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Time-resolved PIV measurements of flow around and through a permeable rectangular prism G.L. BLOIS, J.M. BARROS, J.L. BEST, K.T. CHRISTENSEN, University of Illinois at Urbana-Champaign — The unsteady turbulent wake dynamics generated by flow around and through a permeable rectangular prism is experimentally investigated using a refractive-index-matching (RIM) approach. A 7-mm diameter cylindrical flow passage was drilled through the center of an acrylic rectangular prism (25.5-mm thick; 51.0-mm long) along its streamwise axis. This permeable prism was then immersed in an aqueous solution ($\sim 63\%$ by weight) of sodium iodide (NaI) within a recirculating flow loop wherein the refractive index of the NaI was accurately matched to that of the acrylic prism via control of the NaI concentration and solution temperature. This RIM approach enabled simultaneous optical interrogation of the flow both around and within the permeable prism with time-resolved particle-image velocimetry at $\mathrm{Re} > 10^4$. The interaction between the flow exiting the passage and the vortices shed from the model dramatically modifies the dynamics of the wake compared to that of a solid prism of identical dimensions. While the flow through the passage was found to be relatively steady, it generated a pulsating jet that penetrated into the wake, yielding strong internal–external flow interactions.

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