Building Design and Construction

Air Barriers The Latest Tool in Moisture Control

By Dave Barista, Managing Editor -- 1/1/2007

When it comes to controlling moisture at the building envelope, the construction industry has traditionally focused on blocking water and vapor from entering and getting trapped in the external wall assembly.

But recent theories suggest that there's a third culprit in the moisture intrusion mystery—air.

If allowed to pass freely through a building's envelope, moisture-laden air can cause condensation on internal wall system components, which can lead to moisture problems like mold and rot on exterior components, and can cause freeze-thaw damage, paint failure, staining, and oxidation. This theory applies to the intrusion of outside air and air from within the building.

"The flow of air can carry a lot of moisture with it," says David Altenhofen, director of technology in the Philadelphia office of Hillier Architecture, Princeton, N.J. He says the idea that air leakage can contribute to moisture intrusion is fairly new and is often misunderstood by AEC professionals when designing and constructing building envelopes.

"It's well understood that within any exterior wall assembly there's a need to control the transfer of heat through insulation; transfer of moisture through water-resistant barriers like building felts, housewrap, or dampproofing; and transfer of vapors with vapor barriers," says Altenhofen. "But the idea of the ability of air to carry moisture is fairly new."

To combat the effects of moisture damage as a result of air leakage, designers like Altenhofen are specifying the installation of air barriers in conjunction with vapor barriers and water-resistant barriers. Some AEC professionals confuse air barriers with vapor and water-resistant barriers because one material may function as one, two, or all three of these barriers (see sidebar). Regardless, Altenhofen says the very specific functions of all three systems must be included in the enclosure assembly.

Air barriers create a near-airtight seal around all six sides of the building (floor, walls, and roof) to prevent or restrict the passage of air through the building enclosure system. This seamless air seal is achieved by joining any number of building enclosure components (windows, doors, walls, roof systems, etc.) that are rated for a minimum level of air permeance—a measure of the amount of air that will work its way through a material. Air barrier components range from common building materials such as gypsum wallboard and cast-in-place concrete assemblies to specially designed liquid-applied or self-adhered air barrier membranes. A common air barrier wall assembly for the commercial sector, for example, may involve a brick wall or metal-panel veneer backed up with an air cavity, insulation, and a spray-applied or peel-and-stick air barrier installed on the CMU or sheathing and metal stud backup. In this case, the air barrier is also the vapor and water-resistant barrier.

BASF Corp., Carlisle Coatings and Waterproofing, Grace Construction

Products, and Henry Co. are among the companies that manufacture specialty air barrier products. Most offer three-in-one products that perform the function of the air barrier, water-resistant barrier, and vapor barrier. Altenhofen cautions designers to take into account the regional climate, interior conditions, and location of insulation when incorporating these vapor-tight air barriers into a wall assembly (vapor-permeable air barriers are also available).

"Vapor barriers must be installed on the warm side of the insulation, so in Miami, Phoenix, and Los Angeles, that's the exterior face, while in Chicago and Boston, it's the inside face," says Altenhofen. The decision isn't as cut and dried in mixed climates, such as Washington, D.C., and the Carolinas, because the heating and cooling seasons are almost equal. An exception is when the insulation is located within an air cavity where all materials are selected for their ability to withstand wetting.

Another key challenge, says Altenhofen, is ensuring a continuous air barrier on all six sides of the structure. "If you take a cross-section drawing of a building and put a pencil down on the line that represents the air barrier, you should be able to trace around the perimeter of the building without lifting the pencil," he says. "The membrane itself may not be continuous (for example, at the windows and doors), but the barrier should be continuous."

Getting the walls, roof, and floors airtight is not too difficult. Most mishaps occur at the joints between the roof and the walls and between the windows and the walls. Altenhofen says most architects and contractors are so focused on making the outer veneer watertight, that gaps in the air barrier often go undetected.

"It's a big problem for architects to understand the detailing and for contractors to understand the construction, especially if the air barrier also acts as the water-resistant barrier," says Altenhofen. "It's more important that the air barrier be continuous and not leaking than trying to keep moisture from penetrating the veneer." This requires increased attention to the construction details like flashing around the windows and doors and the sealant between curtain wall systems and walls.

When Building Teams get the air barrier right, the building owner will find that the benefits go beyond mitigation of moisture intrusion. Air barriers can also improve thermal comfort, HVAC performance, indoor air quality, and energy efficiency. A June 2005 report by the National Institute of Standards and Technology shows that owners can achieve a 30-40% reduction in heating and cooling costs by making their building envelope airtight.[1]

References

[1]*"Investigation of the Impact of Commercial Building Envelope Airtightness on HVAC Energy Use," Steven J. Emmerich, Timothy P. McDowell, Wagdy Anis, June 2005.*
www.fire.nist.gov/bfrlpubs/build05/PDF/b05007.pdf