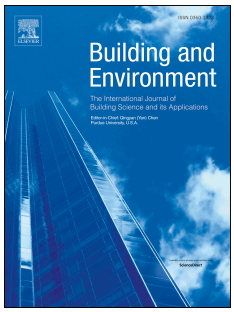
Accepted Manuscript



A study of hybrid ventilation in an institutional building for predictive control

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PII: S0360-1323(17)30515-2

DOI: 10.1016/j.buildenv.2017.11.008

Reference: BAE 5161

To appear in: *Building and Environment*

Received Date: 25 July 2017

Revised Date: 4 October 2017

Accepted Date: 5 November 2017

Please cite this article as: Yuan S, Vallianos C, Athienitis A, Rao J, A study of hybrid ventilation in an institutional building for predictive control, *Building and Environment* (2017), doi: 10.1016/j.buildenv.2017.11.008.

A study of hybrid ventilation in an institutional building for predictive control

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Abstract

Hybrid ventilation can be employed to precool thermally massive buildings, reducing energy consumption for cooling the following day, particularly at night when the outdoor temperature is lower, and especially when its operation is done in a predictive manner by incorporating weather forecasts. An important requirement is defining the temperature low limit for admitting exterior cool air into a building through transition spaces, to ensure thermal comfort. This paper uses a case study of a 17-story high institutional building with a hybrid ventilation system. To develop a strategy for the admission of outside air into the building, this study focuses on the corridors as generic transition zones/buffer spaces with flexible thermal comfort limits and with the motorized façade openings to determine how the air temperature evolves with distance from the inlets. A developed thermal model, calibrated from a full-scale test, calculates the amount of heat removed from the 0.4 m thick concrete floor. Through 4 hours of night cooling with an average local exterior temperature of 8.3 °C, the air temperature rises to about 12 °C in the transition corridor region at a time when occupancy in that area is expected to be nearly zero. Taking into consideration the flexibility in thermal comfort in the corridor transition spaces, control strategies are developed, based on exterior temperature and humidity. Using humidity ratio instead of relative humidity as criterion for admitting outdoor air potentially results in the system being active for 49% - 180% more hours during the year.