Heat transfer from a vertical fin array by laminar natural convection and radiation-A quasi-3D approach

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ABSTRACT
A quasi-3D numerical model is developed to study the problem of laminar natural convection and radiation heat transfer from a vertical fin array. An enclosure is formed by two adjacent vertical fins and vertical base in the fin array. Results obtained from this enclosure are used to predict heat transfer rate from a vertical fin array. All the governing equations related to fluid in the enclosure, together with the heat conduction equation in both fins are solved by using the Alternating Direction Implicit (ADI) method for getting the temperatures along the height of the fin and the temperature of the fluid in the enclosure. Separate analysis is carried out to calculate the heat transfer rates from the end fins in the fin array. A numerical study has been carried out for the effect of fin height, fin spacing, fin array base temperature, and fin emissivity on total heat transfer rates and effectiveness of the fin array. The numerical results obtained for an eight-fin array show good agreement with the available experimental data. Results show that the fin spacing is the most significant parameter and there exists an optimum value for the fin spacing for which the heat transfer rate from the fin array is maximum. Correlations are presented for predicting the total heat transfer rate, average Nusselt number, and effectiveness of the fin array.

KEYWORDS:
Heat transfer; Natural convection; Quasi-3D approach; Radiation; Vertical fin array

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