Seismic Design of Foundations

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Concepts and applications

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Preface

In order to carry out design of foundations in seismically active areas, one requires some level of expertise in seismic hazard assessment, soil behaviour under cyclic loading, structural dynamics and soil-structure interaction, in addition to standard foundation analysis and design concepts. As a result, this subject initially emerged as a specialist area for only a few researchers as well as a handful of professional engineering consultants, although over the years, it has gradually appeared on specialist undergraduate and postgraduate courses at many universities.

The flow (that is, the structure) of the book follows a pattern that would be typical of a design process: assessment and quantification of seismic hazards that would affect foundation design (Chapters 2 to 7), followed by design and mitigation aspects. The design of foundations requires a fundamental understanding of probabilistic concepts of seismic hazards, ground response analysis and structural analysis, and these subjects can themselves be the subjects of an entire book. Therefore, only the necessary analysis and design concepts – including, but not limited to, response spectra, modal analysis, beam on Winkler foundations, and ground response analysis – are covered in brief, and only the fundamentals are explained, along with some examples. Wherever possible, references are provided for further reading. The authors have sincerely attempted to make the book as useful and practicable as possible by providing case studies, example applications, and solved examples from the real world.

The 11th March 2011 Tōhoku earthquake (Japan) was a rare and a landmark event which can be described as an act of war between nature and earthquake engineers. It is fair to say that if the effects of the tsunami are discounted, the overall performance of the structures under the action of earthquake (together with liquefaction) shows that there is a lot to learn from Japanese earthquake geotechnical engineers. The first author (Professor Bhattacharya) was in Japan on that day and had first-hand experience of the performance of these structures. Following the 2010–2011 Canterbury earthquake sequence (New Zealand), the second author (Associate Professor Orense) worked over a period of more than 18 months to investigate the impact of ground shaking and soil liquefaction on the built environment of Christchurch and surrounding areas. This book heavily draws upon the experiences of these two recent earthquakes, as well as from lessons learned in other recent large-scale earthquakes.

The book is born out of research by the authors as well as postgraduate and CPD (Continuing Professional Development) teaching and specialist lectures they delivered at various universities and organisations. Examples include: Professor Bhattacharya's courses on earthquake engineering at the University of Surrey (MSc course) and University of Bristol (MEng course) in the UK, Indian Institutes of Technologies (IIT Kharagpur

and IIT Bhubaneswar as a part of ISWT (International Summer and Winter Term) and GIAN (Global Initiative for Academic Networks) courses respectively), ASRANet CPD courses in Delft, London and Brussels as well as at Yamaguchi University and Tokyo Institute of Technology (Japan), Zhejiang University (China), Tongji University (China) and Harbin Institute of Technology (China). Associate Professor Orense (second author) provided lectures on the same topic at the University of Auckland (New Zealand), University of Tokyo and Yamaguchi University (Japan), the University of the Philippines and through technical workshops and seminars sponsored by the Engineering New Zealand (EngNZ) held in various cities in New Zealand.

It is hoped that this book will be ideal for any student studying postgraduate geotechnical engineering or structural engineering, as well as researchers and practitioners working in the field of earthquake geotechnical engineering. Due to the changing requirements in the current technological age and market demands of the modern educational system, ICE Publishing wishes to make individual chapters of the book available to readers through its e-book platform ICE Virtual Library. Therefore, to make each chapter self-sufficient, there are some inevitable repetitions of some figures and textual analysis.

This field of engineering is constantly evolving as each major earthquake teaches us something new. Many of the methodologies or calculation procedures presented here may become outdated or be modified in the next few years, at which point this book may require a new edition. There may also be errors and omissions in the book and we would be grateful if those were brought to our attention. Please email the authors at Subhamoy.Bhattacharya@gmail.com or r.orense@auckland.ac.nz and the comments will be duly acknowledged in the next edition.

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