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The structure of turbulence overlying impermeable and permeable rough walls T. KIM, G. BLOIS, J. BEST, Univ. of Illinois, K.T. CHRISTENSEN, Univ. of Notre Dame — Turbulent flow overlying complex topographies, both impermeable and permeable, occur across a broad range of scales in both natural and engineering environments. Permeability of the wall introduces a higher degree of both structural and conceptual complexity, with previous studies suggesting that interactions between the turbulent free flow and pore flow occur along the permeable interface and play a defining role in momentum exchange across the interface. Here we employ a Refractive-Index-Matching (RIM) technique in order to access the flow across the permeable interface with the particle image velocimetry (PIV) method, resulting in unimpeded optical access to the fluid flow at and within a permeable bed. Cubic-packed hemispheres are studied in both impermeable and permeable configurations, with models cast by an acrylic resin whose refractive index matched that of the working fluid (aqueous sodium iodide). The statistical and structural features of the flow in the near-wall region of the impermeable case and the interfacial region of the permeable case are compared to understand the role of permeability in driving momentum exchange processes as a function of Reynolds number. Comparisons to recent numerical simulations are also made.

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