

# **Measurement for Exterior Wall Airtightness of High-Rise Buildings Using Stack Effect/Individual Air Conditioning and Outdoor Air Entering through Entrance Doors**

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## **ABSTRACT**

A simple test method of airtightness that uses buoyancy caused by the stack effect in a high-rise building to pressurize or depressurize the building was developed in 1980s in Japan instead of pressurization or depressurization by a blower. In other words, when doors and windows are opened near the ground floor or near the rooftop of the building, it is the same as pressurizing or depressurizing the building with a blower. The amount of airflow in and out of an open door or window at this time corresponds to the amount of air supplied and exhausted by the blower. Based on these results, the equations for the inflow and outflow volumes at the exterior wall can be formulated to estimate the airtightness of the exterior walls constructed by concrete, precast curtain walls, and metal curtain walls.

Through the activities of the Technical Committee of the Architectural Institute of Japan (AIJ), we calculated the amount of air leakage at the exterior walls of 3 model buildings (middle-rise, high-rise, and super high-rise buildings) and developed equations that can manually calculate air infiltration rates. These results were introduced to the Guideline for Calculating Cooling/Heating Loads of the Society of Heating, Air-conditioning and Sanitary Engineers of Japan (SHASE).

Since individual air-conditioning systems for each floor began to be widely used in high-rise buildings in 2000s, we also developed and implemented a method to measure the airtightness of the exterior walls on a reference floor using such systems. The method we used to measure airtightness of exterior walls of a high-rise building is introduced and measurement results are discussed in this presentation.

Furthermore, considering large impacts of the stack effect in high-rise buildings on heating loads in the winter, the results of measurements in a high-rise building for opening and closing time of entrance doors, outdoor air volumes entering through the entrance doors, and resulting heating loads are also reported and discussed.

## **KEYWORDS**

Measurement, airtightness, exterior wall, stack effect, individual air conditioning, entrance door, heating load.