Non-local numerical treatment of non-linear behavior by means of Helmholtz equation, with variable coefficients. Application to reinforced concrete structures.

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Numerous work has been done with the aim of modeling the cracking of reinforced concrete (RC) structures. Among the recent methods proposed in the literature, the combination of reinforcement-concrete equilibrium combined with the linear behavior of the interface leads to a Helmholtz equation which takes account of the slip between the homogenized reinforcements and the concrete in presence of localized cracks [1][2]. In the case of large cracks openings, it is necessary to consider the non-linear behaviors of material and interfaces, such as the plasticity of reinforcements or the damage of the matrix-reinforcement interface. These phenomena induce variations of the coefficients in the Helmholtz equation, which leads to two levels of iterative procedures: one at a global level considering equilibrium of homogenized RC, and another one at a non-local level taking account of equilibrium between reinforcement and concrete. The implementation of a convergence criterion is then needed at each level. The goal of this paper is to describe the developments implemented in the Finite Element code Cast3m to perform non-local Helmholtz type calculations with non-constant coefficients. This method, using an acceleration method [3] is illustrated by the cases of reinforced concrete tie and beam, with homogenized reinforcements.

References :

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