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and

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Late Emeritus Professor, University of Cape Town



* Deceased 1991

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Preface

Although concrete engineering is over one hundred years old, it continues to diversify and become ever more sophisticated as new applications are discovered, new structural forms are conceived and the requisite theories are formulated. One important diversification has been the application of concrete in various high temperature environments, for example, those encountered in the chemical industry, nuclear reactor structures and fire protection. These applications necessitate a good knowledge of concrete properties at high temperatures and their mathematical modelling. In response to these needs, intense researches have been conducted, especially during the last two decades, and a large new body of knowledge has emerged. However, the research results have been scattered over a wide range of periodicals, proceedings volumes and chapters of various books of broader scope. There has been a gap with regard to a systematic and focused coverage. It is our hope that the present monograph will fill this gap.

This book aims to provide a systematic review of the properties and mathematical modelling of concrete at high temperatures. It is intended for university researchers and graduate students in civil engineering and materials science, engineers in research laboratories as well as practising engineers occupied with fire resistance, chemical technology vessels or nuclear reactor structures. Part I of the book, written mostly by the second author, deals with material properties and behaviour in a descriptive non-mathematical manner. It calls for a background at the B.Sc. level in civil engineering or materials science, including the basic courses in mechanics, in concrete technology and design, and in material properties. Some portions of Part II, devoted to mathematical modelling, can be understood on the basis of the same background; however, much of Part II, written by the first author, requires a deeper erudition in mathematics, mechanics and physics, at least to the M.Sc. level. Although this is not a textbook, it can be used as a reference for courses on the properties and mechanics of concrete.

The idea of writing the present monograph was conceived in the autumn of 1984, during the first author's Visiting Professor appointment at the University of Cape Town. However, except for a gradual accumulation of materials and preparation of extensive notes, a concentrated writing effort was not begun until 1990. In August 1991, at the culmination of this effort, came the untimely death of the second author, just after he had completed a draft of Part I. Even though his tragic departure prevented interactive integration of both parts of the book, the initial goals of this writing project have essentially been met.

Maurice Kaplan, sadly, can no longer express his acknowledgements. I, the first author, wish to acknowledge, with deep gratitude, the generous research funding from the US National Science Foundation, as well as the Department of Energy which provided funding as subcontracts with Los Alamos National Laboratory and Argonne National Laboratory. My long-term engagement as Staff Consultant with Argonne National Laboratory, begun in 1974, has provided me tremendous stimulation and is the source for much of the material in Part II. In this regard, I wish to express gratitude to my collaborators at Argonne, particularly the late Dr Stanley H. Fistedis and also Dr Al Marchertas. Consulting on safer nuclear containment designs for the Electric Power Research Institute, Palo Alto, California, during 1980–1982, which led to preparation of a state-of-the-art report (Bažant *et al.*, 1982) on the subject of the present book, also provided me invaluable experience. Further, I wish to mention that completion of this work would not have been possible without the understanding and encouragement of my wife, Iva M. Bažant, MD, and my children Martin and Eva. Despite the barrier of an ocean and, until recently, the much greater barrier of the Iron Curtain, the influence and encouragement of my father, Zdeněk J. Bažant, Professor Emeritus at the Czech Technical University in Prague, has also been of great significance. Finally, it is proper for me to express thanks to Carol Surma, Departmental Secretary at Northwestern University, for her expert word-processing of the mathematical portions of this manuscript, and to Robin Ford for her excellent and devoted secretarial assistance, and to graduate research assistants Vijay Kumar, for his help in organizing the literature reference list, and Sandeep Baweja, for his help in proofreading and preparation of the index.

Zdeněk P. Bažant
Evanston, Illinois
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