



The effect of stratification on the aerodynamic roughness length and displacement height for urban and woodland surfaces

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The roughness length and displacement height are fundamental concepts presented in numerous textbooks on fluid mechanics, dynamic meteorology and physical oceanography. They characterise the resistance exerted by the roughness elements on turbulent flows and provide a conventional boundary condition for a wide range of turbulent-flow problems. Classical laboratory experiments and theories treated them as geometric parameters independent of the properties of the flow. In this paper, we demonstrate essential stability dependences - stronger for the roughness length (especially in stable stratification) and weaker but still pronounced for the displacement height. We also develop a scaling-analysis model for these dependences, verify it against experimental data and make recommendations for practical applications.