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EDITORIAL

Long-Term Performance of Structural Systems

In structural design, the checking of the system performance is usually made with reference to the initial time of construction. However, for structures exposed to damaging environments the performance must be considered as time-dependent, mainly because of the progressive deterioration of the mechanical properties of materials that make the structural system less able to withstand the applied actions. Therefore, a consistent approach to structural design should lead to structures that are able to comply with the desired performance, not only at the initial stage when the structure is supposed to be fully intact, but also during the whole expected service lifetime. This can be carried out by taking into account the effects induced by unavoidable sources of mechanical damage and by eventual maintenance interventions, amongst others.

At present, design for durability with respect to chemical-physical damage phenomena is based on simple criteria associated with prescribed environmental conditions. As an example, for concrete structures, such criteria introduce threshold values for concrete cover, water-cement ratio, amount and type of cement, and others, to limit the effects of structural damage induced by carbonation of concrete and corrosion of reinforcement. However, a durable design cannot be based only on such indirect evaluations of the effects of structural damage, but also needs to take into account the global effects of the local damage phenomena on the overall performance of the structure. In recent years, a considerable amount of research work has been carried out, and relevant advances have been accomplished in the fields of modelling, analysis, design, monitoring, maintenance and rehabilitation of deteriorating structural systems.

In this context, the goal of this Special Issue is to present some results of the research currently under development in Italy. The issue consists of seven papers. Bontempi *et al.* present a general framework for maintenance and health monitoring of complex structural systems. In Gioffrè *et al.*, an experimental approach is used for identifying the structural parameters and for monitoring the dynamic response to environmental loading of a historical masonry bridge. The contribution of Zambrano *et al.* deals with the dynamic response of railway bridges to moving vehicles, and proposes an application to the case of an old iron bridge. Bertolini gives a review of the mechanism of corrosion of steel in concrete and analyses its influence on the service lifetime. The same issue is considered in Rinaldi *et al.*, where a simplified methodology to assess the residual lifetime of concrete structures undergoing corrosion is proposed. The paper of Giordano *et al.* shows the role of uncertainty in safety evaluations with respect to serviceability and durability performance of concrete structures. Finally, Biondini and Marchiondelli propose an evolutionary procedure for the optimal design of deteriorating structural systems.

We hope that this Special Issue will contribute to promoting, in both theory and practice, a new vision of structural engineering where the role of the long-term system performance is explicitly taken into account.

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