Air Tight Drywall, Simple Caulk and Seal for Air Movement Control

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Reducing air leakage in a building's envelope is an important component in energy efficiency and structural durability. Poorly sealed buildings allow costly conditioned air to easily leave through gaps in the thermal envelope that traditional construction techniques often create. Such gaps can be almost anywhere in the structure, however, they are most often found in ceilings, walls, around windows, doors, and other penetrations of the building's exterior.

Well-sealed building cavities do not allow random air movement within themselves and result in the insulation inside the cavities yielding their peak performance. For example, as little as a 7 mile per hour (11.3 kilometers per hour) draft inside the insulation system can degrade the R-value of fiberglass insulation as much as 40%. Such small drafts are very common to find in buildings that have not been sealed correctly. Many people have experienced such drafts when air blows out of electrical outlets located on exterior walls, during windy weather.

Besides the loss of conditioned air, water vapor can be carried into wall and ceiling cavities by air movement. This often causes damage to building insulation and structural materials when it cools and condenses on the cold surfaces of these materials. This is the main reason why airtight wall and ceiling cavities are important, and competently and safely sealing the building envelope by carefully detailing both a vapor diffusion retarder and an air barrier is critical.

Sealing the building envelope requires both a vapor diffusion and an air retarder (or barrier). A vapor diffusion retarder must restrict vapor diffusion, which is the movement of water vapor through a material. The amount of water vapor moved by diffusion in a wall cavity is very small (less than 2%) relative to the amount that can travel with air movement in a typical building. An air retarder inhibits the movement of air in and through cracks and seams in the wall. To do this effectively, it must meet certain criteria. The material must be continuous and virtually impermeable to air. It also must be able to withstand the air pressure loads that act on it.

One of the most widely used methods of sealing the building envelope is to install and seal polyethylene sheeting. The sheeting acts as an air retarder and a vapor diffusion retarder. Although polyethylene sheeting meets the requirements of both air retarders and vapor diffusion retarders, it has some serious drawbacks. The installation process necessary to maintain a proper seal is complicated. During and after installation it may be subject to cuts and tears that make it ineffective as an air retarder. Also, since air retarders and vapor diffusion retarders serve different functions and have distinct characteristics, it may be more practical to install them as separate systems.

While polyethylene is an effective vapor diffusion retarder, other building materials that are already being installed can be made to work as an effective air retarder. The logical series of sealing and detailing steps pioneered by the Canadians in the *Airtight Drywall Approach* (ADA) and *Simple Caulk and Seal* (SCS) is usually less expensive, simpler, and more effective than more commonly used polyethylene sheeting techniques. The ADA uses the drywall already being installed, plus gaskets and caulking, to create a continuous air retarder. SimpleCS, a variation on ADA, differs in its use of some air-sealing techniques and when they are applied in the building process. The guiding principle for both systems is to make an effective air retarder by sealing the drywall to the building structure.

Both ADA and SCS use the drywall and exterior sheathing, plus carefully placed gaskets or caulk to create a continuous air barrier. Durable and high quality and flexible sealants and gaskets are necessary, since they need to last as long as the building. The sealants must be compatible with the materials they are sticking to. (Some types of silicone caulk can slowly dissolve plastics.)

The basic idea is to make an effectively airtight wall by sealing the exterior sheathing and the interior wall finish to the framing. The exterior sheathing can be sealed with a variety of methods. Caulking the seams of the plywood (or the foam board insulation) is one way. More common though, is the use of a house wrap or a special tape made specifically for house sheathing.

Depending on the climate, additional water vapor control may also be specified. These often include polyethylene plastic sheeting, faced fiberglass insulation, foil-backed wallboard, or an interior "vapor barrier" paint.

The main difference between ADA and SCS is that in SCS, seams and gaps are sealed *after* the exterior sheathing and drywall have been installed and finished. In ADA, sealing is carried out during the entire construction process.

The typical procedure for ADA is to seal any seams and joints where the foundation, sill plate, floor joist header, and sub-floor meet. The space between floors, the sub-floor, rim joist, and plates is also sealed. The wall framing plates are sealed to the lower sub-floor and the upper rim joist. Gaskets are often used at the top and bottom wall plates (between the drywall and framing) and between ceiling drywall and attic joists. Airtight electrical boxes (or the sealing of standard electrical boxes with caulk) complete the air barrier. Holes where pipes and cables pass through also need to be sealed before the wall and ceiling finishes are applied. After all this has been done, and the perimeter drywall seams have been finished, the room is effectively sealed from expensive and uncomfortable drafts.

In some ways SCS is superior to ADA because it's less disruptive to the tradespersons and allows the construction process to proceed faster. Sealing after the drywall is finished also allows the persons doing the sealing to work in a drier environment. This can help to assure that the sealing job performs well, since most caulks don't stick to wet surfaces. The down-side is that SCS is it's less comprehensive than ADA and so may "miss" some critical points inside building cavities that become inaccessible after the wall board is installed.

Tests done on both ADA and SCS detailed homes indicate that both resulted in similar energy savings. After a year of monitoring, one study found that the ADA house had 0.67 to 1.80 air changes per hour (ACH) at 50 Pascals pressure. An identical conventional home without ADA had a 2.23 to 2.59 ACH at 50 Pascals. [Fifty Pascals of pressure imitates a 20 mile per hour (32 kilometer per hour) wind striking the building from all sides at the same time.]

Such high performance buildings often consume a third less energy when compared to similar, but conventional buildings. Also, test measurements of airborne contaminants in an ADA or SCS detailed building (including those with mechanical ventilation) found that the reduction of air infiltration did not diminish the indoor air quality significantly. However, to assure your health and safety it is strongly recommended that items such as Heat Recovery Ventilators (HRV) or Enthalpy Recovery Ventilators (ERV) be installed in very tight homes.

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