**PAPER TITLE**
Measuring the Air Tightness of Mid and High Rise Non-Residential Buildings

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**ABSTRACT**

There is currently little information on the air tightness of recently constructed midrise buildings. To fill this gap in our knowledge, the ASHRAE 1478 RP Project involves blower door testing 16 non-residential buildings, constructed after the year 2000 in climate zones two through seven of the IECC Climate Zone map. The ASTM E779 protocol is used for testing with modifications to address the complexities of larger buildings, as the buildings in this study are four stories or greater with complex mechanical systems. An advanced protocol was developed during this process, that resulted in a test protocol for commercial buildings, further developed by the Air Barrier Association of America and adopted by the US Army Corps of Engineers. During testing, a single zone is created by opening interior doors and the careful placement of test fans. Pressure measurements in the interior, at each orientation of the building, on the roof, and at one other elevation are tracked in real time. To ensure uniform pressure, zonal pressure differences must be no greater than 10% of the shell pressure. In preparation for the test, all operable intake, relief, and exhaust dampers are closed. In addition, exhaust or relief outlets that have no dampers are sealed manually using plastic. This step allows the researchers, after measurement of the enclosure airtightness, to unmask the HVAC equipment at the end of testing to understand its contribution to air leakage. Besides pressurization and depressurization tests accomplished at every site, other tests conducted intermittently include changing the location and method of pressure measurement, air leakage of different aspects of a building, and test repetition to understand accuracy. All of the data is analysed and reported according to ASTM E779. An existing standard published by the US Army Corps of Engineers states that buildings should only allow 0.25 cubic feet per minute of air to flow at 0.3” w.g. (75 Pascals) (1.25 L/s/$m^2$ @ 75 Pa) of pressure for every square foot of enclosure area, which includes all six sides of the building. Of the 13 buildings with currently calculated results, the range in air leakage is between 0.057 to 0.59 CFM75 / $ft^2$. Not only is this range large, it displays no airtightness trend concerning the structures that were built to environmental standards, such as LEED certification. Another finding of this project is the lack of tightness of HVAC equipment, determined using the louver or damper unmasking test. Both of these results expose a great need for more careful design and implementation of air tight barriers. Primary fenestration seals, soffit conditions, and damper airtightness and control or lack of dampers are just a few examples of building leakage locations seen during this study that could be improved to increase the air tightness, and therefore energy efficiency, of our built environment.