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Determining Horizontal Groundwater Flow Velocity Magnitudes in Permeable Layers and Across a Perforated Borehole

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Estimation of groundwater flux in permeable layers from water flow velocity in a borehole may be feasible if reliable analytical and/or numerical solutions are available because researchers have explored methods to measure velocity in boreholes to predict flux in the permeable layers. There have been studies that investigated both analytically Sano (1983) and experimentally Momii et al. (1993) such flow fields. They verified that the center of the flow in a borehole is three times greater than that of the average groundwater flux in porous medium. In this study numerical simulation was conducted to investigate relation between horizontal groundwater flow velocities in permeable layers and across a perforated borehole. The numerical simulation model was a two-dimensional horizontal cross-section of a confined aquifer with a perforated borehole. Darcy law was used for flow in the permeable layer the Navier-Stoke equation was used for fast flow across the perforated borehole and the Brinkman equation was used in the interfacial zone between porous and borehole interface to bridges the differences between these two distinct flow regions. Horizontal groundwater flow velocity magnitude in permeable layer and across a perforated borehole was determined. Also the analytical result of Sano (1983) was numerical verified using different governing equations. The results of this numerical simulation showed that if the water flow velocity in a borehole is available the average groundwater flux in the surrounding permeable layers of the borehole can be calculated with high accuracy.

Keywords: Numerical Simulation, Groundwater velocity magnitude, Permeable layers, Borehole