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Friction laws for planar channels with idealized periodic roughness elements. D. KASITEROPOULOU, A. LIAKOPOULOS, T. KARAKASIDIS, Dept. Civil Engineering, University of Thessaly, Volos, Greece — Laminar 2D and turbulent flows in channels formed by two infinite parallel walls (a smooth lower wall and a rough upper wall) have been studied numerically. Roughness of upper wall is modeled by periodically-spaced rectangular or triangular protruding elements. Laminar flows were studied by Direct Numerical Simulation (DNS) while the Reynolds-averaged Navier-Stokes equations (RANS) were employed for the turbulent flow. The dependence of flow pattern on protrusion type, channel geometry dimensionless parameters, and Reynolds number is investigated. Protrusions promote formation of vortices even at very low Reynolds numbers. An inherently unstable shear layer is formed between the low-speed fluid trapped between adjacent protrusions and the high-speed fluid streaming in the central channel part. The force exerted by the walls on the fluid is larger in the case of rectangular protrusions, at least in the range of Reynolds numbers and protrusion heights studied. The calculated pressure drop is compared with theoretical relations for planar Poiseuille flow and empirical relations for turbulent flows. An effort is also made to determine the validity of laminar flow scaling relations for micro and nano-flows. Acknowledgments: The project is co-funded by the European Union – European Social Fund & National Resources – Epeaek II.

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