MODEL-BASED COMMISSIONING METHOD FOR FIX-PLATE ENERGY RECOVERY UNIT IN BUILDING VENTILATION SYSTEMS

FL Wang[1,*], HYoshida[1] and K Goto[2]

1 Department of Urban and Environmental Engineering, Kyoto University,
Yoshida-Honmachi, Sakyo-ku, Kyoto 606-8501, Japan
2 Research & Development Center, YANMAR CO., LTD
1600 Umegahara, Sakata-gun, Maibara-cho, Shiga, Japan

ABSTRACT
This paper describes a newly developed model-based commissioning method for the fixed-plate type energy recovery unit used in building ventilation systems to exchange heat between outside air and exhaust air. The model is developed through fitting manufacturers' specification data to simulate the performance of a fault-free fixed-plate type energy recovery unit. The model uses air volume flow rate as inputs to simulate the sensible heat efficiency and total heat efficiency of a fault-free energy recovery. Through comparing the simulated fault-free performance with the real performance of a fixed-plate type energy recovery unit, the automated commissioning for the energy recovery unit can be realized. The validity of the commissioning method is checked through commissioning a cross-flow fixed-plate type energy recovery unit really in use. The verification results show that this method can successfully realize the automated commissioning.

INDEX TERMS
Model-based commissioning, Simulation, Ventilation, Energy recovery unit

INTRODUCTION
Outside air supplying is an essential way to ensure indoor air quality and prevent sick building syndrome, the important issue that 30% of buildings are prone to and 30% more are likely to develop (Vitel 2001). However the demand energy for heating ventilation air tends to be 60% of total annual energy demand for a building (Fehrm et al. 2002). Furthermore the Energy Crisis caused by the Middle East War in 1973 to 1974 makes energy efficiency an urgent and important issue (Scott 1994). Therefore in the field of buildings, tighter buildings are constructed to decrease uncontrolled air infiltration and the technique of heat recovery from ventilation air was applied. However, some analyses on the data from the buildings participating in the energy conservation program revealed that many of the installed energy efficiency measures were not performing as expected (BPA 1992). Therefore the idea that commissioning is a viable method to help ensure good performance of buildings and their Energy Conservation Measures (ECM) was gradually conceived since 1989. Building commissioning is the process of ensuring that systems are designed, installed, functionally tested, and capable of being operated and maintained to perform in conformity with the design intent (ASHRAE 1996).

However building commissioning is a time and cost-consuming work because there are too many types of equipment and components in an air-conditioning system should be verified. Furthermore, the verification check and functional performance test for one facility should be conducted under a wide range of load conditions. Therefore to reduce commissioning cost and time is an urgent problem to solve. Automating commissioning process is a viable way to reduce commissioning cost and time. Simulation is considered to be a powerful tool to automate commissioning progress because it can automatically give the performance of a building and its systems matching the design intent (Wang and Yoshida 2003). Balen et al. (2003) analyzed performance of coil energy recovery loop system. Simonson and Besant (1999) derived dimensionless groups to calculate the heat and mass transfer of energy wheel. Hirano et al. (2004) develop a network model to calculate the ventilation air volume efficiency of fix-plate energy recovery unit. However study on automated commissioning method for fix-plate energy recovery unit cannot be found. This paper focuses on developing an automated commissioning method for fix-plate energy recovery unit. The key components of an automated commissioning tool should include a set of models suitable for commissioning, a set of test sequences, and software to implement the test sequences and to analyze data to give commissioning recommendation (Annex40 2004). This paper developed a model suitable for commissioning through fitting manufacturer's specification data because manufacturer's data are fault-free and

* Corresponding author email: fuwang@archi.kyoto-u.ac.jp