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Influence of wall roughness and thermal conductivity on turbulent natural convection PAOLO ORLANDI, SERGIO PIROZZOLI, MATTEO BERNARDINI, Universita' di Roma La Sapienza — We study turbulent natural convection in enclosures with conjugate heat transfer. The simplest way to increase the heat transfer in this flow is through rough surfaces. In numerical simulations often constant temperatures are assigned on the walls, but this is an unrealistic condition in laboratory experiments. Therefore, in the DNS, to be of help to experimentalists, it is necessary to solve the heat conduction in the solid walls together with the turbulent flow between the hot and the cold walls. Here the cold wall, $0.5h$ thick is smooth, and the hot wall has 2D and 3D rough elements of thickness $0.2h$ above a solid layer $0.3h$ thick. The simulation is performed in a bi-periodic domain $4h$ wide. The Rayleigh number varies from 10^6 to 10^8 . Two values of the thermal conductivity, one corresponding to copper and the other ten times higher were assumed. It has been found that the Nusselt number behaves as $Nu = \alpha Ra^\gamma$, with α increasing with the solid conductivity and depending of the roughness shape. 3D elements produce a heat transfer greater than 2D elements. An imprinting of the flow structures on the thermal field inside the walls is observed. The one-dimensional spectra at the center, one decade wide, agree with those of forced isotropic turbulence.

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