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Xuansheng Cheng

Thermal Elastic Mechanics Problems of Concrete Rectangular Thin Plate

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Preface

The concrete rectangular thin plate is widely used in civil engineering field, such as rectangular liquid-storage structure, shear wall, concrete roof plate, airport runway and concrete rigid pavement. According to the boundary of the rectangular thin plate, the rectangular thin plate can be generally divided into two types, with four edges supported and with free edges. First, due to the thermal inertia of concrete material itself, concrete thin plate under the effect of non-uniform temperature, a larger temperature difference will be formed in the internal structure so that temperature stress cannot be ignored. Due to the low tensile strength of concrete, if effective measures are not taken to eliminate or resist the temperature stress, the cracks in concrete structures will be caused after the structures are shortly used, and normal use of the structure will be affected. Seriously, structural safety accidents will happen. Second, the instability of concrete thin plate structure can be caused by in-plane compression load, also can be caused by thermal load, if the internal temperature of concrete thin plate structure is too high, instability and failure of concrete structures will be led to. Finally, the vibration problem of concrete structure under the action of mechanical load is drawing more attention nowadays, and few people pay attention to the vibration because of thermal load. In fact, if the existence of the thermal environment vibration is ignored, the calculation error of structure natural frequency and deformation can be caused, so that frequency and the deformation in structure design can overestimated or underestimated.

Since 1998, I have taken lots of design tasks of the rectangular thin plate structure, and found that the cracks of the concrete plate will appear in different degrees under the action of temperature. Therefore, this book describes the thermal bending, thermal buckling, and thermal vibration of thin plates, which have important engineering significance. This book introduces the thermal bending of rectangular thin plate with four edges supported and with free boundary rectangular thin plate, the thermal buckling of concrete rectangular thin plate and thermal vibration with four edges supported, which is the sublimation and summary of my research results about thin plate structure for many years, the publication of the book is bound to have important theoretical significance and engineering practice effect in the civil engineering and mechanical engineering, etc.

The whole book is divided into five chapters. Chapter 1 is the introduction, which mainly introduces the basic situation and the necessity of the research on the thermodynamics of the rectangular thin plate; Chap. 2 is the thermal bending of the rectangular thin plate with four edges supported. According to the common rectangular thin plate with four edges supported in engineering, the concrete rectangular thin plate is divided into six types, which is four edges simply supported, four edges clamped, three edges clamped and one edge simply supported, one edge clamped and three edges simply supported, two adjacent edges clamped and two adjacent edges simply supported, two opposite edges clamped and two opposite edges simply supported, and the thermal bending of the rectangular thin plate is introduced in detail; Chap. 3 describes the thermal bending of rectangular thin plate with free boundary. The thermal bending problem about six types of concrete rectangular thin plate are considered, namely, three edges simply supported and one edge free, three edges clamped and one edge free, two opposite edges clamped one edge simply supported and one edge free, two adjacent edges clamped one edge simply supported and one edge free, two opposite edges simply supported one edge clamped and one edge free, two adjacent edges simply supported one edge clamped and one edge free; in Chap. 4, the thermal buckling of concrete rectangular thin plate is introduced. The thermal buckling of concrete rectangular thin plate with four sides simply supported is discussed. Chapter 5 is about the thermal vibration of concrete rectangular thin plate structure, and the free and forced vibration of the rectangular thin plate with four sides simply supported is introduced.

For people engaging in scientific research, engineering design and construction technology, this book can provide important mechanics concepts, theoretical calculation method and calculation table when analyzing the crack, deformation, stability, comfort design of the concrete rectangular thin plate structure. For the relevant professional researchers (including undergraduates and graduates) in universities and in research institutes, this book can be used as a reference material for concrete structures, thin plate elastic mechanics.

Before the book will imminently be published, the author would like to extend sincere thanks to people who support and care related research projects and the organization workers of publishing. Specially, thanks to National Natural Science Foundation Committee! Thanks to selfless care of Prof. Yong feng Du in Lanzhou University of Technology! Thanks to Dr. Jing Wei and Xinhai Zhou, Masters Xiao yan Zhang, Jia Chen, De Li, Bo Liu and Liang Ma! They have made an indispensable contribution for publication and compilation of this book.

Although the book has made perfect scientific research achievements in the thermodynamic theory problems, for the thermal bending, thermal vibration and thermal buckling with free boundary of the concrete thin rectangular plates, the results need further validation, and the experimental study on thermal vibration and thermal buckling problems still need to be further designed. In order to make the research results widely applicable in design and construction of thin plate structures in civil engineering, the support from professional and technical personnel of civil engineering, engineering mechanics and mechanical engineering is vigorously

needed. The book will inevitably have some defects in the theoretical analysis, or could even have some mistakes; criticism and comments from the researchers and readers will be appreciated and please send your suggestions to my e-mail chengxuansheng@gmail.com. The author will very appreciate your help.

Lanzhou, China
November 2016

Xuansheng Cheng

*The original version of the book
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text has been updated. The erratum
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