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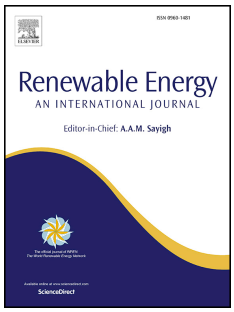

Role of multiple solar heaters along the walls for the thermal management during natural convection in square and triangular cavities

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Role of multiple solar heaters along the walls for the thermal management during natural convection in square and triangular cavities

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Abstract

The role of multiple discrete solar heaters have been studied for energy efficiency in the heating of fluids. Current work involves natural convection studies with the various locations of the double heat sources along each side wall of the triangular-design 1 (regular isosceles triangle), triangular-design 2 (inverted isosceles triangle) and square enclosures for various cases (case 1: larger heater in lower half and smaller heater in central half, case 2: larger heater in central half and smaller heater in lower half, case 3: two heaters of identical lengths are located at the central and lower halves) involving various fluids (Pr = 0.015 and 7.2) for various Rayleigh numbers, $10^3 \leq Ra \leq 10^5$. The thermal mixing and energy flow in the cavities are visualized using the mathematical tool of heatlines. Also, the overall rate of heat transfer in conduction and convection dominant regimes is evaluated using Nusselt numbers (average and local). The case 2 discrete heating configuration is inferred as the optimal heating configuration based on the larger zone of uniform temperature and thermal mixing. Also, the thermal management is significantly improved in triangular-design 2 and square cavities.

Key words: Multiple solar heaters; thermal mixing; natural convection; square enclosure; triangular enclosure; heatlines

1 Introduction

The increasing growth of population around the world has resulted in the enormous usage of the various non-renewable energy resources, such as oil, fossil fuel, coal, etc [1, 2].

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