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On numerical investigation of semi-empirical relation representing development length for a fluid flow in a closed conduit (Article)

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Abstract

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The development of the velocity gradient at the opening of a closed conduit plays an essential role in monitoring the heat transfer behavior. Hence it is indispensable to examine the minimum critical length at which the velocity gradient is fully developed. Ultimately the flow is fully developed. The developing length determination is very useful for many industrial problems. This can be concluded from the literature survey. The role played by the wall shear in creating the profile is of strong consideration against the Reynold number of flowing fluid. Therefore, the development length for laminar and turbulent flow are defined separately. The determination of average Reynold number through the conduit is mandatory to be known in terms of developing length. In the latter part of the article, semi-empirical relations are defined for developing length separately for laminar and turbulent flow. In order to minimize the effort on experimentation, simulations are carried out in the present studies in ANSYS CFX 18. The developing length carries $1/6^{th}$ power to the Reynold number. For determination of developing length in terms of Reynold number, SST turbulence model was used.

Author keywords

Critical length | Velocity gradient | Wall shear

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