

## BOOK REVIEW

### Interfacial Transition Zone in Concrete

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**REFERENCE:** *Interfacial Transition Zone in Concrete*, J. C. Maso, Ed., E&FN Spon, London, 1996, 179 pp.

This book presents a review of state-of-the-art characterization of the interfacial transition zone (ITZ) in concrete and its role in influencing the performance properties of these materials. It is a compilation of contributions from members of RILEM technical committee 108-ICC, Interfaces in Cementitious Composites. The book is divided into three major topical areas: microstructure of the ITZ, properties of the ITZ, and the influence of ITZ on the properties of concrete.

The section on microstructure consists of two chapters, one detailing experimental methods for quantifying the ITZ microstructure and the other presenting results on its microstructural development and characteristics, including extensive coverage of fiber-cement paste interfaces. X-ray diffraction, X-ray photoelectron spectroscopy, mercury intrusion porosimetry, and optical and scanning electron microscopy (SEM) have all been used to quantify features of the ITZ microstructure. Of these, in recent years, SEM has been the most widely employed, as it provides direct images of a two-dimensional view of the ITZ microstructure at a resolution suitable for quantitative phase abundance analysis. The first chapter presents several graphs illustrating this quantitative analysis (plotting paste properties as a function of distance from the aggregate surface) for concretes of different ages and interprets the results in terms of the various mechanisms contributing to the formation of the ITZ (the particle packing or "wall" effect, bleeding/settling, and the "one-sided" growth effect). The second chapter proceeds to further discuss the mechanisms by which the ITZ is formed and the effects of mixture composition on the resultant ITZ microstructure.

The second section of the book, consisting of three chapters, focuses exclusively on the mechanical properties of ITZ, covering both measurement and modeling. Direct testing to determine the ITZ's mechanical properties is arduous due to difficulties in preparing consistent specimens and the lack of standard tests. Nevertheless, bond strength, microhardness, and fracture mechanics properties have all been quantified to some extent. Modeling has been approached both from a micromechanics point of view and from a continuum theory approach, with the presented results being preliminary in both cases.

The final section of the book, consisting of four chapters, deals with the effects of these ITZ regions on the properties of concrete. Here, separate chapters are concerned with mechanical properties, transport properties, action of environmental conditions, and the effects of aging, the latter two both dealing with durability issues. The ITZ will influence many of the mechanical properties of concrete such as elastic modulus and crack propagation, and these effects may be different in conventional, lightweight, and high-performance concretes. For transport properties, in addition to the microstructure of the ITZ, the connectivity of the individual ITZs will also play a prominent role and should influence permeability and diffusion, although the experimental results presented in this chapter are limited. In terms of durability and aging, the long-term stability of the cementitious phases forming in the ITZ is of importance. The final chapter also discusses methods of "engineering" the microstructure of the ITZ to enhance the long-term performance of concrete.

The book should serve as a valuable introduction to the topic of ITZs for researchers and engineers. It contains numerous references to research that has been previously performed in this field. It is written at a level that assumes the reader has a general knowledge of concrete as a material and some familiarity with engineering concepts such as fracture mechanics and permeability. Each chapter is generally well organized and can be read as an individual unit. Some of the chapters on properties are heavily mathematical in nature, while the ones on microstructure contain few if any equations. The second and ninth chapters contain numerous high-quality micrographs illustrating microstructural features of the ITZ.

In the reviewer's opinion, the shortcomings in this book are to be found in its timeliness and coordination. Published in 1996, the book contains few references to research papers published later than 1992. Thus, although the book would serve admirably as a state-of-the-art report in 1992, five years later at the date of this review, many of the latest research developments are not mentioned. The reviewer recognizes the inherent difficulties of coordinating a state-of-the-art report among a large group of laboratories, in this case, spanning the globe. However, it is hoped that as science enters the communication age, the proliferation of the world wide web and other electronic forms of communication will allow the more timely and up-to-date production of such state-of-the-art reports. A more minor reservation concerns the repeating of background information throughout many of the chapters comprising the text. While it is understandable that each chapter should stand alone as a complete and comprehensive source, the reviewer feels that a greater amount of coordination amongst the chapters could have eliminated many of these redundancies.