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Cohesive modeling of corrosion-induced cracking in concrete

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ABSTRACT

Corrosion of reinforcing steel in concrete due to chloride ingress is one of the main causes of the deterioration of reinforced concrete structures. Structures most affected by such corrosion are marine zone buildings and structures exposed to de-icing salts like highways and bridges. This corrosion process is accompanied by an increase in volume. Depending on the level of oxidation, steel can expand as much as six times its original volume. This increase in volume exerts tensile stresses in the surrounding concrete which may result in cracking and spalling of the concrete cover if the concrete tensile strength is exceeded. In this work we apply cohesive theories of fracture [1] to study the cracking process induced by corrosion. A self-adaptive procedure [2] is adopted to take into account the topological change as multiple cracks propagate. The volume change resulted from oxidation is implemented as a gradual radial displacement expansion imposed to the concrete-steel interface. The crack patterns and crack opening displacement are compared with experimental data of Molina et al [3]. The parametric studies suggest that the characterization of both the oxidation mixture and concrete mechanical properties is essential for the validation of numerical models.

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