Fully Developed Laminar Forced Convection Through Partially Insulated Triangular Duct

A Thesis

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Abstract

The predictions of the convection heat transfer through a non-circular duct suffer from low availability of results specially in the case of the triangular cross section duct. In spite of the triangular duct can be used in many applications so, there are a need for providing results for the triangular duct but, to do this we should identify correct thermal boundary conditions in a given application that plays an important role in accurate estimation of heat transfer coefficients. The different thermal boundary conditions generally applied in fluid interfaces domain are: constant wall temperature (T), constant wall heat flux and circumferentially constant temperature (H1), and constant wall heat flux Axially and circumferentially (H2). the heat transfer under the H2 boundary condition in the triangular duct which is the most applicable thermal boundary condition in many small and micro channel heat exchangers. However, there are very few solutions available for this boundary condition, also until now there are no solutions for the different insulation configurations under "H2" boundary condition .

The current work aimed at addressing two outstanding issues in this field:
(i) Predicting heat transfer rate at different apex angles and aspect ratios of isosceles triangular channels under H2 and T boundary conditions, and (ii) predicting heat transfer rate at different insulations configurations for isosceles triangular channels under H2 and T boundary conditions.
A numerical model using CFD software, FLUENT is developed to predict accurate fluid flow and heat transfer effects in isosceles triangular duct under T and H2 boundary conditions. Based on the predicted numerical results for a wide range of aspect ratios and apex angles, generalized correlations for fully developed laminar Nusselt number as a function of channel aspect ratio are presented for all the cases of insulation configuration at T or H2 boundary condition and therefore, this provides better understanding for the effect of aspect ratio and insulation on the heat transfer through the triangular duct.