Air Barriers

TDS 240

Air Barriers are becoming more and more necessary in the building industry, whether commercial or residential. The pursuit of energy efficiency and creating more suitable living environments is driving the industry to recognize the need, and the want, for well-engineered and continuous air barrier systems. Many U.S states have adopted air barrier requirements in their commercial energy conservation codes, and one can expect this list to keep growing.

With modern buildings using more technologically advanced materials, it is becoming essential to engineer a better building envelope to ensure a long building life expectancy, a healthy building for its occupants, and an energy efficient building. A well designed and continuous air barrier can facilitate these goals.

Air Barrier: The definition of an air barrier as defined by the Air Barrier Association of America (ABAA) is as follows: "***Air Barriers** control the unintended movement of air into and out of a building enclosure.*"

Air barrier systems are not simply a house wrap; the air barrier system contains a combination of air barrier materials that tie into each other and make up the entire building envelope, including all 6 sides of the building. They are continuous systems, with every side, change of planes and penetrations all tied within one single continuous air barrier. An air barrier material cannot exceed 0.004 cfm /ft² under a pressure differential of 0.3" (7.6mm) of water in accordance with ASTM E2178 "Standard Test Method for Air Permeance of Building Materials". The air leakage of the entire building envelope cannot exceed 0.40 cfm/ft² as tested per ASTM E2357 "Standard Test Method for Determining Air Leakage of Air Barrier Assemblies."

There are 3 main components to each building; the building envelope, the people that occupy the building, and the mechanicals. Each of these can contribute positively and negatively to the life of the building.

Air flow plays a big role in the life expectancy of a building. For example, air flow can transport vapor, pollutants, odors and more. Air flow has 4 main drivers: stack effect, wind, building occupants and mechanicals.

<u>Stack Effect:</u>

Hot air always flows from warm to cold, and it also rises due to being less dense than cold air. This can create what's called stack effect. Stack effect can create air extrusion at the top of a building, air intrusion at the bottom, and a dead air zone in the middle. When air is allowed to extrude on top of the building, condensation can be created at the point when warm air meets a cold surface Dew point), which can lead to multiple problems such as rot, freeze/thaw damage, etc... In addition, the loss of heated air means more money being spent to heat the space, as cold air enters from the bottom of the building.

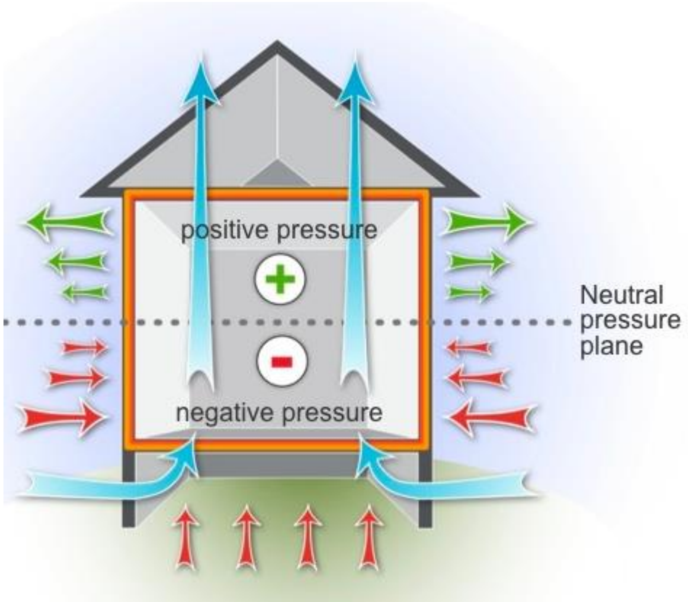

Image source: http://www.nachi.org/energy-movement.htm

Wind:

Wind can also create air leakage in a building. The windward side (side that the wind hits) of the building is subjected to high pressure while the downwind side of the building is subjected to low pressure, creating an air current throughout the building.

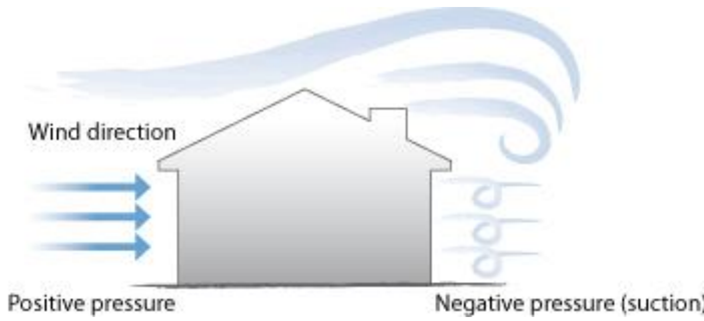

Image source: http://www.southlandexteriors.net/everything-you-need-to-know-about-existing-and-product-design-wind-pressures-sw-florida/

Occupants:

The occupants of the building can also cause air changes by opening a window or doors. It is common to see residential building tenants on top floors with open windows in the winter. Stack effect causes the heat rise, creating a warmer environment on the upper floors, leading the tenants to open the windows to cool down the space. In effect they are facilitating the stack effect, cooling down the lower levels and causing these tenants to crank up the heat.

Mechanicals:

Mechanicals also can play a negative roll inside a building if not designed correctly, or if misused. Mechanicals can force air in, or force air out of a building, by causing a change of pressure. For example: If a fan is blowing air out of a building from the ceiling, this causes the neutral pressure plane to rise, this change of pressure will effectively pull air into the building due to its equalization properties. If a fan was blowing air into a building from the ceiling, the neutral pressure plane is lowered, forcing air into the building.

All of these factors can be controlled with a well designed air barrier system. Stopping unnecessary air exchange will help reduce stack effect, minimize wind driven air currents, ameliorate living conditions for the occupants, and eliminate potential issues with vapor driven moisture. This will also greatly reduce the energy usage necessary to heat up and cool down the building, leading to smaller and more efficient mechanicals.

Designing an Air Barrier

The most important goal is to design a continuous air barrier system. Failure to do so will render the entire air barrier system useless. The design will start with the architects and engineers, detailing the air barrier system on 2 dimensional details as part of the blueprints. Testing for continuity on paper is simple enough and referred to as the pen test. One shall be able to place a pen on the line representing the air barrier and be able to follow it around the building without having to lift the pen from the page. This is a very simplified yet very effective test of the design, it should be followed on all 6 sides of the building, especially at transition points between planes such as the roof transition. Most air barrier failures are shown to be at these locations.

Once an air barrier system is designed and moving to the build phase, it is important to recognize a qualified installer. Training programs are available and being offered by different manufacturers and associations, such as the ABAA. Many project specs require materials and installers to be ABAA Certified.

Test methods to determine failure points

Multiple methods exist to test and determine failure points. The blower door test is one of the standard ways of testing a building's air tightness. The test consists of mounting a powerful fan to a building's exterior door, blowing the air outward lowering the indoor air pressure and causing air intrusion. The air pressure difference is then monitored, and air leaks are found using smoke pens (ASTM E1827 "Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door", ASTM E779 "Standard Test Method for Determining Air Leakage Rate by Fan Pressurization").

Infrared cameras are also a popular test to determine the location of air leaks. By simply doing a visual test using the thermal camera, one can determine air leakage through temperature and heat signals in the building envelope.

Air Barrier Materials

Multiple manufacturers make many different air barrier systems using different materials. Many are proven and tested by the ABAA, each having their pros and cons. It is important to do some research for each application in order to determine which system would best suit your needs. All the following systems have been tested for ASTM E96 (desiccant method) "Test Method of Water Vapor Transmission" and E2178 "Standard Test Method for Air Permeance of Building Materials". Each system requires qualified installers to ensure a continuous and successful installation.

The peel and stick membranes are typically 40 mil (1mm) thick and have a self-adhesive backing that are installed in a shingle fashion. The adhesion is also reliant on the application of a primer to the substrate prior to installing the sheets. Of course, transition tape and sealants are to be used on all transition points, penetrations and seams.

The liquid applied membranes also require the use of sealants and transition tapes, but the main application can be done with an airless spray gun or a roller. While most require a 2 coat application, some membranes can be applied in one pass. In one pass applications the mil thickness is more difficult to achieve and could potentially be a point of failure if not met in all areas. MVIS™ Air & Water Barrier system requires 2 coats, each at 15-22 mil (0.4 – 0.6mm) wet and includes transition tapes, flexible transition and sealant as required.

The Spray Polyurethane Foam (SPF) systems are sprayed onto the substrate much like the liquid applied membranes, the liquid then expands 30 to 35 times to provide a complete envelope on the substrate while providing a layer of insulation.

Mechanically applied air barriers are commonly seen on commercial and residential construction. These are long sheets of material, fastened straight to the studs. This type of air barrier is just as effective as any if installed properly. In this case the membrane is penetrated by a fastener designed for the application. The installation is critical to the performance of the air barrier.

Board stocks are wall panels typically used in block construction. The panels are glued to the block in a staggered joint pattern between brick ties for support. The seams are treated with a spray foam to render the installation airtight. The panels can be cut to size and perforated for wall penetrations. Each penetration is treated with the spray foam.

Conclusion

Many states have already adopted energy conservation codes, with more to follow. Air barriers will become more and more prominent as more states adopt the energy conservation codes. The cost savings of having an air barrier can be substantial with an effective AC system, the Passivhaus standard (a rigorous energy conversation standard) has proven to save as much as 40% of energy costs per year. Along with energy savings comes less repair work and a longer life for the building, all effectively reducing the ecological footprint of the building and its occupants.

There are many different types of air barriers. While these systems can provide a long lasting and effective air barrier all will fail without good design and proper installation. The costs of doing it right the first time far outweigh the costs of diagnosing and repairing a poorly designed or a poorly installed air barrier.

For a complete list of LATICRETE Air Barrier components please see: https://laticrete.com/en/masonry-veneer-installation-system/air-and-water-barrier

For all ABAA compliant Air barrier systems, please see: http://www.airbarrier.org

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