

Preface

More than ten years ago, when the first version of the textbook *Basic Principles of Concrete Structures* was published in Chinese, I started considering writing a textbook with same contents in English. The primary motivation at the time for this idea was to help Chinese undergraduate students with a language environment so that they could keep learning English continuously, while those foreign undergraduate students in China could be able to study this specialty course more easily when they have a textbook in English. However, this idea turned out to be a tough work for me. As different countries have different codes in civil engineering, those existing textbooks in English from other countries cannot be used directly for students in China. It only made sense that I wrote a new textbook in English to not only introduce basic principles of concrete structures and existing Chinese codes, but also reflect the most recent research results and practical experiences in concrete structures in China. Now I am very happy to see that my dream has come true and the textbook is to be published pretty soon. I hope that this textbook can also serve as a window for those outside China who are interested in China and its developments in civil engineering.

As a basic specialty course for undergraduates majoring in civil engineering, *Basic Principles of Concrete Structures* is different from either the previously learnt mechanics courses or the designing courses to be learnt. Compared with mechanics courses, quite a number of basic theories of reinforced concrete structures cannot be derived solely by theoretical analysis. And compared with designing courses, this course emphasizes on introductions of basic theories rather than simply being a translation of designing specifications. That means the course of *Basic Principles of Concrete Structures* should focus on both theoretical derivations and engineering practices. Therefore, based on the latest version of designing codes both for buildings and bridges (GB 50010-2010 and JTG D62-2004), the textbook starts from steel and concrete materials, whose properties are very important to mechanical behavior of reinforced concrete structural members. Step by step, analyses of reinforced concrete members under basic loading types (tension, compression, bending, shearing, and torsion) and environmental actions are

introduced. One of the characteristics of the book that I was trying to distinguish it from other textbooks on concrete structures is that more emphasis has been laid on basic theories on concrete structures as well as on applications of the basic theories both in designing new structures and in analyzing existing structures. Examples and problems in each chapter are carefully designed to cover every key knowledge point and practical case.

Professor Xianyu Jin prepared the draft for Chaps. 1, 4, and 5. I prepared the draft for Chaps. 2, 3, and 6–9. Prof. Xiaozu Su prepared the draft for Chap. 10. Dr. Feng Lin prepared the draft for Chap. 11. Prof. Weiping Zhang prepared the draft for Chap. 12. Dr. Qianqian Yu and Ph.D. candidate, Mr. Chao Jiang, drew all of the figures. Dr. Xiaobin Song helped me with the first revision of the draft, while Dr. Yong Zhou helped with the second revision, based on which I finished modifying the final draft. Without help from my colleagues and students, it would be very difficult for me to finish this tough work. I would like to deliver my sincere thanks to all of them. I would also like to thank Mr. Yi Hu from Tongji University Press for his support on the publication of this book. Finally, I would like to thank Publication Foundation of Books at Tongji University for their financial support.

May 2015

Xianglin Gu

Contents

1	Introduction	1
1.1	General Concepts of Concrete Structures	1
1.1.1	General Concepts of Reinforced Concrete Structures	1
1.1.2	Mechanism of Collaboration of Concrete and Steel	3
1.1.3	General Concepts of Prestressed Concrete Structures	3
1.1.4	Members of Concrete Structures	4
1.1.5	Advantages and Disadvantages of Concrete Structures	5
1.2	Historical Development of Concrete Structures	6
1.2.1	Birth of Concrete Structures	6
1.2.2	Development of Concrete Materials	7
1.2.3	Development of Structural Systems	9
1.2.4	Development in Theoretical Research of Concrete Structures	10
1.2.5	Experiments and Numerical Simulation of Concrete Structures	14
1.3	Applications of Concrete Structures	15
1.4	Characteristics of the Course and Learning Methods	17
2	Mechanical Properties of Concrete and Steel Reinforcement	21
2.1	Strength and Deformation of Steel Reinforcement	21
2.1.1	Types and Properties of Steel Reinforcement	21
2.1.2	Strength and Deformation of Reinforcement Under Monotonic Loading	24

2.1.3	Cold Working and Heat Treatment of Reinforcement	29
2.1.4	Creep and Relaxation of Reinforcement	30
2.1.5	Strength and Deformation of Reinforcement Under Repeated and Reversed Loading	30
2.2	Strength and Deformation of Concrete	33
2.2.1	Compression of Concrete Cubes	33
2.2.2	Concrete Under Uniaxial Compression	36
2.2.3	Concrete Under Uniaxial Tension	44
2.2.4	Concrete Under Multiaxial Stresses	46
2.2.5	Strength and Deformation of Concrete Under Repeated Loading	49
2.2.6	Deformation of Concrete Under Long-Term Loading	50
2.2.7	Shrinkage, Swelling, and Thermal Deformation of Concrete	52
	Appendix	55
3	Bond and Anchorage	59
3.1	Bond and Mechanism of Bond Transfer	59
3.1.1	Bond Before Concrete Cracking	59
3.1.2	Bond After Concrete Cracking	60
3.1.3	Bond Tests	62
3.1.4	Mechanism and Failure Mode of Bond	64
3.1.5	Mechanism of Lap Splice	65
3.2	Bond Strength Between Concrete and Reinforcement	65
3.2.1	Bond Strength	65
3.2.2	Influential Factors on Bonding Strength	67
3.3	Anchorage of Steel Bars in Concrete	68
3.3.1	Anchorage Length	68
3.3.2	Practical Equation for Anchorage Length Calculation	71
3.3.3	Hooked Anchorages	71
4	Tension and Compression Behavior of Axially Loaded Members	75
4.1	Engineering Applications and Details of Members	75
4.2	Analysis of Axially Tensioned Structural Members	77
4.2.1	Experimental Study on Axially Tensioned Structural Members	77
4.2.2	Relationship Between Tensile Force and Deformation	80

Basic Principles of Concrete Structures

Gu, X.; Jin, X.; Zhou, Y.

2016, XXII, 606 p. 397 illus., 13 illus. in color., Hardcover

ISBN: 978-3-662-48563-7