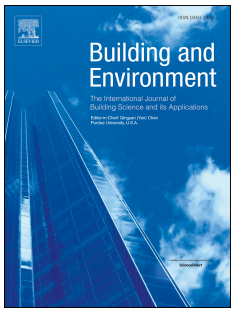
Accepted Manuscript



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PII: S0360-1323(17)30247-0

DOI: 10.1016/j.buildenv.2017.06.013

Reference: BAE 4941

To appear in: *Building and Environment*

Received Date: 22 April 2017

Revised Date: 4 June 2017

Accepted Date: 5 June 2017

Please cite this article as: Tian W, Sevilla TA, Zuo W, Sohn MD, Coupling fast fluid dynamics and multizone airflow models in Modelica *Buildings* library to simulate the dynamics of HVAC systems, *Building and Environment* (2017), doi: 10.1016/j.buildenv.2017.06.013.

Coupling Fast Fluid Dynamics and Multizone Airflow Models in Modelica *Buildings* Library to Simulate the Dynamics of HVAC Systems

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Abstract

Multizone models are widely used in building airflow and energy performance simulations due to their fast computing speed. However, multizone models assume that the air in a room is well mixed, consequently limiting their application. In specific rooms where this assumption fails, the use of computational fluid dynamics (CFD) models may be an alternative option. Previous research has mainly focused on coupling CFD models and multizone models to study airflow in large spaces. While significant, most of these analyses did not consider the coupled simulation of the building airflow with the building's Heating, Ventilation, and Air-Conditioning (HVAC) systems. This paper tries to fill the gap by integrating the models for HVAC systems with coupled multizone and CFD simulations for airflows, using the Modelica simulation platform. To improve the computational efficiency, we incorporated a simplified CFD model named fast fluid dynamics (FFD). We first introduce the data synchronization strategy and implementation in Modelica. Then, we verify the implementation using two case studies involving an isothermal and a non-isothermal flow by comparing model simulations to experiment data. Afterward, we study another three cases that are deemed more realistic. This is done by attaching a variable air volume (VAV) terminal box and a VAV system to previous flows to assess the capability of the models in studying the dynamic control of HVAC systems. Finally, we discuss further research needs on the coupled simulation using the models.

Key words: Fast Fluid Dynamics, Multizone Airflow Networks, Modelica, HVAC Modeling

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