Special Issue on “Architectural Structure”

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This Special Issue on “Architectural Structure” aims to gather general advances in human-made constructions which simultaneously are driven by aesthetic and structural engineering considerations. Such advances include the analysis of architectural typologies, the study of the mechanical performance of structural materials, structural systems and components, the proposal of techniques to evaluate the mechanical performance in existing structures and also new construction techniques. The aim of this Special Issue is also to inspire researchers and practitioners to share their knowledge and findings in these fields, and also to help explore new trends for the future. This Special Issue brings together twelve contributions covering the previously referred topics.

The global performance of an architectural structure strongly depends on the mechanical performance of its components and also on the used structural materials. Accordingly, the majority of the published articles in this Special Issue focus on the experimental and/or numerical behavior of structures, structural components and structural materials, including innovative ones. In [1], an innovative composite shear wall built with double steel-concrete, able to substitute classic reinforced concrete walls, was studied and a design method was proposed. A refined model, aiming to contribute to the optimum and economical design of thin-walled steel beams, nowadays widely used in architectural steel structures, was proposed in [2]. The incorporation of fly ash in both cementitious and alkali-activated concretes presents environmental advantages and allows to obtain concrete members with glossy and black surfaces, which might be aesthetically appealing for architectural structures with exposed concrete. In [3], the results of a study on the mechanical performance of reinforced beams built with mortar incorporating fly ash was presented, pointing out some important aspects to be further investigated in order to allow for the structural application of such a material. A contribution to the better knowledge of the mechanical performance of a geopolymer obtained by alkali-activation of a new binder was presented in [4], in order to, in the near future, enable the use of this environmental material in innovative architectural structures with finishes of different colors and textures. Although high strength concrete is nowadays used in practice, some particular aspects of the structural behavior of members built with this material still need to be checked for optimum design. This is the case of structural concrete members under primary torsion. In [5] a study on the mechanical performance of prestressed high strength concrete hollow beams under torsion was presented, the results of which can help in the design of box bridges. Half precast solutions have been widely used for structural applications. In [6] the mechanical performance of a recent structural system of half precast concrete slabs with inverted multi-ribs was investigated and guides for a design method were proposed. Block masonry has been used since ancient times as the main component in constructions and is still used nowadays throughout the world. Recently, the manufacture of such components has evolved based on environmental requirements. The mechanical performance and environmental benefits of recycled aggregate concrete hollow blocks were studied and guides for design were also proposed in [7]. Tall buildings are some of the most emblematic architectural structures. One of the main challenges for the designer is to control the lateral displacements. For this, in [8] the efficiency of an innovative outrigger system made of reinforced concrete wall with multiple openings was modeled and studied, and some guide rules for design were proposed.

Many existing structures must be evaluated for maintenance and rehabilitation concerns. In some projects, the structural performance of their structural materials and members must be checked to ensure the structural safety. In the past few years, self-compacting concrete has been widely used due to, for instance, its ease of placement in geometrically complicated formworks and also due to the obtained smooth and well-finished surfaces after concreting. These aspects are important to fulfill many architectural requirements. In [9], the applicability of non-destructive tests to estimate the compressive strength of self-compacting concrete was studied and useful correlations were presented for practice. Additionally, the performance of structural members in existing structures may have to be evaluated in light of current codes of practice. In this sense, in [10] a study was presented to evaluate the real cyclic load bearing of a traditional ceramic-reinforced slab incorporated in an existing building. The testing methodology and the results of the analysis were presented, which could be useful for practitioners.

Construction systems have evolved in the past few years, namely for geometrically complex structures. Two emergent moldless fabrication techniques for complex spatial forms of natural fiber-reinforced polymer structures were presented and validated in [11]. Such techniques could be, in the near future, applied to build larger building elements for more sustainable building systems.

Finally, the analysis of existing architectural typologies may help a future generation of designers to think about new typologies for architectural structures. In [12], the content of the spatial Rudolf Steiner's architecture, using reinforced concrete in architectural structures with complex geometries, and which is considered a unique case in the history of architectural heritage, is determined and discussed.

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