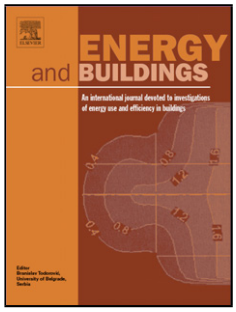

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Testing and Simulation of a Low-Temperature Air-Source Heat Pump Operating in a Thermal Buffer Zone

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Abstract:

Air-source heat pumps (ASHPs) are commonly used in temperate climates throughout Europe and Asia to provide energy efficient heating and cooling. However, ASHPs have not been widely adopted for heating in colder climates because the coefficient of performance (COP) is lower when outdoor temperatures are colder. While many researchers are working on improving the cold-temperature performance of ASHPs by altering the design of the equipment, this work examines an innovative way to improve performance by operating an existing 'off-the-shelf' ASHP within a thermal buffer zone. This paper shows that operating an ASHP in a thermal buffer zone (TBZ) created by an enclosed balcony space can improve the COP in cold temperatures. An ASHP operating in a TBZ was tested in a climate chamber where the performance was monitored under a variety of climatic conditions. The temperature drawdown of the TBZ and the associated impact on the COP were observed. The TBZ solar heat gain rates required to improve the COP were identified for a range of exterior temperatures. Then, a suite-based energy model was developed and calibrated to simulate the performance of the ASHP operating in the TBZ. The model provided a reasonable prediction of the ASHP performance below 10^{o}C.

Key words:

air source heat pump; MURB; energy efficiency; suite-based equipment; energy model