-- Blower Door measures Air tightness …? CFM that link in. <--volumetric flow rate

NetAtmo ---> convert to CFM

Blower door---> convert to CFM

Look for data in EnergyCodeAce.com
Tools

Questions:

- Does a exhalation-based tracer gas measurement of infiltration match the standard blower-door test?
- Does this method offer advantages over traditional methods.
- Similarities, differences, costs, ease(?), practicality, usefulness, applications.

Related Literature:

- Tracer gas infiltration measurement

Impacts:

- Why would someone adopt this technique?
- Why is it worth pursuing?

Related Topic info pull:
WIKI:
-A **building envelope** is the physical separator between the conditioned and unconditioned environment of a building including the resistance to air, water, heat,[1] light, and noise[2] transfer The building envelope is all of the elements of the outer shell that maintain a dry, heated, or cooled indoor environment and facilitate its climate control.

Control of air flow is important to ensure indoor air quality, control energy consumption, avoid condensation (and thus help ensure durability), and to provide comfort. Control of air movement includes flow through the enclosure (the assembly of materials that perform this function is termed the air barrier system) or through components of the building envelope (interstitial) itself, as well as into and out of the interior space, (which can affect building insulation performance greatly). Hence, air control includes the control of windwashing[6] (cold air passing through insulation) and convective loops which are air movements within a wall or ceiling that may result in 10% to 20% of the heat loss alone.[7]

The physical components of the envelope include the foundation, roof, walls, doors, windows, ceiling, and their related barriers and insulation. The dimensions, performance and compatibility of materials, fabrication process and details, connections and interactions are the main factors that determine the effectiveness and durability of the building enclosure system.

Common measures of the effectiveness of a building envelope include physical protection from weather and climate (comfort), indoor air quality (hygiene and public health), durability and energy efficiency. In order to achieve these objectives, all building enclosure systems must include a solid structure, a drainage plane, an air barrier, a thermal barrier, and may include a vapor barrier. Moisture control (e.g. damp proofing) is essential in all climates, but cold climates and hot-humid climates are especially demanding

-The **infiltration rate** is the volumetric flow rate of outside air into a building, typically in cubic feet per minute (CFM) or liters per second (LPS). The **air exchange rate**, (*I*), is the number of interior volume air changes that occur per hour, and has units of 1/h. The air exchange rate is also known as **air changes per hour** (*ACHs*).

https://en.wikipedia.org/wiki/Air_changes_per_hour

-Building science is the collection of scientific knowledge and experience that focuses on the analysis and control of the physical phenomena affecting buildings and architecture. It traditionally includes areas such as building materials, building envelope, heating, ventilation and air conditioning systems, natural and electrical lighting, acoustic, indoor air quality, passive strategies, fire protection, and renewable energies in buildings.
^wiki

STACK EFFECT:

“Since buildings are not totally sealed (at the very minimum, there is always a ground level entrance), the stack effect will cause air infiltration. During the heating season, the warmer indoor air rises up through the building and escapes at the top either through open windows, ventilation openings, or unintentional holes in ceilings, like ceiling fans and recessed lights. The rising warm air reduces the pressure in the base of the building, drawing cold air in through either open doors, windows, or other openings and leakage. During the cooling season, the stack effect is reversed, but is typically weaker due to lower temperature differences.

In a modern high-rise building with a well-sealed envelope, the stack effect can create significant pressure differences that must be given design consideration and may need to be addressed with mechanical ventilation. Stairwells, shafts, elevators, and the like, tend to contribute to the stack effect, while interior partitions, floors, and fire separations can mitigate it. Especially in case of fire, the stack effect needs to be controlled to prevent the spread of smoke and fire, and to maintain tenable conditions for occupants and firefighters.[1]”

“Climate is the most important environmental factor and the first one that architects and engineers should consider when designing a building.”

“The climate can dictate what passive design strategies are most suitable and effective for the building site.”
“ Fenestrations are any opening in the structure: windows, skylights, clerestories, etc.”
“The flow of heat through a building envelope varies both by season (heat always flows from hot to cold and generally flows **from** a building in winter and **to** a building in summer) and by the path of the heat (through the materials of a building’s skin, or by outdoor air entering). These complexities must be considered by a designer who intends to deliver comfort and energy efficiency. “
https://sustainabilityworkshop.autodesk.com/buildings/climate-analysis

California climate: Zone2: a look at degree days, average temp, and climate classification in our area:
http://www.pge.com/includes/docs/pdfs/about/edusafety/training/pec/toolbox/arch/climate/california_climate_zones_01-16.pdf

Literature:

“The specific test requirements are based on the flow rate of air produced by a blower door at a specified pressure (50 pascals or 0.2 inches of water) when exterior doors are closed, dampers are closed but not otherwise sealed, exterior openings for continuous ventilation systems and heat recovery ventilators are closed but not sealed, HVAC systems are turned off, and duct supply and return registers are not covered or sealed. The infiltration rate is the volumetric flow rate of outside air into a building, typically in cubic feet per minute (CFM) or liters per second (LPS). The air exchange rate, (I), is the number of interior volume air changes that occur per hour, and has units of 1/h. The air exchange rate is also known as air changes per hour (ACH). ACH can be calculated by multiplying the building’s CFM by 60, then dividing by the building volume in cubic feet. (CFM x 60)/volume. The requirement is expressed in ACH, which takes account of the overall size (volume) of the home: Total air leakage < 3-5 ACH (air changes per hour) What is a blower door? It is a powerful fan that attaches and seals to a door (typically the entrance door to the home) and blows air into or out of the house to pressurize or depressurize the home. The inside-outside pressure difference will cause air to force its way through any cracks in the building thermal envelope. Measuring the flow rate at the specified test pressure indicates the leakiness of the envelope.”
https://www.energycodes.gov/sites/default/files/documents/BECP_Buidling%20Energy%20Code%20Resource%20Guide%20Air%20Leakage%20Guide_Sept2011_v00_lores.pdf

Design Infiltration Rate Calculation

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.510.8703&rep=rep1&type=pdf

"Air leakage or infiltration in buildings may cause an increase in heating and cooling demands, noise, condensation and mold growth problems on the exterior wall surface. The building air tightness has become an important factor affecting indoor air quality and energy consumption in a building"
http://0-www.sciencedirect.com.iii.sonoma.edu/science/article/pii/S0378778813002028

NetAtmo
https://www.netatmo.com/helpcenter/weather/1/measurements-and-calibration/1/how-does-the-air-quality-measurement-work/4

Normal CO2 values:

- Outdoors CO2 is always in the order of 400 ppm.
- In a regularly ventilated room, the level of CO2 remains below 1000 ppm.
- In the case of a closed room (a closed meeting room, a small bedroom at night) CO2 can easily exceed 1000 ppm.