Book review

Seismic Design of Foundations: Concepts and Applications

S. Bhattacharya, R. P. Orense and D. Lombardi. ICE Publishing, London, UK, 2019, ISBN: 978-0-7277-6166-8, £85.00, 468 pp.

Seismic Design of Foundations: Concepts and Applications justifies its title by delivering a solid exposition of theory along with practical worked-out examples that are required for designing the foundations of different structures like buildings and bridges subjected to seismic loading. This book is an excellent resource for students, educators, researchers and practicing structural, geotechnical and earthquake engineers, and is an amalgamation of theoretical concepts, case studies and practical problems that describe the whole process of seismic analysis and design of foundations in detail. The structure of the book is thoughtfully designed, starting with basic engineering seismology, going through ground response analysis and liquefaction and, finally, culminating in the analysis of shallow and deep foundations and their designs following different available codes of practice.

Chapter 1 of the book provides a brief overview of earthquake engineering and its significance on foundation design and soil mechanics. Different phenomena of geotechnical earthquake engineering learnt from past earthquakes are discussed with brief a discussion of case studies. In chapter 2, plate tectonics, elastic rebound theory and seismic hazard analysis procedures are described with multiple case studies in the form of examples. Chapter 3 describes the criteria for selection of ground motion and different methods like the direct method, the method of scaling motion record to expected peak bed rock acceleration, and method of scaling of motion compatible with code specific response spectrum. A case study associated with spectral matching method is produced as example in a later section of the chapter. Chapter 4 deals with wave propagation through layered elastic media, methods of ground response analysis and dynamic soil properties. In chapter 5, the fundamentals of structural dynamics are described. The modal combination method related to response spectrum analysis of foundations is well presented. The effect of liquefaction on the response spectrum of soil–structure systems is also described. Further, the basics of performance-based design is provided. In the soil–structure interaction part, a detailed procedure for construction of p – y curves in liquefiable soil is discussed with examples, along with a brief discussion of beams on non-linear Winkler foundations. Chapters 6 and 7 deal with the basic theories and applications of liquefaction. Description of soil constitutive behaviour under liquefaction based on the critical state concepts are covered in chapter 6 with an introduction to numerical

modelling. In chapter 7, discussions on cyclic shear–stress ratio and cyclic resistance ratio along with different provisions of liquefaction susceptibility given in different codes of practice are given. Chapters 8–10 deal with seismic analysis and design of foundations. Bearing capacity and settlement of shallow foundations under earthquakes are covered in chapter 8. Pile foundation behaviour under seismic conditions along with analysis and design methods are covered in chapter 9. Chapter 10 covers seismic design of deep foundations for bridges with particular emphasis on caissons. In chapter 11, seismic slope stability and seismic analysis of retaining structures are covered. Chapter 12 describes the different ground improvement techniques to reduce liquefaction susceptibility and methods for strengthening of foundations.

The uniqueness of the book lies in the fact that the theories given in each chapter are substantiated with practical case studies. Engineering is an applied science where the goal is to implement the theoretical knowledge in practical problems, and practical case studies relevant to the theories play an important role in helping us understand the subject matter. From that point of view, the case studies provided in this book do justice in making the exposition of the theories and concepts far more accessible than what is generally found in other similar textbooks. Descriptions of the different procedures in the form of flow charts and pictures make the content highly attractive and easy to understand. Moreover, the numerical examples presented for the analysis of the soil–structure–foundation systems at different stages of earthquake loading do a solid job in augmenting the theories. References from codes of practice followed in different jurisdictions like the Eurocode, Indian Standards, Indian Road Congress and Japanese Road Association are a highlight of the book.

The book elaborately provides the concepts related to the seismic design of foundations. The gradual building up of the theories and concepts through the different chapters, and the completeness of the content with case studies and numerical examples make this a self-study book. Thus, the book can be an effective pedagogical tool for graduate students that have a basic understanding of structural mechanics and vibration theories. This book can also be a useful document for structural and geotechnical designers because it covers detailed analysis procedures, practical case studies, relevant references from different standard codes and references to commercial software packages. Researchers in the fields of liquefaction and earthquake geotechnical engineering will also find the book helpful as it contains in-depth description of the latest research, along with a set of relevant references.

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