abstract
A large fraction of the total energy consumption in the world comes from heating and cooling of buildings. Improving the energy efficiency of buildings to reduce the needs of seasonal heating and cooling is one of the major challenges in sustainable development. In general, the energy efficiency depends on the geometry and material of the buildings. To explore a framework for accurately assessing this dependence, detailed 3-D thermo-fluid simulations are performed by systematically sweeping the parameter space spanned by four parameters: the size of building, thickness and material of wall, and fractional size of window. The simulations incorporate realistic boundary conditions of diurnally-varying temperatures from observation, and the effect of fluid flow with explicit thermal convection inside the building. The outcome of the numerical simulations is synthesized into a simple map of an index of energy efficiency in the parameter space which can be used by stakeholders to quick look-up the energy efficiency of a proposed design of a building before its construction. Although this study only considers a special prototype of buildings, the framework developed in this work can potentially be used for a wide range of buildings and applications.