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MODELING AND VALIDATION OF NON-UNIFORM UNSATURATED INFILTRATION DYNAMICS IN PERVIOUS CONCRETE

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Abstract. This study conducts an investigation into the dynamics of water infiltration within pervious concrete drainage structures with the objective of advancing urban stormwater management practices. In a previous work, a one-dimensional (1D) infiltration experiment was performed in order to calibrate the constitutive parameters for the unsaturated fluid flow model. This model is solved through the Richards Equation, which in turns requires a diffusivity model. Such model quantifies the effects of saturation over the capillary pressure and permeability, represented by a set of coefficients that should be determined for every material. Through the 1D experiments, the Van Genuchten-Mualem model was found to be the most suitable, giving a proper set of parameters. In this work, from a localized infiltration experiment with spatial drainage discrimination, the numerical prototype is tested. The experiment consists of a pervious concrete plate with a single water source on top and collectors in the bottom part. Such collectors enable to estimate the total infiltration volume at every measuring sector. The challenge for the numerical model is to reproduce this intrinsic three-dimensional (3D) problem with comparable precision than the former results. This analysis is numerically performed within the OpenFOAM platform in the frame of the finite volume method. The simulations are based on the implementation of the porousMultiphaseFoam toolkit, which integrates the Van Genuchten-Mualem model for resolving the Richards equation. The goal of the 3D prototype is to obtain the set of Van Genuchten-Mualem parameters and compare them with those previously found, in order to check for the robustness of the modelling process. By focusing on unsaturated infiltration dynamics within a 3D framework, this study aims to deepen the comprehension of the fundamental mechanisms governing water transport in pervious concrete drainage assemblies, while characterizing the material's porous network for enhanced stormwater management.

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