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REVEIW ARTICLE

Degradation Mechanisms and Residual Mechanical Properties of Reinforcing Steel Bars Exposed to Natural and Artificial Corrosion – Review & Analysis

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ABSTR AC T

Reinforcement corrosion is the most problematic phenomenon and one of the main sources for the degradation of structures and infrastructures all across the world, that leads to their premature deterioration before design life has been attained. Therefore, the structural effects of rebar corrosion are crucial in determining the structural performance and residual strength of impaired structures. In the present work, the corrosion initiation mechanisms, corrosion products, corrosion types, corrosion consequences on structural performance and detrimental factors related to corrosion were presented in brief. Moreover, the propagation period and the main consequences on mechanical properties of steel and concrete are analyzed. Analyses of the available statistical data collected from literature were performed for 443 specimens. The findings are further interpreted from structural point of view, and deterioration equations for the mechanical properties of the corroded reinforcements are developed. The relations are well analyzed, leading to the definition of decay equation for yielding and ultimate stresses, and ultimate strain. It was found that the mass loss of 1% due to the rebar corrosion can cause the strength loss of 1.34%, 1.30%, and 3.54% respectively for yield strength, ultimate strength, and elongation. The suggested formulas can be applied in analytical and numerical structural applications.

Reinforcement bars, [redacted] pitting corrosion.

INTRODUCTION

In recent years, corrosion phenomena of the reinforcing steel have received extreme attention because it is among the primary materials that result in mechanical damage to reinforced concrete (RC), which is the most commonly employed building material. The corrosion phenomena of reinforcement bars embedded through concrete considered in a way or another as an extreme substantial factor leading to the event of deterioration of any structures built out of concrete and thus, bring out severe damage. Concrete reinforcing bars protected by ordinarily a passive film established through alkaline environment (*pH* of 13.5) due to cement hydration products. Yet, the passive film could be ruined via the entree of aggressive ions like carbon dioxide and chloride. Due to the variety of extrinsic environments, non-homogeneous properties of these two; passive film and concrete cover, metallurgical and compositional non-uniformity of steel reinforcement, corrosion phenomena in implementation are overwhelmingly seemed to be non-uniformly disseminate along the length of a steel bar. Corrosion process is renowned in reinforced concrete structures by brown patches of rust that protrude on the concrete surface and/or cracked concrete cover. Direct consequences of the corrosion practicability are: (i) reduction of rebar area and ductility, and (ii) volume expansion of corrosion products (Garcia et al., 2019; Jiang et al., 2020; Garcia et al., 2021;