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The diversion capacity of curve-shaped capillary barrier interface

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Despite decades of numerous studies on the capillary diversion along linear-sloped capillary barrier interfaces of texturally distinct fine-over-coarse porous materials, curve-shaped interfaces for use as barriers might have received little attention except for a study that addressed parabolic-shaped capillary barrier interface [Selker (1997), Water Resources Research 33]. In this study diversion capacities of linear-sloped, concave-shaped and convex-shaped capillary barrier interfaces, defined as the distance downslope that the funneled flow can be diverted along sloping interfaces before breakthrough into the coarse layer occurs (fingering flow) under steady state rainfall infiltration conditions, were measured in a laboratory model comprised of two interspersed sloping layers of Touyora sand over coarse glass bead (1-mm diameter) within a container of 80 cm long, 90 cm high and 2 cm thick under a rainfall simulator. Eight experimental runs for different angles of linear-sloped interfaces, six runs for different concavities of concave-shaped interface profiles, and six runs for different convexities of convex-shaped interface profiles were conducted under different rainfall rates. Numerical simulations using HYDRUS-2D, a two-dimensional variably-saturated water flow model that solves the Richards equation using the finite element method, were shown to adequately simulate diversion capacities along linear-sloped, concave and convex-shaped interfaces as compared to all experimental runs. The analytical equation developed by Ross (1990) [Water Resources Research 26] and extended by Steenhuis *et al.* (1991) [Water Resources Research 27] for linear-sloped capillary barrier interface was also used to estimate diversion capacities along concave and convex-shaped interfaces by applying an adaptation of the Steenhuis *et al.* model calculations based on the slope of the fine-coarse interface at every point on concave and convex-shaped interface profiles, as well as on the consideration of

breakthrough along interfaces only when the accumulated funneled flow exceeded the diversion capacity. The Steenhuis *et al.* model provided similar estimates of diversion capacities along linear-sloped and concave-shaped interfaces to those obtained from experiments and numerical simulations. However, the Steenhuis *et al.* model was not capable of estimating diversion capacity along convex-shaped interface.