

Preface

Housing needs and demands are dynamic having been changed in the course of time. The shifts in socio-demographics highlight the emergence of non-traditional households and influence housing configurations and performances. Homes need to be *customisable* in order to raise the level of social sustainability in accommodating users' individual requirements, desires and expectations. In the light of fuel poverty issues arising in various countries in which the drastic hike of energy cost is a serious concern, the notion of housing affordability has been extended to encompass both initial and operating costs. In view of economic sustainability at macro and micro levels, homes need to be *affordable*. Global warming accelerated with excessive carbon dioxide (CO₂) emission is becoming conspicuous. Generally, a house consumes a significant amount of energy before and after occupancy, and the associated CO₂ emission is contributing partially to the climate change. Towards securing environmental sustainability, housing needs to be net carbon neutral (or *zero energy*) in consideration of CO₂ emission derived from the overall energy use.

In response to market needs and demands for social, economic and environmental sustainability of housing in developed and developing countries, the *zero energy mass custom home* (ZEMCH) integrated lean design and construction concept was envisaged and discussed globally. Towards the ZEMCH delivery, an emerging notion of *mass customisation* was scrutinised initially. It emerged in the same year as the general concept of *sustainable development* was widespread in 1987. The oxymoron was recognised eventually as a means to lessen housing design and construction costs whilst achieving the customisability through economies of scope rather than economies of scale.

In order to crystallise a wide spectrum of hopes and fears around the design, production and marketing approaches to the ZEMCH delivery in global contexts, *ZEMCH Network* was established in 2010. Today, the R&D collaboration network consists of over 500 partners from nearly 40 countries and the enrolment is constantly on the rise. Originally, the ZEMCH Network was formed by a group of

academics, who participated in the 2010 industry-academia knowledge transfer technical visits to production and sales facilities of low to zero energy mass customised housing manufacturers in Japan. The technical tour, later called *ZEMCH Mission to Japan*, dates back to the 2006 operation and it celebrates the 10th anniversary in 2016.

This book is the collective knowledge gained through global ZEMCH R&D activities, consisting of 12 chapters that packaged essential engineering design, construction, and commercialisation techniques and strategies applicable to the ZEMCH delivery: Chapter 1 identifies the general notion of sustainable development as a start to consider how ZEMCH practice can meet global housing market needs and demands; Chap. 2 revisits mass housing developments with the aim to articulate the necessity for enhancement of production efficiency without sacrificing design customisability; Chap. 3 introduces prefabrication seen as a means to standardise housing products and processes for construction efficiency; Chap. 4 summarises the origin of mass customisation and its application to the delivery of quality affordable homes; Chap. 5 crystallises a new notion of mass personalisation applicable to affordable housing developments; Chap. 6 summarises inclusive design techniques that aim to accommodate housing users' changing needs and demands over their lifetime; Chap. 7 clarifies how energy is used in housing before and after occupancy; Chap. 8 recaps various passive design approaches being applied to lessening energy demands of housing; Chap. 9 showcases a variety of active systems available for supplementing energy use in housing with mechanical innovations; Chap. 10 introduces the global movement and practice of zero energy homes; Chap. 11 demonstrates the significance of building energy and environmental performance simulation; and Chap. 12 unveils Japan's successful business operation essential for the ZEMCH delivery.

ZEMCH movement came to life and emerged from the grass roots needs and demands of housing in developed and developing countries. First, I would like to express my sincere gratitude to all authors, who contributed to the development of this book, which is indeed the first of this kind. Their expertise and experience streamlined ZEMCH technical knowledge and made the multidisciplinary contexts comprehensive to a wide range of audience. Second, I am thankful to all chapter leaders of this book, Sara Wilkinson, Kheira Anissa Tabet Aoul, Arman Hashemi, Victor Bunster, Karim Hadjri, Haşim Altan, Jun-Tae Kim and Laura Aelenei, for not only their first authorship, but also their dedication to the team management and leadership that helped secure the quality outcomes.

Lastly, I would like to thank all ZEMCH Network's global partners and regional experts centre directors for their generous, constructive support and cooperation. So far, ZEMCH Network established four regional centres in Brazil, Italy, UAE and UK, being responsible for the organisation and operation of annual industry-academia knowledge transfer events—i.e. ZEMCH Mission to Japan, ZEMCH International Conference and ZEMCH Design Workshop. The success is rooted in the network partners' individual efforts and collaborative actions.

ZEMCH R&D activities have been thriven for continuous improvement of the built environments in developed and developing countries, budding out the global movement for people and society.

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