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Direct numerical simulation of turbulence and heat transfer in a hexagonal shaped duct OANA MARIN, ALEKS OBABKO, MCS, Argonne National Laboratories, USA, PHILIPP SCHLATTER, KTH Mechanics, Sweden — Flows in hexagonal shapes frequently occur in nuclear reactor applications, and are also present in honeycomb-shaped settling chambers for e.g. wind tunnels. Whereas wall-bounded turbulence has been studied comprehensively in two-dimensional channels, and to a lesser degree also in square and rectangular ducts and triangles, only very limited data for hexagonal ducts is available, including resistance correlations and mean profiles. Here, we use resolved spectral-element simulations to compute velocity and temperature in fully-developed (periodic) hexagonal duct flow. The Reynolds number, based on the fixed flow rate and the hydraulic diameter, ranges between 2000 and 20000. The temperature assumes constant wall flux or constant wall temperature. First DNS results are focused on the mean characteristics such a head loss, Nusselt number, and critical Reynolds number for sustained turbulence. Profiles, both for mean and fluctuating quantities, are extracted and discussed in the context of square ducts and pipes. Comparisons to existing experiments, RANS and empirical correlations are supplied as well. The results show a complicated and fine-scale pattern of the in-plane secondary flow, which clearly affects the momentum and temperature distribution throughout the cross section.

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