**Ask Jon Eakes**

# Applying Rain Screen Principles - Pressure Equalization - to the Window/Wall interface in low rise residential construction

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THE CHALLANGE FOR INSTALLERS AND MANUFACTURERS
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There are many variations on how to install a window into a wall, largely differing between new construction and renovation, but there is one almost universal principle presently in practice: Stop both the water and the wind at the outer face of this crack between the wall and the window – the window/wall interface.

Many window manufacturers slide over the questions of installation, leaving that responsibility to the installer while staying as far away as possible from responsibility for work that they cannot control. Often on site, one person builds the wall, another applies moisture protection to the wall framing, a third attaches the window, a fourth applies insulation and perhaps a fifth attempts to seal the whole operation. Sloped sill supports are rare and shims are often simply left out because of the convenience of the mounting flanges. Even in cases where far more care and coordination takes place, windows tend to eventually leak. The best of current efforts are centered on simply doing a better job of sealing out water.

I tend to work mostly in renovation, and the golden rule of a window change-out is to pull out the whole frame, repair water damage in the structure, and then install the new window, much like the old one was installed. But why do we accept rotten wood under or around windows as normal? Maybe it is more than just poor workmanship.

With today's building science knowledge and modern materials one would think that we could find a way to install windows that are easy to get perfect in the field providing permanent protection against water getting to any wood. Understanding the Rain Screen principle, commonly used for both commercial and residential walls, and applying it to this narrow but so vulnerable space between walls and windows might just be the key allowing us to have leak proof windows with no exterior caulking to age or be subject to poor maintenance.

That is the challenge I launched at FenCon18 in March of 2018. Basing my drive for a way to apply this moisture control technology on two research projects published in 2011 and 2013 by the IRC (Institute for Research in Construction of the National Research Council of Canada) - those two construction summaries backed up by over 6 years of lab research. I began to look at why there is so little change in window installation despite significant failures, especially in colder climates.

The primary conclusion of these two research projects is that you should not attempt to stop both the water and the wind on the same plane.

That has interesting ramifications. When we caulk on the outdoor side of this whole assembly, we break this rule right from the start – we flow water over caulking that was imperfectly applied (ever seen that?) or that is inadequately maintained and then subject the water flowing over an open crack to the full force of the wind. You loose – the water is forced inward.

So why not simply accept the outer most assembly of things does no more than most siding, it sheds the major portion of rain but is not even an attempt to waterproof the installation. Maybe we don't need any exterior caulking at all - removing the illustion that our caulking efforts are protecting the wall.

Now inside we can make a far more effective moisture barrier shedding water that gets through the siding and the window trim – again without attempting to make it totally waterproof. We are not building with wishful thinking about perfect workmanship and perfect never aging or moving materials. So although the wind is buffered by the siding, the wind pressure always gets behind the siding – most are actually made to permit that to happen – it is called a Rain Screen wall. So we get a reduced amount of water flowing over the window/wall interface with a slightly reduced wind pressure.

DRAINAGE PATHS

Now we can apply the rain screen principle to the window/wall interface by leaving a small empty drainage path totally free and open behind the moisture barrier. This could be behind the mounting flange, or in the absence of the mounting flange behind strapping that butts up to the window casing itself, or even further back behind insulating sheathing that is not sealed. Behind this is a backer rod that controls where the shim space insulation stops, leaving the drainage path free and open. At the bottom of the drainage paths that direct water down the sides of the window is an open and slopped waterproofed sill, directing any water to the outdoors.

AIR SEALING ON THE INSIDE

But you are not done until you fulfill the other important element of a Rain Screen – totally air seal the window/wall interface air tight ON THE INSIDE of the window assembly. This creates a dead air space that will quickly pressurize with any wind flowing up from below (following the drainage path upward but without carrying any water) pushing back on the driving force of the wind across the moisture barrier where the water has been stopped. So small imperfections in the moisture barrier let very little water through, and what does get past the barrier is not blown in further by the force of the wind, but simply flows down to the sill region. There is no driving force on this water, it just drips out.

MAINTENANCE FREE PERMENANT SEALS

With modern elastomeric sheets or liquids we can easily waterproof the rough framing. With backer rod and caulking we can efficiently create a perfect air seal on the inside because of the indoor working conditions. With properly placed water shedding and open drainage paths we have a window installation that will permanently keep the house structure dry, with no maintenance.

WHAT WE DON'T KNOW

There is a lot of discussion to have about the advantages of exterior jam extensions allowing recessed glazing and elimination of thermal bridging, even just how much and what type of insulation we really need when we are working with dead air spaces.

I have regrouped a growing number of manufacturers, consultants and researchers who are rising to my challenge with an ad-hoc prairie window interface committee. We have not perfected how to do all of this efficiently and economically as yet. Personally I feel we will need more and better external jam extensions and the elimination of the window mounting flange – but that is not yet a consensus. This is a work in progress that came out of FenCon18 and I am sure will continue right up to FenCon19.

RAIN SCREEN RESEARCH

In the early 1980's a lot of Canadian research went into how to keep walls dry in wet humid climates. The result was a clear definition of Rain Screens for walls that eventually got into a number of regional building codes. It was determined that Wall Rain Screens would lessen the moisture load on the wall and accelerate drying.

In 2011 and 2013 the IRC (Institute for Research in Construction, National Research Council of Canada) published two studies on why modern window installations continue to leak and allow for moisture damage in window framing and wall sheathing. (CTU #76 and CTU #80) Their basic conclusion, read by very few in the industry, was that when you try to stop the wind and the water on the same plane, the wind will eventually win and the water will get pushed inward. The primary

recommendation was to separate the moisture barrier and the air barrier, creating a dead end drainage layer (air sealed on the inside face of the wall) behind the moisture barrier with full open and sloped drainage out the bottom of the installation. This is essentially applying the Rain Screen principles to the Window/Wall interface – shed most of the water, remove the force of the wind from the flow of water, and have a free fall drainage path to the outside -- but do not try to stop the rain and the wind at the same place.

Although there are some scattered efforts in this direction, nothing has shown up clear and simple to define how to do this in real life in a cold climate – and the majority of window installations continue to rely on tape, membranes, foam insulation, caulking and other efforts to block both the wind and the water at the same place.

Think for a moment -- site applied sealing efforts on the outside, on ladders or scaffolds, often fall short of perfection with subsequent water penetration problems. Is it possible to apply the practice of pressure equalization to residential low rise window and door installations to eliminate the need for exterior water sealing? The IRC was pointing in that direction before budget cuts. I raised that possibility during the development of the CSA FIT standard development, but few were interested. I raised that possibility in several window conferences before covid, and two colleges came forward to do some lab developmental testing – Red River College in Winnipeg and George Brown College in Toronto. Covid then shut that all down but in the fall of 2022 that is all coming back to life. See the note at the bottom of this article to see how to receive the project newsletter updates.

As I always feel that actually seeing a problem, or a solution, goes a long way to solving problems, I produced this little video of a transparent Window/Wall Interface in my shop. It is certainly not a piece of art, or a perfect calibrated model, but it does dynamically show the relationships between wind, water and air spaces.

IN SHORT:

Waterproof membrane on the rough opening;

An air tight barrier on the inside of the house at the window/wall interface;

Baffles (window flanges, strapping etc) to intercept bulk water and impose surface tension on the water flow as a control measure;

Pressure equalization of the drainage path to remove the driving force from the wind driven water.

Water allowed in, but guided out through the window sill.

This is radically different from present practices, and may redefine the use of mounting flanges so common today in order to assure vertical drainage paths or increase the use of external jam extensions, common in Quebec, for the same purpose. I find it especially interesting that the greatest interest for these ideas is coming from the coldest regions of the country.

Fall 2022 update -- after a delay for Covid, we are back in the labs. I presented a research update report at the 2022 WinDoor window industry conference. You can download that update by clicking here.

Fall 2023 update -- Finally the George Brown College research team have published their research report, with some editing of video to come later. The report and related information can be found with this link. The BETAC report on the thermal effect of swapping insulation space for moisture control drainage paths is still hung up in finalizations. When that becomes available it too will be found at the above link.

If you would like to send me your comments about this research or have your name added to the

occasional Newsletter dedicated to this project, you can reach me here.

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