Effects of wall proximity on the airflow in a vertical solar chimney for natural ventilation of dwellings

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Authors: Y Quoc Nguyen, John Craig Wells

Abstract
This study investigates performance of a vertical solar chimney, which absorbs solar energy and induces airflow for natural ventilation and cooling of dwellings, under effects of walls neighboring to its air channel. A computational fluid dynamics model was developed to predict induced flow rate and thermal efficiency of a vertical solar chimney with four types of nearby walls: a vertical wall to which the solar chimney was attached, a horizontal plate above the outlet of the air channel, a horizontal plate, and a horizontal wall below the inlet of the air channel. Examined factors included the heat flux in the air channel, the chimney height, the air gap, the distance of the walls, and the location of the heat source in the air channel. The results showed that effects of the wall proximity were modulated by the location of the heat source and the ratio G/ H between the air gap and the chimney height. Particularly, performance of the chimney was enhanced when the heat source was on the opposite side of the vertical wall and when G/ H was large.