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EDITORIAL

Advanced Methods and Techniques Against the Degradation of Civil Structures: Detection, Evaluation and Retrofitting

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Corrosion and degradation phenomena lead to significant safety problems in civil structures. Particularly, they are linked to the loss of strength capacity due to the reduction of steel (bond, shear, *etc.*) and concrete (load capacity, protection of steel) cross-sections. Costs linked to degradation increases annually and scientific community and practitioners need to work synergistically in order to take on the challenge of durability of structures, particularly referring to infrastructures, schools, peopled places, *etc.* Existing structures are the majority of the built heritage and can behave differently than new contemporary structures, since they are often characterized by poor details (short anchorage lengths, insufficient reinforcement both in flexure and in shear, use of smooth steel bars, *etc.*). Moreover, damages caused by deterioration can affect the structural capacity in terms of strength and ductility, modifying the seismic behaviour of the whole structure. The assessment of the effective performance of an existing civil structure, as well as the prediction and the evaluation of its future structural performance with or without damage, is a new boundary of engineering and a special challenge for scientists.

The proposed Special Issue aims to provide an overview on degradation themes linked to civil structures, starting from new methods and materials for the prevention, passing towards diagnostic methods and structural evaluations, leading the use of new retrofitting technologies to increase the safety and the residual service life of degraded structures. The scientific community is making a real effort in order to win challenge of degradation of structures. Particularly, it is very important to find new methodologies of protection, prevention and diagnostics in order to attain the required durability/structural capacity of the structures all over their service life.

In the paper of Gazzani *et al.* [1] "Influence of FE modelling approaches on vulnerabilities of RC school buildings and proposal of a CFRP retrofitting intervention", the global vulnerability assessment against earthquakes of existing RC school buildings in Central Italy was contributed evaluated through the pushover analysis. Three different numerical models of the RC school building, namely lumped plasticity, distributed plasticity (fibre) and 3D Continuum Finite Element (FE) approaches, have been implemented. The comparison among the results of three models shows that the 3D Continuum model is the most accurate technique to describe the complex and combined mechanisms developed in the joint panels. It is followed by the lumped plasticity model, which is closer to reality than the fibre model, even if it does not take into account the concomitance of bending, shear and axial force and the interaction between them in the inelastic response. Finally, local strengthening interventions of unconfined beam-column joints based on Carbon Fibre Reinforced Polymer (CFRP) have been considered as an effective retrofitting technique in improving the ductility of the case study buildings.

The work by Di Lorenzo and Landolfo [2] "Sensitivity study of dynamics variability for mild-carbon steel structures affected by corrosion" investigates the vulnerability of mild carbon truss structures in roofs and towers due to the corrosion depth propagation. The examined structures have been optimized with a reduced weight/span ratio and a reduction in structural thickness of metal elements can modify masses, stiffness and, consequently, their dynamic behaviour. Therefore, the vulnerability of these structures to wind actions before and after corrosion has been discussed. Finally, the corrosion/structure interaction has also been discussed examining the structural dynamics variability due to the reduction of steel thickness.

The paper written by Formisano *et al.* [3] "Non-destructive tests on carpentry steels" deals with experimental non-destructive tests on metal carpentry structures mainly belonging to the Industrial Archaeology, which represents a modern branch of urbanism and architecture studying the industrialization process from its origins to the actuality. While the identification of constructive schemes of these historical

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structures is based on direct surveys, the definition of material properties requires material testing and investigation. For metal structures, the standards involve destructive investigations only through sampling of specimens, which often conflict with the protection requirements of the artefact. Therefore, considering the need of providing non-destructive investigations in order to reduce extraction of specimens from steel structures due to testing, in the paper, the Leeb method, based on the use of a portable micro-durometer, has been employed for hardness in-situ evaluation of carpentry steels. So, a very novel application in the field of seismic assessment of historical metal structures has been carried out by implementing theoretical relationships for carpentry steels able to put in relationship Leeb hardness test values with experimental tensile strengths. Through these formulations it has been possible to indirectly evaluate, starting from Leeb hardness values measured in-situ on carpentry steels, the strengths of those materials to be used for their mechanical characterization when seismic analysis and improvement/retrofitting of steel artefacts are required.

Finally, in the paper of Imperatore and Rinaldi [4] “Cracking in reinforced concrete structures damaged by corrosion: an overview” the influence of the current density on the degradation of a reinforced concrete element has been investigated with particular reference to the kind of formed oxides and to the crack width. An experimental survey on steel rebars embedded in concrete cylinders and subjected to an electrolytic corrosion has been performed, with different increasing current densities. Furthermore, an analytical model, based on the classical thick-walled cylinder theory already proposed by the authors, has been applied for validating the experimental results. The oxides produced by artificial corrosion with different current densities have been analyzed with Xray diffractometry measurements and the influence of the current density on the crack widths has been also pointed out. The analyses of the obtained results have shown that for the analysed specimens and current density range, no significant differences have been found for the oxides composition. On the contrary the influence of the current density on the crack width has been pointed out, and an upper limit of this parameter has been indicated.

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