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Prediction of an internal boundary layer on a flat plate after a step change in roughness using a near-wall RANS model MINGHAN CHU, Department of Mechanical Engineering, University of Saskatchewan, FANXIAO MENG, Department of Mechanical Engineering, University of Manitoba, DONALD J. BERGSTROM, Department of Mechanical Engineering, University of Saskatchewan — An in-house computational fluid dynamics code was used to simulate turbulent flow over a flat plate with a step change in roughness, exhibiting a smooth-rough-smooth configuration. An internal boundary layer (IBL) is formed at the transition from the smooth to rough (SR) and then the rough to smooth (RS) surfaces. For an IBL the flow far above the surface has experienced a wall shear stress that is different from the local value. Within a Reynolds-Averaged-Navier-Stokes (RANS) formulation, the two-layer k-ϵ model of Durbin et al. (2001) was implemented to analyze the response of the flow to the change in surface condition. The numerical results are compared to experimental data, including some in-house measurements and the seminal work of Antonia and Luxton (1971,72). This problem captures some aspects of roughness in industrial and environmental applications, such as corrosion and the earths surface heterogeneity, where the roughness is often encountered as discrete distributions. It illustrates the challenge of incorporating roughness models in RANS that are capable of responding to complex surface roughness profiles.

Minghan Chu
Department of Mechanical Engineering, University of Saskatchewan

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