All Sciences Proceedings
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AS-ABSTRACTS
https://as-proceeding.com/index.php/as-abstracts
ISSN: 2980-1834

All Sciences Abstracts,
Volume 1, pp 22, 2, 2023

Numerical Simulation of Unsteady Turbulent Flow and Heat Transfer of Dynamic Thermal Flow Sensor

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Abstract – Improving energy efficiency in the building's design is a priority area. To avoid unnecessary energy consumption, electronic control (intelligent) systems can be used to measure and monitor heat exchange between building walls and the surrounding environment, as (Calorimetric Sensor, Heat Flux Sensor ...). They are ideally suited for research in rationalizing and improving thermal efficiency.
The aim of this study was a computational fluid dynamics investigation of unsteady turbulent flow and heat transfer of dynamic heat flux sensor for quantitative description of the heat transfer between the building's walls and the surrounding environment.
Using CFD software, we numerically simulated the wind tunnel where the sensor was installed; we used six different air speeds (V_{inlet}=2m/s to 12m/s) in the inlet. To improve the standard features of the CFD code, the User-Defined Function (UDF) was written in the C language program and integrated into the solver of ANSYS Fluent, in order to determine the thermal flow file applied to the surface of the sensor. Heat transfer coefficient (h_0) values are obtained according to each speed. The results obtained were compared to results in previous experimental and theoretical literature. There is a good compatibility of all results that allows dependence on numerical simulations in the future as a way of stewardship when studying energy rationalization.

Keywords – Heat Transfer; Unsteady Turbulent Flow; Efficiency Thermal Assessment; CFD; Dynamic Sensor.

GRAPHICAL ABSTRACT