Preface

Pile foundations are widely used both onshore and offshore to transfer superstructure loads into the ground. In seismic regions there is uncertainty regarding their performance, particularly when the soil strata that the piles pass through or bear on are susceptible to liquefaction. This book aims to clarify the mechanisms by which pile foundations may fail when the soil suffers liquefaction. In addition, the problem of down slope movement of nonliquefied ground that overlies liquefied layers and its effect on pile foundations is considered. One of the key factors to remember is that the pile foundations are often carrying substantial axial loads from the superstructure at the time of the earthquake. It is therefore imperative to consider the pile behaviour in liquefiable soils when they are subjected to both axial and lateral loads. This can have consequences for pile behaviour such as sudden and catastrophic buckling instability or excessive and unwarranted settlements.

This book is organised into six chapters. It aims to marry the most recent research findings on pile behaviour to the needs of practical designs in seismic regions. Accordingly, it is intended to be used by graduate students and researchers interested in pile foundation design, as well as geotechnical practitioners faced with the problem of designing or assessing the seismic risk to existing pile foundations in regions with liquefiable soils.

Chapter 1 introduces the static design of piles using traditional or CPT-based methods. It looks at the performance of piles in past earthquakes through some well-documented case studies. The concepts of performance design and the importance of estimating deformations of pile foundations are highlighted.

Chapter 2 deals with the inertial and kinematic loads attracted by pile foundations during earthquake loading. These are considered initially for normal ground and later on in liquefiable soils. Limit equilibrium-based methods are introduced to estimate the loading due to laterally spreading nonliquefied layers.

Chapter 3 introduces liquefaction as a foundation hazard and discusses how the consequent loss of soil strength influences the axial load that can be safely carried by pile foundations. Possible axial failure modes including liquefaction-induced bearing capacity failure and instability (buckling) are discussed in relation to the static considerations outlined in Chapter 1.

Chapter 4 discusses the lateral spreading of sloping ground and the particular problems that arise when pile foundations pass through such laterally spreading ground. Recent research experiences are presented and compared with current codal provisions.

Chapter 5 brings together the material in Chapters 2 to 4 in considering the design of pile foundations against combinations of transient seismic loads (Chapter 2), axial load (Chapter 3) and kinematic forces due to lateral spreading (Chapter 4).

Chapter 6 presents a series of design examples to demonstrate how the methods outlined in Chapters 1 to 5 may be combined within an inclusive design method.

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