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A mean profile formulation for canonical wall-bounded turbulent flows consistent with the mean momentum equation JIMMY PHILIP, IVAN MARUSIC, Department of Mechanical Engineering, University of Melbourne, JOSEPH KLEWICKI, Department of Mechanical Engineering, University of New Hampshire & Department of Mechanical Engineering, University of Melbourne — The mean velocity profile for wall bounded flows is formulated in a manner that is consistent with the magnitude ordering of terms and characteristic length scales associated with the mean momentum equation. Close to the wall, the viscous length characterizes the dynamics, and Prandtl's law-of-the-wall holds. In an outer inertial region where the dominant balance is between the Reynolds stress gradient and the pressure gradient (or mean advection), the mean flow is most closely approximated by a logarithmic function. The width of this region is (asymptotically) characterized by the outer length scale. As initially demonstrated by Wei et al (2005), for all canonical wall-flows the mean viscous force retains dominant order out to a wall-normal location that, in inner units, is $O(\sqrt{\delta^+})$, where δ^+ is the Karman number. The present formulation respects these known properties. This formulation predicts that for low δ^+ the log-law is approached from "above" the logarithmic line, while for high δ^+ the log-law is attained from "below." These subtle properties and the general functional form are shown to be in very good agreement with the mean velocity data available from boundary layer, pipe and channel flows.

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