Asia, the Middle-East and Central America in the design and construction of buildings and infrastructure. Gustavo organises regular training workshops for Medair shelter and infrastructure staff world-wide.

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Hannah Edmond is a Chartered Principal Civil Engineer working in the water sector at Mott MacDonald. Originally from the UK, Hannah is currently based in New Zealand. She is a RedR UK Affiliate and has a core interest in humanitarian relief, international development, and how private sector skills and experiences can be used to support these roles. Her work includes coordination of RedR UK's Hands on Weekends.

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Carrie Eller is a civil engineer working for Mott MacDonald's International Development Services, specialising in hydraulic engineering. Previous projects have included irrigation rehabilitation, dams and reservoirs, micro-hydropower and flooding. Carrie has worked on small-scale advisory projects with Water Aid and Concern, and volunteered with Engineers without Borders UK and RedR UK.

Bill Flinn

Bill Flinn is a senior shelter advisor at CARE International UK. He is a qualified architect, and has worked in development and humanitarian relief in five continents, and for many years in domestic construction in the UK. In recent years he has been a leading proponent of supporting self-recovery as an appropriate modality for post-disaster recovery, collaborating on research projects with the Overseas Development Institute, University College London, Oxford Brookes University and the British Geological Survey.

Dan Flower

Dan Flower is a principal and the design director at HKS Architects' London office. Combining creativity and design thinking with a sophisticated approach to material and technical solutions, Dan brings over 15 years of experience to his role as the design lead on major EMEA region projects. He has applied his knowledge of both architectural design and masterplanning to a variety of projects, and is dedicated to delivering innovative, efficient environments. Bringing a lifelong passion for applying design solutions to improve the quality of life for all, he has worked as the architectural advisor for Engineers for Overseas Development (EFOD) for 15 years and is also a key studio leader of Citizen HKS, an HKS initiative providing architectural solutions for NGOs.

Ian Flower

Ian Flower is a Chartered Civil Engineer with over 40 years' experience in the construction industry. Ian has worked for consultancies throughout his career, on major construction projects in the UK and Trinidad, and managed an office in Cardiff for Mott MacDonald for over 20 years. As the chair of the Institution of Civil Engineers (ICE) in Wales group in 2000, he was asked to help to solve the problem of inadequate sanitation in downtown areas of Banjol, The Gambia. Ian challenged a team of six young graduates to design a solution to the problem, raise funds, and visit site for 2 weeks in pairs to hire labour, buy materials and supervise the construction of latrine blocks in downtown areas of the city. EFOD was born. Ian has run EFOD from its inception, initially as a subgroup of ICE Wales, and since 2011 as an independent charitable company. EFOD encourages teams of young members of the construction industry to enhance their experience by working together to deliver projects for the benefit of some of the rural poor in Sub-Saharan Africa. He is a fellow of ICE, and was awarded an OBE in 2006 for services to civil engineering and international development. Together with Helen, his wife, he also runs SaltPeter Trust, a Christian charity that works with Baptist churches in Teso, Uganda, providing educational, medical and agricultural support for widows and orphans.

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Step Haiselden leads CARE International's Emergency Shelter Team based in London. He is a Chartered Structural Engineer with considerable experience in private practice as well as the charity sector. His humanitarian work in both shelter and water, sanitation and hygiene (WASH) has taken him to many post-crisis contexts in the Caribbean, Africa, Asia and the South Pacific. He and Bill Flinn first worked together in the aftermath of the 2005 Pakistan earthquake.

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Lewis Kelly is a Scottish architect, and technical consultant for the International Federation of Red Cross and Red Crescent Societies (IFRC) Shelter Research Unit. His interests lie in the role of architecture and the built environment addressing the environmental and social challenges faced in society. Building on training from Edinburgh University and further training in sustainable design in Catalunya, he has engaged in field-based research

into architecture and urbanism in developing contexts, having worked closely with humanitarian and development organisations. With the IFRC Shelter Research Unit he has researched environmentally informed humanitarian shelter and settlement approaches, and the integration of circular economy approaches into post-disaster reconstruction operations.

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Jim Kennedy has a PhD in the design of refugee camps from Delft University of Technology, and has more than 15 years' experience in programming, coordination and guidance development in the humanitarian shelter sector. Jim has worked extensively with the UN, the Red Cross and international NGOs, in both armed-conflict- and natural-disaster-related responses, and is also the author of a number of articles and booklets on various aspects of shelter response, including site planning.

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Ellis Lui is a civil engineer in the water sector at Mott MacDonald, working on small to large non-infrastructure and infrastructure potable and waste water projects. Ellis is currently deployed in Bangladesh, supervising construction works on a new potable supply scheme. His technical expertise includes pipeline and hydraulic design, civil infrastructure design and construction supervision. Ellis has previously organised disaster relief workshops with RedR UK and delivered NGO-affiliated design schemes at varying professional capacities.

Robert O'Toole

Robert O'Toole is a winner of the National Teaching Fellowship Scheme, and is based in the UK but works internationally. He specialises in developing and implementing transformational strategies that work for real people in schools, colleges, universities and businesses. Research led and practically focused, he uses empathetic and participatory methods to work with communities to create designs that fit, stick, spread and grow – a definition of good design developed in his PhD thesis on design thinking. Collaborating with other colleagues, Robert has developed a suite of interdisciplinary undergraduate and postgraduate for-credit courses at the University of Warwick, developing students as designerly change agents.

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Tom Newby is a Chartered Structural Engineer and a specialist in emergency shelter provision in humanitarian emergencies. He was until 2019 the head of humanitarian for CARE International UK, and prior to that was he was the global emergency shelter lead for CARE International. He has worked in humanitarian responses in Haiti, the Philippines, Nepal, India, Jordan and Lebanon, among others. He has a strong interest in the power dynamics of humanitarianism and engineering, as well as gender equality, inclusion and meaningful accountability in humanitarian responses.

Daniel Paul

Daniel Paul started his professional career in the British military, before moving into project management for the humanitarian sector. He then turned to security risk management, ensuring the safety of those working overseas – an area he is passionate about. He currently works as a security advisor and consultant, as well as lecturing at Coventry University on disaster management and emergency planning. Daniel holds a PhD, during which he studied how organisations keep their staff safe in high-risk environments and how this can be improved with knowledge management. Daniel also has a bachelor's degree in international security and disaster management.

Alberto Piccioli

Trained as an architect/engineer and urban designer, Alberto Piccioli worked on participatory planning and design for community buildings and public spaces before joining the humanitarian shelter sector with the IOM in Geneva. He led the development of two editions of the interagency publication *Shelter Projects*, as well as provided remote and field-level support to IOM shelter and settlement operations and coordination across several countries. Since 2020 he has been based in Maiduguri, focusing on site planning and shelter operations in North East Nigeria.

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Amina Saoudi has worked in the humanitarian sector for the past 13 years, including with the UN High Commissioner for Refugees, International Committee of the Red Cross, Shelter Centre and IOM. After joining IOM in 2010, Amina worked with the Shelter/Non-Food Items (NFI) and Camp Coordination and Camp Management (CCCM) Clusters in Pakistan, South Sudan and Myanmar. In 2016, Amina joined the Global CCCM Team in IOM's Department of Operations and Emergencies. She currently manages IOM's Global project, aiming at improving operational response to GBV in displacement crises, including in CCCM, Shelter/NFI, Site Planning and Displacement Tracking Matrix operations.

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