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A universal scaling for viscous flows around micro- and nanofabricated pillars CARL MEINHART, NIMISHA SRIVASTAVE, CHANGSONG DING, NOEL MACDONALD, UCSB — Complex geometries that involve an intricate network of channels and pillars are increasingly being used in microfluidic devices. Central to the successful operation of these devices is a fundamental theoretical framework that explains the effects and interplay of viscous, inertial and capillary forces in these geometries. One such geometry is a dense (1000 by 1000) array of micron-sized pillars. We will present a universal scaling (over four orders of magnitude) that predicts viscous, pressure driven flows in these pillars. We have developed a finite element model that simulates Stokes' flow between pillars. Building upon a universal scaling law for viscous losses in the pillars, we developed a model that accurately predicts flow rate through the pillars. We have found that pressure-driven viscous flow within the pillars depends nearly linearly with the height (h), inversely with the square root of the diameter (d), and a power law behavior with the gap between the pillars. In addition, we have observed lubrication- like scaling in low Reynolds number (Re <0.5) viscous flows around an array of microfabricated pillars. Numerical results compare well to experimental observation.

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