



# Editorial: Corrosion of Reinforced Concrete Structures

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## Editorial on the Research Topic

### Corrosion of Reinforced Concrete Structures

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## INTRODUCTION AND SCOPE

Corrosion of reinforced concrete structures is nowadays one of the major concerns on the durability and serviceability of buildings and constructions. Corrosion management and monitoring of infrastructure and civil engineering structures are required to guarantee their lifetime in service. Current society demands for new materials; diagnosis techniques and computational modeling then can contribute to increase corrosion resistance, thus improving safety and extending the service lifetime of reinforced concrete structures.

Sustainability of reinforced concrete structure is crucial for better social development because of the importance of structural safety, preservation of environment, and economy. In developed countries, corrosion economic losses due to maintenance, repair, and replacement of existing structures and infrastructure account for up to 4% gross domestic product (GDP). It is worth to note that production of new materials not only is costly but also requires a large amount of energy consumption, which dramatically influences greenhouse effect because of CO<sub>2</sub> emissions.

Over the last years, the development of new techniques, materials, and corrosion protection strategies is contributing to better understand corrosion phenomena of steel in concrete. The development of new embedded sensors in concrete provides an enormous advantage for corrosion monitoring and risk evaluation of reinforced concrete structures. In addition, new localized electrochemical techniques are contributing to elucidate corrosion mechanism. Efforts toward a better understanding of environmentally assisted cracking combining electrochemical and mechanical features are of high interest to elucidate corrosion of steel in concrete. New trends in corrosion control of reinforced concrete structures focus on the use of stainless steel reinforcements, corrosion inhibitors, smart coatings, cathodic protection, and new geopolymer cementitious materials.

This Research Topic on “Corrosion of Reinforced Concrete Structures” is aimed to cover all major aspects of corrosion of steel in concrete—from experimental studies to predictive modeling. A wide spread of research studies comprising highly interesting subjects is included, such as pitting corrosion, uniform corrosion, stress corrosion cracking, service lifetime prediction, electrochemical techniques, and surface characterization techniques.

## CONTRIBUTIONS

The contents of this Research Topic include five different papers focused on Corrosion of Reinforced Concrete Structures.

Morales et al. studied the pitting factor on carbon steel reinforcements to estimate the prestressed structure service lifetime under a corrosive environment, concluding that pitting factor value varies between 1.20 and 1.85. Service life of the tendons can be significantly reduced for a service stress of 70% of the bar ultimate load.

Castorena-González et al. proposed a new predictive model using the corrosion damage function by 3D finite element modeling (FEM) analysis of the cover crack width in the surface of reinforced concrete. The model is based on geometry, free concrete cover depth, steel rebar diameter, anodic zone length, and the mechanical properties of the concrete: modulus of elasticity, tensile strength, and Poisson’s modulus. It was concluded that before the crack initiation stage, the material properties and the geometrical array are relevant; however, during the crack growth and propagation stages, they become less significant.

In a work by Baltazar-Zamora et al., the corrosion behavior of galvanized steel embedded in concrete, used in infrastructure such as bridges, buildings, and pavements exposed to soil contaminated with chlorides, was presented.

Tu et al. proposed a computing method to solve the problem of monitoring the tensile strength degradation of glass fiber-reinforced polymer (GFRP) rebars during service lifetime. It was found that the tensile strength degradation law based on Arrhenius theory also applies to elastic modulus.

Montoya and Nagel presented a simulation study by FEM of the capillary water absorption and chloride transport in mortar. The model described the water uptake phenomenon in mortar samples exposed to atmospheric corrosion by using Richard’s equation and the vaporization process of water.

## CONCLUSIONS AND CAVEATS

This Research Topic on “Corrosion of Reinforced Concrete Structures” is focused on current trends in corrosion science,

engineering, and technology, from fundamental to applied research, thus covering subjects related to corrosion mechanism and modeling and protection and mitigation strategies.

In summary, new models that correlate accelerated laboratory test and natural exposure corrosion on-site testing need to be developed for predicting corrosion damage and service lifetime. Further research in advanced materials, diagnostic tools, and characterization techniques, together with modeling, will envisage a promising scenario to fully understand corrosion mechanisms. Therefore, new strategies will implement the safety and extension of the service lifetime of reinforced concrete structures.

The Research Topic on “Corrosion of Reinforced Concrete Structures” presents a collection of research articles covering the relevant topics and current state of the art in the field. As guest editors, we hope that this collection of original research papers and reviews may be useful to researchers working in the field, promoting more research studies, debates, and discussions that will continue to shed light and bridge the gap in understanding the corrosion and protection fundamentals and mechanisms of steel in concrete.

## AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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