

Book review

The interfacial transition zone in cementitious composites

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This book forms the Proceedings of a RILEM-Conference with the same title, which was held at the National Building Research Institute of the Technion-Israel Institute of Technology in Haifa, Israel, 8–12 March 1998. It contains, apart from the introductory and concluding remarks by the Conference Chairman, a total of 34 contributions by authors from 16 different countries. The largest number of contributors were from France (9) and the host country Israel (6). Its content is divided into 10 sections, with the first including the keynote lecture only 'Interfacial transition zone: reality or myth' by S. Diamond and J. Huang, and the 10th section being limited to the 'Concluding remarks to the conference' by A. Bentur (apparently the book has been structured the same way as the Conference—and hence the 10 sections; scientifically speaking, there would not have been a need for such a large number of divisions). In the remaining eight sections the topics range from the description of the interfacial transition zone (ITZ), its structure in relation to the properties of concrete, the chemical and physical influences on its constitution, such as those exerted by aggregates, additives and admixtures, to the role of the ITZ in connection with the durability of concrete (diffusion, permeability), etc.

It seems that the precise mechanisms involved in the formation of the ITZ are still not entirely clear. However, it is undisputed that one major cause is the problem of the packing of particles on the surface of aggregate particles, fibres added or of steel reinforcements ('wall effect'). It was already noted in the

keynote lecture that the ITZ, which is richer in water and poorer in cement compared to the bulk cement paste, is not consistent within the concrete and that there are differences in its thickness and composition. Thus, it is not surprising, as shown by various contributions, that measures that help to increase packing density, such as the use of micro-cement, the addition of silica fume and BFS, intensive mixing or the use of superplasticisers—the latter to improve wetting and to avoid coagulation—lead to a more dense ITZ. Since the sensitivity of the ITZ to mechanical stress and corrosive chemical impact (secondary mineral formation) is strongly influenced by its porosity and as its permeability increases as porosity increases, measures to reduce the porosity and thickness of the ITZ are likely to reduce the vulnerability of the concrete, i.e. they will improve its durability. Apart from the factors above and the w/c ratio, the structure and porosity of the ITZ depends also on aggregate used. It was reported in one of the papers, *inter alia*, that concrete containing (non-reactive) quartzite was more sensitive to frost than that containing limestone. This was explained by the fact that the adhesion between quartz and cement paste failed and cracks developed around the aggregate particles whereas limestone was reactive and the transition zone and the cement paste formed a regular network, limiting crack formation and enhancing frost resistance. Another contribution demonstrated very clearly that ITZ has a strong influence on the sulfate resistance of concrete. If concrete is in contact with sulfate-containing water or soil, the ITZ's

overlap between the aggregate particles and form a relatively easy route for the sulfate ions to penetrate. Another author reported that samples produced with porous sandstone were damaged by ASR because of the high porosity of the ITZ, which made it easy for alkali hydroxides to reach the aggregate particles. As pointed out by the Conference Chairman in his conclusions, ITZ is not a material but a system parameter and is not—as suggested by the term ITZ—a phase with a defined microstructure of its own. In the interior of concrete, it is to be understood as an inhomogeneity between cement paste and the aggregate particles and, therefore, the name interfacial inhomogeneity would be more appropriate.

While these articles dealt with the ITZ between cement and aggregates, others focused on the ITZ between cement and steel reinforcement (especially on

the role played by the ITZ in steel corrosion), between fibres, and between the surface of rocks or existing concrete structures and mortar applied onto them. In the latter case, the ITZ is fundamentally different from that around aggregate particles in the interior of the concrete.

Apart from conveying the present knowledge on the ITZ, the book provides a valuable insight into the measuring techniques presently available in this field, such as micro-hardness determination. All in all, the book gives a fine survey of the state of research in 1998 on the topic referred to in its title. It not only offers the reader a quick overall view, but, owing to the large number of contributions and numerous references, it will be much appreciated by everyone working in the field of concrete.

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