UTC Project Information	
Project Title	MPC-688 – Response of Bed Shear Stress in Open-Channel Flow to a Sudden Change in Bed Roughness
University	South Dakota State University
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Start and End Dates	May 24, 2022 to July 31, 2024
Brief Description of Research Project	Sudden change in bed roughness can occur in many situations in open- channel flows including flow through culverts, flow around bridge piers and abutments, and overtopping of roadways in the floodplain, where bed materials can change abruptly from that of the original riverbed to riprap protection, and vice versa. A sudden change in bed roughness also occurs frequently in the laboratory when soil erosion is studied using a sediment recess in an open-channel flume or water tunnel. In all the above, the bed shear stress is a fundamental hydraulic parameter that must be determined accurately. The proposed research will investigate the evolution of fluid velocity profile and bed shear stress near bed roughness transitions. Velocity measurements will be obtained over smooth-to-rough and rough-to-smooth transitions in an open-channel flume using a Particle Image Velocimetry (PIV) system. The measured data will be used to evaluate different methods for determining the bed shear stress around roughness transition. Bed shear stress will be determined using the channel slope, from the measured velocity profile using the logarithmic law, from the measured Reynolds stress distribution, and from direct measurement of bed shear stress (on a smooth bed) using a hot-film anemometer.
Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	An MS thesis was completed based on this study and a journal paper summarizing the major findings has been accepted for publication in Environmental Fluid Mechanics. These publications will provide researchers and engineers with the information to determine the erosive force of water at channel transitions more accurately, both in the field and in the laboratory. The former may include flows through hydraulic

	structures such as bridge crossings. The latter involves a common situation found in laboratory studies of sediment erosion and scour where a free-surface flow may change abruptly from a smooth bed (the flume bottom) to a rough bed (the sediment bed) and vice versa.
Impacts/Benefits of Implementation (actual, not anticipated)	The broader impact of this study will be a better understanding of the flow characteristics and bed shear stress developed when free-surface flow in an open channel suddenly encounters a different type of bed surface. This situation can occur in laboratory study of sediment erosion and scour in a flume, and in rivers and streams where changes in bottom roughness are caused by sediment deposition or erosion or by the installation of scour countermeasures. In both cases, accurate determination of the bed shear stress exerted by the flowing water is critical for reliable estimation of soil erosion and scour.
Web Links Reports Project Website 	 MPC Final Report – <u>Response of Bed Shear Stress in Open-Channel</u> Flow to a Sudden Change in Bed Roughness