Proceedings of the 7th International Conference on Fluid Flow, Heat and Mass Transfer (FFHMT'20)
~~Niagara Falls, Canada~~ Virtual Conference – November, 2020
Paper No. 120
DOI: 10.11159/ffhmt20.120

Numerical Investigation of Turbulent Flow inside a Cubical Cavity with Heat Transfer from the Top

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Abstract - Numerical investigation of natural convection in cavities with heating from below, adiabatic sidewalls, and variable heat flux in combination with radiative and convective heat transfer on the top is the framework of this research. The goal is to develop a computational model for investigation of overall heat transfer coefficients through different types of thermal screens and their integration with greenhouse covers in order to improve greenhouse insulation. The model was developed by applying hot box methodology, and calculations are validated by published results for convective flow in the cubical cavity model. A greenhouse covering combined with moveable thermal screens can block a high amount of IR radiation. Moreover, thermal screens in combination with cooling/heating and dehumidification systems may provide desirable conditions in a closed greenhouse and reduce year-round energy consumption. By significantly reducing fossil energy consumption, this design contributes to sustainability as well. The numerical modeling supported by laboratory experiments is not only enhances understanding of the greenhouse insulation material processes but also of other material processing and technological applications, including high-temperature technologies, solar collectors, and residential and industrial construction.

***Keywords*:** Natural convection, Computational Fluid Dynamics (CFD), turbulent flow, heat transfer, greenhouse Microclimate.