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Nonlinear optimal control policies for buoyancy-driven flows in the built environment SALEH NABI, PIYUSH GROVER, Mitsubishi Electric Research Labs, COLM CAULFIELD, BPI/DAMTP U. of Cambridge — We consider optimal control of turbulent buoyancy-driven flows in the built environment, focusing on a model test case of displacement ventilation with a time-varying heat source. The flow is modeled using the unsteady Reynolds-averaged equations (URANS). To understand the stratification dynamics better, we derive a low-order partial-mixing ODE model extending the buoyancy-driven emptying filling box problem to the case of where both the heat source and the (controlled) inlet flow are time-varying. In the limit of a single step-change in the heat source strength, our model is consistent with that of Bower et. al (JFM 2008). Our model considers the dynamics of both 'filling' and 'intruding' added layers due to a time-varying source and inlet flow. A nonlinear direct-adjoint-looping optimal control formulation yields time-varying values of temperature and velocity of the inlet flow that lead to 'optimal time-averaged temperature relative to appropriate objective functionals in a region of interest.

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