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A HOMOGENIZATION APPROACH TO CONCRETE FLOW THROUGH REINFORCING BARS

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Mechanical performance, surface quality, and durability of concrete structures is to a significant extent influenced by the casting process. Thus, predicting the flow behavior of concrete in the formwork, and identification of critical zones, has become an important part of the design procedure of concrete mixes.

There is a variety of computational tools available to simulate fresh concrete flow at different level of resolution, based on, e.g. homogeneous (single-fluid) models, discrete particle flows, or fluid-suspended particles [3]. From the practical point of view, the homogeneous approach appears to be the most suitable, since it allows for large-scale simulations with acceptable accuracy, when modeling fresh concrete as a yield stress fluid of the Bingham type, e.g. [2, 3]. Of course, this comes at the expense of the fact that sub-scale phenomena, such as the influence of reinforcement or aggregate segregation, are difficult to capture.

The aim of the present contribution is to model the effect of reinforcing bars in the single-fluid approach by means of computational homogenization, e.g. [1]. Our approach builds on results of a numerical-experimental study by Vasilic et al. [6], who demonstrated that the presence of reinforcing bars can be accounted for by an empirical modification of the constitutive law proposed for non-Newtonian porous media. We justify this procedure on the basis of recently developed variational framework for homogenization of Stokes flow in porous media by Sandstöm and Larsson [4] and Sandstöm et al. [5], and present a systematic numerical study comparing the relations used in [6] and the outcomes of the numerical homogenization method.

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