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Published in:
Proceedings of Roomvent 2007

Publication date:
2007

Document Version
Publisher's PDF, also known as Version of record

On the use of hot-sphere anemometers in a highly transient flow in a double-skin facade

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1. Introduction

Hot-sphere anemometers are widely used for measurement of air velocity in the occupied zone. In this paper, the ability of hot-sphere anemometers to measure transient flow in a Double-Skin Façade (DSF) is investigated. When hot spheres are used in a DSF, the conditions are very different from the measurement of air velocity in the occupied zone. The velocity is higher and the flow is more transient, the anemometer is subjected to high loads of direct solar radiation and wide temperature ranges and, finally, the direction of the flow is important.

2. Methods

There are three test cases described in the paper. Each test case provides knowledge on one specific feature of the hot-sphere anemometer and all the test cases together give a background for an application of hot spheres for air flow/velocity measurements in the DSF cavity.

1. The response of hot-sphere anemometers to the flow dynamics is tested by placing the anemometer in the laminar air flow generated by a jet-wind tunnel. By means of a crank movement the sensor is oscillated back and forth in the air flow and overlaps the laminar flow with an almost pure sine wave. Readings from the hot-sphere anemometer are compared for different frequencies of oscillation.

2. Temperature compensation is the working principle of anemometers. The ability to compensate for different temperatures when exposed to solar radiation is investigated in a controlled environment using a powerful lamp as a radiant heat source. Readings from the hot-sphere anemometer subjected to the high radiant heat flux are compared with the readings when no flux added.

3. In the Double-Skin Façade both upward and downward flow will occur and therefore it is important to determine the direction of the flow, meanwhile the exact angle of flow direction is insignificant. A simple method to register the flow direction using two hot-sphere anemometers separated by a small plate is tested and explained.

3. Conclusions

According to the experimental results, hot-sphere anemometers respond well to the fluctuations up to 1Hz, but the amplitude of measured velocities becomes smaller at the frequency of 1.6 and 2Hz. Particularly, problems can be noticed when the low velocities are to be measured (0.05 m/s), which is explained by the time constant of the sensor having the largest influence on the readings at the minimal velocities.

The hot-sphere anemometers dos not change their performance when exposed to direct solar radiation. Even in the range of low velocities it was not possible to distinguish any influence from the radiative heat flux.

It is possible to use two hot-sphere anemometers separated by a plate to distinguish flow direction in the DSF cavity. The best results were obtained with a 7 by 7 cm plate and a spacing of 3 cm between the hot spheres and the plate.