PhD Thesis Topic

Experimental analysis of natural convection flow in a vertical channel inside a cavity.

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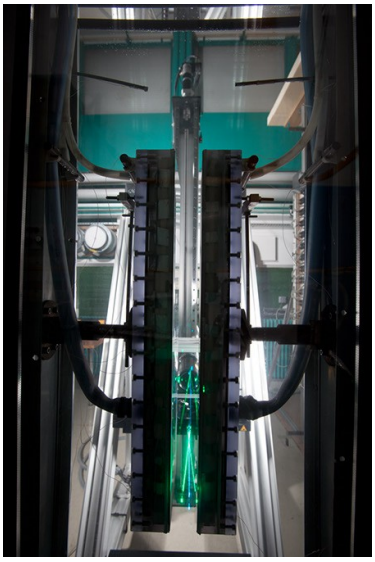
Context



Natural convection in vertical channel has been the subject of numerous researches for applications in the field of building energy. Indeed, a promising way to integrate of solar energy in buildings is to use double-skin facade. Such double-envelope are made by adding a wall exposed to direct sunlight separated from the primary building wall by an air gap. Such component may be used to recover heated air to drive a cross-ventilation of the building in summer or to act like a preheating system of the air in winter (solar wall). When the secondary wall is equipped with solar panel, one speaks about photovoltaic double-facade (PVDF). In that case, one obtains multi-energy component producing hot air and electricity. However, modeling such a system for building energy simulation software is a tricky problem and the classical correlation currently used cannot predict complex phenomenon such as transition to turbulence which is a key point to obtain an accurate temperature inside the air gap. From an academic point of view, these applications can be reduced to configuration of an open-ended vertical channel located in an infinite surrounding, with wall heating. For numerical and experimental studies, the channel is located in a finite domain or cavity whose impact on the flow in the channel is widely documented: plume-top wall interaction, fluctuation at the entry, thermal stratification ... Therefore, the transposition of results to applicative cases is not obvious and required investigations.

Work

The aim of this thesis is to understand the channel-cavity interaction, to characterize the external flow and to analyze intrinsic channel behaviors. We will focus in particular on the role of the external flow on the transfers in the channel. For this study, the laboratory has an experimental bench of natural convection in water between two walls with wall heating. This device is currently well characterized in terms of response time, temperature stability and accuracy of measured quantities. The experimental bench is already widely instrumented for measurements of temperature, heat flow and fluid velocity (Particles Images Velocimetry, Laser Doppler Velocimetry) allowing a complete mapping of the flows. The candidate will work on several aspects:

- Modification of the experimental setup for a better control of the external flow,
- Analysis of the flow in the channel for different external flows,
- Identification of the key parameters in the surrounding to predict average flow behavior

Scientific profile

The candidate has a solid background in fluid mechanics. Knowledge in thermal / energetics or physics would be appreciated. He/She has a strong taste for experimental work and abilities for teamwork.

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