Preface

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Biographical notes: Yilmaz Akkaya has completed his MSc degree in 1995 at Istanbul Technical University (ITU). After receiving his PhD degree from Northwestern University in 2000, he worked at the Center for Advanced Cement Based Materials in Evanston as a Research Associate. He is the Director of the Marmaray Laboratory at ITU, a project-dedicated laboratory for testing property development at early ages for crack risk calculations, durability, and concrete petrography. He is the Academic Coordinator of the International Dual Diploma Programmes at ITU since 2010. His research interests include supplementary cementitious materials, fibre-reinforced concrete, early-age properties, fracture and durability of concrete and nondestructive testing.

The most used human-made material in the world, Portland cement concrete, is susceptible to cracking and durability issues. As the sustainability of human development and the environmental issues increase the awareness on the materials and methods used in the production of concrete, there is a demanding need for further research on high performance concrete and its economic/environmental impact. The porous microstructure and cracks lead to loss of material strength, ingress of aggressive ions and eventually, disintegrity of the structural members. Service life considerations and life-cycle analysis of structures became the major concern for civil engineering applications and specifications in the modern world.

This special issue of *International Journal of Materials and Structural Integrity* introduces the latest advancements in the civil engineering materials science and engineering. The articles deal with emerging research areas in high performance concretes for special applications. Concrete continues to be the leading building material choice for not only the conventional structures, but also for the construction projects with special requirements and infrastructures.

Articles provide summaries of background information and through reviews of previous studies. The state-of-the-art research is presented, and the developments in the fresh, hardening and hardened states are introduced. The developments in the mechanical properties and durability issues are discussed. The readers will be inspired from future opportunities and research needs in the field.

The influence of cracking on the fluid absorption in concrete by an X-ray transmission/attenuation method is investigated by Weiss et al. Their study proved that the moisture front, heterogeneous nature of concrete, aggregate volume at a specific location and crack geometry can be determined by this novel method. Shao et al. deal with the curing effect of carbon dioxide absorption and carbon uptake in concrete at early

ages. The immediate carbonation of concrete was found to be increasing the early strength.

An overview of calcium carbonate biomineralisation process, and its relation with hydration, microstructure, and performance of cement-based materials is provided by Zhang et al. Opportunities and concerns in the biomineralisation process, and directions for future research is discussed.

Lomboy and Wang introduces the semi-flowable self-consolidating concrete (SFSCC) for pavement concrete production. Flow, green strength and compaction factor properties are identified, and examples from field applications, production and curing methods are presented. Ferrara draws attentions to the relationship between casting process and materials used in design of high end engineering applications with fibre reinforcement. Flow induced fibre orientation and randomly dispersed fibres within the structural members could be achieved with adapted rheology. Predictive modelling efforts and non-destructive monitoring of properties are also addressed. Sumanasooriya et al. presents the pervious concrete as a recent addition to the sustainable multifunctional cement based materials. Particle packing-based methodology, using a compaction index from compressible packing model of granular particles, is used in the design process. The pore structure features are characterised using stereological and morphological methods. A three-dimensional reconstruction procedure was used to develop material structure. Permeability of the model structure was predicted and compared with experimental results.