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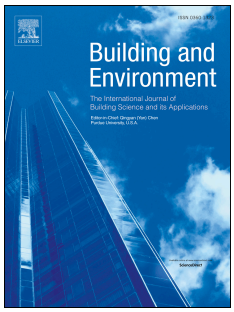

Airflow measurements using averaging Pitot tube under restricted conditions

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Airflow measurements using averaging Pitot tube under restricted conditions

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Abstract

This paper studies the effect of the air damper placed downstream of an averaging Pitot tube (APT) on the flow measurement in air distribution systems. Experiments are conducted to obtain the characteristic curve of the APT under different damper positions. The analysis of variance (ANOVA) is applied and the results reveals a statistically significant correlation between them. A mathematical model for the pressure coefficient with respect to the damper opening angle is proposed to compensate the systematic error caused by the damper. The model is validated under various Reynolds numbers (Re) varying from 6.38×10^3 to 19.1×10^3 with RMSE < 0.02. By applying the proposed model, the flow measurement errors are reduced below 0.6% for all tested cases, and the highest accuracy (0.02%) is achieved when Re = 9.57×10^3. The proposed model significantly improves the performance of current air flow control stations (AFCS) where the ATP is placed immediately upstream of the air damper. This research can be helpful for manufactures to provide AFCS with higher accuracy and larger operating range.

Key Words: air distribution system, air flow control station, flow measurement, averaging Pitot tube, mathematical model, correction.

Nomenclature

A	Pipe cross-sectional area (m^2)
D	Internal diameter of the pipe (m)
K	Flow coefficient of the averaging Pitot tube
ΔP	Measured differential pressure between the Pitot tube and static tube (Pa)

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