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Secondary flow structure development in multi-scale rough wall turbulent boundary layer NASEEM ALI, JULIAAN BOSSUYT, BIANCA VIGGIANO, Portland State University, BHARATHRAM GANAPATHISUBRAMANI, University of Southampton, JOHAN MEYERS, KU Leuven, RAUL CAL, Portland State University — Turbulent flow over an array of heterogeneous multifractal roughness elements is experimentally investigated. The flow fields are captured covering one periodic cell of a multifractal roughness pattern. The roughness elements generate a large velocity deficit behind the roughness, induce flow-separation between low- and high-momentum pathways, and generate small scale turbulence with a length scale on the order of the roughness elements. The vertical velocity is observed to be increased directly prior to the elements indicating the upwards movement over the roughness element. Following the peak, the flow exhibits a negative wall-normal velocity as the localized wake recovers. The flow close to the valleys is perturbed by the wake generated around the small scale of the element, and the signatures of the flow interaction with the roughness scale of the geometry are shown. The formation of secondary motions that grows over the roughness elements is tested. The strength of the secondary flows is most accentuated at the ridges of the roughness. The features of the secondary motions are observed extending the location of high Reynolds stress above the roughness elements. The dispersive stresses reach up into the boundary layer past 0.4 of turbulent boundary layer thickness.

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