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Design of a High-Reynolds Number Recirculating Water Tunnel
LIBIN DANIEL, BRIAN ELBING, Oklahoma State University — An experimental fluid mechanics laboratory focused on turbulent boundary layers, drag reduction techniques, multiphase flows and fluid-structure interactions has recently been established at Oklahoma State University. This laboratory has three primary components; (1) a recirculating water tunnel, (2) a multiphase pipe flow loop, and (3) a multi-scale flow visualization system. The design of the water tunnel is the focus of this talk. The criteria used for the water tunnel design was that it had to produce a momentum-thickness based Reynolds number in excess of 10^4, negligible flow acceleration due to boundary layer growth, maximize optical access for use of the flow visualization system, and minimize inlet flow non-uniformity. This Reynolds number was targeted to bridge the gap between typical university/commercial water tunnels (10^3) and the world's largest water tunnel facilities (10^5). These objectives were achieved with a 152 mm (6-inch) square test section that is 1 m long and has a maximum flow speed of 10 m/s. The flow non-uniformity was mitigated with the use of a tandem honeycomb configuration, a settling chamber and an 8.5:1 contraction. The design process that produced this final design will be presented along with its current status.

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