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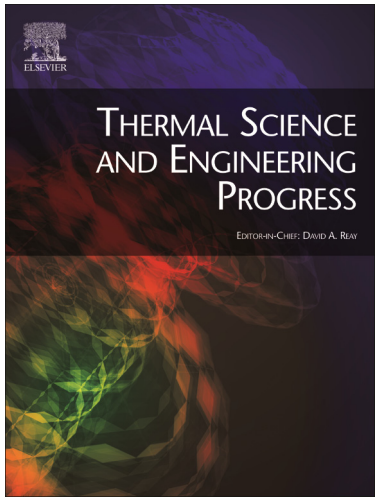

Numerical study on the enhancement of heat transfer performance in a rectangular duct with new winglet shapes

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Numerical study on the enhancement of heat transfer performance in a rectangular duct with new winglet shapes

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Abstract

A numerical investigation on the heat transfer characteristics for three-dimensional laminar flows in a rectangular duct with four different winglets is presented here. The four winglet shapes are the conventional delta winglet and three new winglets namely, arrow, delta-cut and X winglet. The aim is to examine the influence of the winglet shape on the heat transfer rate, pressure loss and thermal enhancement factor for the flow attack angles (α) of $30°, 45°$ and $60°$, and Reynolds numbers (Re) ranging from 300 to 1200. The results are compared with the flow and heat transfer characteristics of laminar flows in a rectangular duct without a winglet. Numerical results predict an augmentation in the heat transfer rate and thermal performance of the rectangular duct flows with a winglet. Increasing Reynolds number leads to a higher heat transfer rate, thermal enhancement factor and additionally, higher pressure loss. An increment in the flow attack angle is found to have a positive effect on the X winglet but a detrimental effect on delta and delta-cut winglets. Improvement in the heat transfer rate and thermal enhancement factor for the present study is found to be $1.38-2.18$ and $1.33-1.94$ times more than the duct flows without a winglet, respectively. The best performing shape is found to be the delta-cut winglet with a thermal enhancement factor of 1.94 at $\mathsf{Re} = 1200$ and $\alpha = 30°$, followed by the delta winglet with a thermal enhancement factor of 1.92 for the same

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