# Simulation of the degraded steel - concrete bond due to corrosion through modeling pull out experiments

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## ABSTRACT

Corrosion of reinforcing steel in reinforced concrete (RC) structures is the most common factor affecting durability especially in coastal areas. Corroded structures face different wear problems that affect the load carrying capacity, such as loss of bond between the reinforcement and the surrounding concrete, cracks or crumbling of the concrete cover, and loss of the reinforcement cross-section and strength. In this work, a three-dimensional (3D) model was developed, using finite element analysis (FE) in ABAQUS to simulate corroded structural components, considering corrosion damage, to be modeled according to Model Code 2010 instructions. For this purpose, was used as a basis for the validation of the model the study *An experimental study on the effects of corrosion and stirrups spacing on bond behavior of Reinforced Concrete[9]*. In the above-mentioned study corroded specimens were used with transverse reinforcement *Φ8/120mm* and without any transverse reinforcement and subjected to pull-out tests of the main eccentrically placed corroded bar. A detailed study was made for the best and most effective way of modeling the complex corroded interface, by selecting the cohesive behavior between the two surfaces to meet those criteria, with modifications appropriate to the parameters, for each level of corrosion of the reinforcement. The modeling of the damage in the concrete was done as found in the literature by reducing its strength (tension and compression) to an area of corrosion influence that is estimated by a separate code found in the relevant literature [47]. Accordingly, the same was applied for the damage of the reinforcement using empirical relations for the degradation of the mechanical properties of the steel. After extracting the bond – slip curves of the simulations, a comparison was made with the experimental ones, resulting in good predictions from the developed model. In terms of maximum strength, the largest deviation is at 9.38% while at the same time positive conclusions are drawn about the failure shapes of the specimens with good predictions of crack formation but not for its representativeness in order of magnitude. An important observation is that the specific model can take into account the density of the transverse reinforcement

with a future for its extension to real constructions and that the instructions of the Model Code 2010 find good agreement for moderately confined specimens. However further investigation needs to be done into slip values that cannot be predicted of increasing corrosion level and to validate the proposed model with other experiments.

Keywords
Bond of reinforced Concrete, Confinement by transverse reinforcement, Finite Element Analysis, Reinforcement Corrosion