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Direct Numerical Simulation of the turbulent flow over an urban canopy made of cubical obstacles[1] STEFANO LEONARDI, Department of Mechanical Engineering University of Puerto Rico Mayaguez, IAN CASTRO, School of Engineering Sciences, University of Southampton, Southampton, UK — Computations of flow over staggered arrays of cubes with various plan area density are presented and discussed. A DNS technique, using an immersed boundary method for the obstacles, was employed. It is shown that the surface drag is predominantly form drag, which has a maximum for an area coverage around 15%. As the effective roughness of the surface increases, so does the ratio of the spatially averaged vertical and axial normal turbulence stresses at the obstacle height, so a major effect of roughness is to change the structure of the turbulence field, thus altering the way that pollutants emitted within the canopy are transported. Time history of the total drag shows large scale oscillations. This should be related to large-scale pair of axially-orientated vortex rolls which are not stable, but "come and go" roughly periodically in time. These vortex structures appear to be much weaker when the total drag has its lowest magnitude. Such rolls are perhaps not unexpected. They have been found in boundary layers developing over similar surfaces but in that case appear to be essentially steady.

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