Abstract

The importance of insulation used at the perimeter of installed commercial windows and doors is discussed in this paper. Research testing results conducted by Graham Architectural Products is also presented.

Insulating Installed Windows & Doors

Windows and doors are tested for thermal performance using a combination of computer simulations and physical testing. In either method, the surrounding conditions and accessories are not included in these measurements. The method of installing a window or door in the opening, and the use of accessories can affect the thermal performance of the opening.

When the thermal performance of the window is reduced, the interior surface temperature of the window is also reduced, which can increase the possibility of condensation to form on the interior surfaces of the window (for more information on how condensation occurs, see Graham Architectural Products (Graham) white paper on Condensation Prevention). Therefore, the following information is being provided to ensure the window opening is providing the best thermal performance.

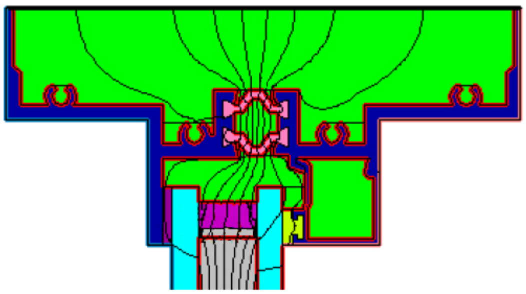
Note: Any insulation used should be water repellant (hydrophobic) so it doesn't absorb water, which can cause mold to form in these cavities. Insulation should not be used in areas where water is expected to flow, such as sill starters with weeps.

1. **In cavity walls, seal between the interior and exterior walls:** Brick is porous, so there are frequently brick weeps in a cavity wall to allow the water to drain from behind the brick. Therefore, water and cold air flow in this cavity. Sealing the cavity around the openings will prevent cold air from bypassing the thermal break of the window. If the cold air bypasses the thermal break, the temperature of the interior side of the window frame will be reduced, which will cause the thermal performance of the opening to be significantly less than the performance ability of the window. In addition, water that bypasses the perimeter seal will cause insulation around the window to become wet, which will reduce the performance of the insulation.

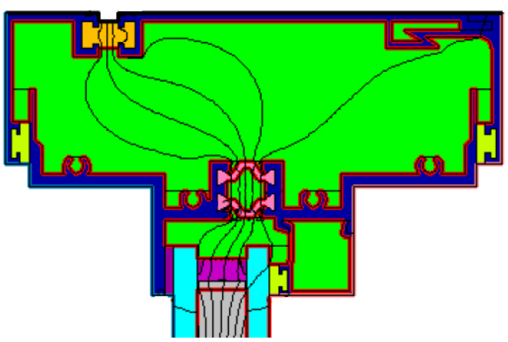
2. **Isolate the frame from the rough opening and insulate between the frame and the rough opening:** If the wall is masonry construction, the masonry becomes a thermal mass. Thermal mass is a term that describes a materials ability to absorb and store heat energy. A lot of heat energy is required to change the temperature of high density materials like concrete, brick and tiles. In this case it means the wall mass can stay colder long after the exterior temperature has risen and longer than surrounding wall materials. Therefore, the cold temperatures can bypass the thermal break of the frame. Isolating the frame from the masonry will prevent this temperature transfer. Insulating between the frame and the rough opening will also help reduce this temperature transfer. If the cavity between the window frame and the rough opening is larger than 1" x 1", the cold air in the cavity will start to fall and the warm air will rise. This will create what is called a convection current, which will transfer temperature between the exterior surfaces and the interior surfaces very efficiently. Insulation in this cavity will prevent these currents from forming.

3. **Insulate between receptors and the head and jambs of the window:** As explained above, if the cavity between the window frame and the receptor is large enough to allow convection currents to form, the thermal performance of the opening will be significantly reduced. Insulating this area will prevent the convection currents from forming.

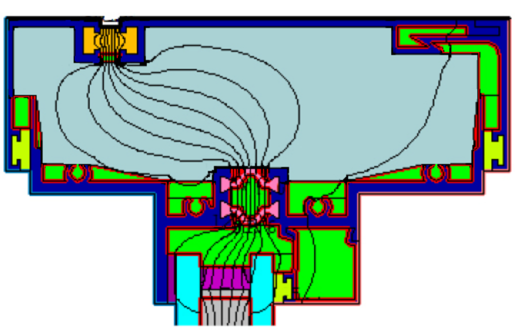
Graham has performed computer simulation and physical tests to verify this issue. Although individual results will vary depending on the window and receptor system used, the results of these tests are listed below:

Thermal Simulation	Thermal Results
	**Base window for testing:** Single fixed window with ¼” 366 low-e / ½” AS / ¼” clear glass with insulation in the frame.

These images illustrate is that a typical non-insulated receptor system increases the overall U-value of the rough opening by 0.07 BTU/ft2/hr, lowers the CRF by 20 points and decreases the coldest interior surface temperature by 23.5 degrees when compared to just the base window. This is a decrease in thermal performance when compared to the window by itself.

	**Base window in receptor without insulation:** Simulated U-value: +0.07 Btu/hr•ft2•F Physical Test U-value: +0.13 Btu/hr•ft2•F Condensation Resistance Factor: -20 Coldest point during testing: -23.5°F

Adding insulation to the perimeter of the receptor system improves this scenario significantly. The U-value reduced by 0.06 BTU/ft^2/hr, the CRF improved by 11 points and the lowest interior frame temperature was 14 degrees warmer when compared to the non-insulated window in receptor. This is an improvement in thermal performance when compared to the window in receptor without insulation. The thermal performance is similar to the window by itself.

	**Base window in receptor with fiberglass insulation:** Simulated U-value: +0.01 Btu/hr•ft2•F Physical Test U-value: +0.07 Btu/hr•ft2•F Condensation Resistance Factor: -9 Coldest point during testing: -9.5°F