The Enclosure

Window Rough Opening Preparation Recommendations

Flangeless windows with buck-out (Exterior Insulation)

A beacon of building envelope excellence!

Client/Owner
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The internet is littered with window installation videos and installation instructions. However as so much of these fail to demonstrate best practices, and at worst will guarantee bulk water entry at this all too important interface, we felt it was important to demonstrate the right way to install and flash a non-flanged window with a buck-out. While great installation guides are available from some manufacturers, these guides have generally not diffused down to the residential building market, as many spec built houses do not involve any form of building envelope consultant. I am hoping that by publishing this guide, I will reach some of this audience.

The key to a great penetration details is the darts, and no we are not talking about the game played in the back rooms of dark English pubs serving cold food and warm beer! We are talking about key pieces of flashing membrane adhered to the vulnerable corners around the window openings, but more on that in a bit.

The first task when installing any window is to obtain the dimensioned drawing of the window frames and deciding, with your building designer, where that window will be placed within the assembly. The best practice is to install the window so that its thermal plane aligns with the thermal plane of the wall that it is to be installed into. This is why flanged windows are falling out of favour in lieu of flangeless models that can be placed at the correct thermal plane. Flanged windows also must also be modified or furred out to ensure they do not trap water at sill further complicating their installation over the flangeless models.

For our wall, we have placed the window slightly outboard of the rough opening to align, roughly, with the middle of the thermal plane.

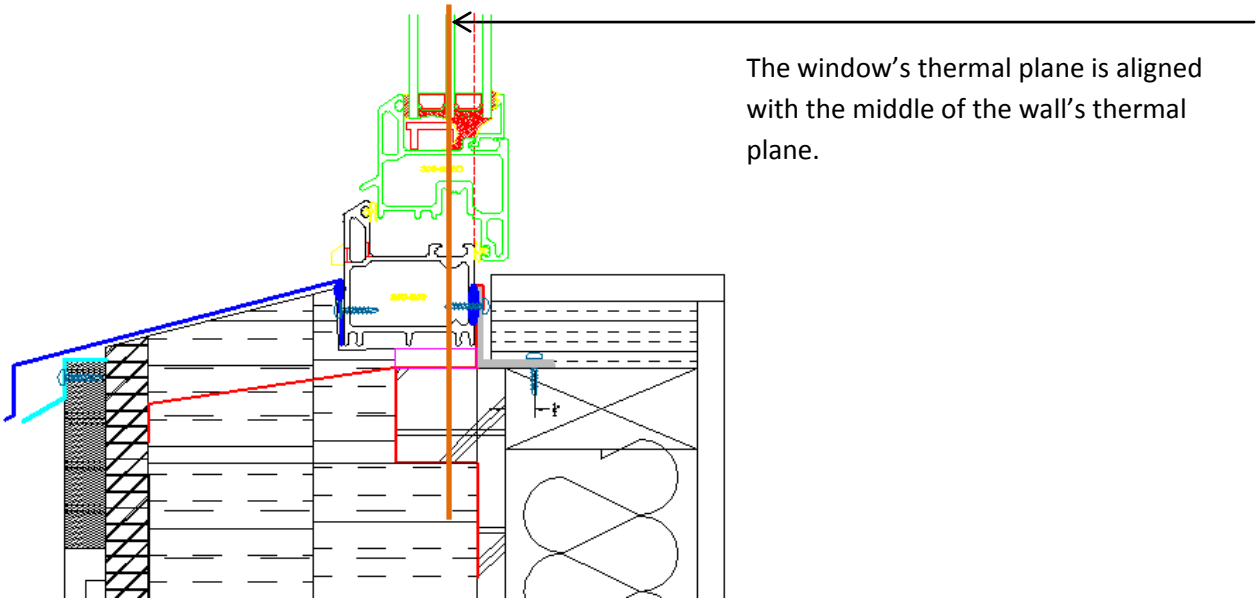

Figure 1 Best practice dictates to line up the thermal plane of the window with that of the wall.

There are various ways to support a window when it is pushed outboard of the sheathing. There are examples of plywood boxes, or full 2x dimensional lumber, bucking out the opening from the sheathing surface all the way through the external insulation to the cladding plane (see goo.gl/mzkBGQ for examples). But in our opinion, these are all less than desirable as they create too much of a thermal bridge through the continuous exterior insulation (defeating it prime purpose – to be continuous). A buck-out all the way to the exterior face also prevents the ability to over-insulate the window frame, which when done, can help improve the overall efficiency of the installed window, and also allow for a trimmer looking installation where less frame is visible.

Instead, we elected to only buck out the distance actually needed to support the window frame (this distance will change depending on window, check with manufacturer). The Cascadia 300 series windows we are using, only need support to the middle 'rib', so we ripped a 2x4 in half (a 2x2 split too easily) and nailed it flat around the opening to provide support at the window sill. This will also provide a backing surface to push the caulking backer rod into place at the jambs and head of the opening. We will later burry this frame in exterior insulation significantly reducing the thermal bridge at the interface between the wall and window.

** When electing to burry a window frame, ensure that you have sub-sill flashing to deflect any water that leaks through the assembly to the outboard side of the exterior insulation. Also check with the manufacturer as to the location of the window weep holes and ensure you have handled drainage from this location. **

Figure 2 - Step 1: Fasten required window support buck around opening. We glued and nailed ours for maximum strength.

Once your outboard bucking is in place, the next step is to strip in your permeable sheathing membrane below the window sill. These strips would generally start at the base of the wall and continue up past the sill of the window by a minimum of 8" as shown below. They should extent out each side of the opening about a foot. We are using self adhered Delta Vent SA as our Water Resistant Barrier (WRB) and Air Barrier (AB), as we only advocate an exterior air barrier for our designed wall assemblies due to its ease of installation and robustness at this location.

Figure 3 - Step 2: Sheathing membrane is installed from base of wall (or lower course if on second floor) and extends past sill by min 8” and to side of opening about a foot. We cut membrane flush with outside edges of buck to prevent bridging that could otherwise occur when applying the peel and stick sill flashing in a later step. The Delta Vent SA membrane is sealed to the foundation membrane with Delta Multi- Band tape providing a robust continuity of the water and air barrier.

Figure 4 – At the base of the wall, our sheathing membrane overlaps and is sealed against our foundation membrane, but not before taking a torch and burning off the surface scrim of the Colphene Torch’N Stick foundation membrane. This also helped seal the sheathing membrane to the foundation membrane before further sealing the interface with Delta’s Multi-Band tape. This will provide an easy to detail, robust air, and water barrier at a key interface that plagues many builders.

The next step is to install the window back dam angle. A back dam ensures that no water, than may leak through the window frame, can ever migrate to the dry side of the assembly, and is considered best practice. It typically comprises of a 1.25” x 1.25” x 1/8” aluminium angle. We upgraded to a 1.5”x1.5” angle, so that there would be enough depth for the screws to penetrate into the rough opening (see figure 1 above). The angle is installed so that it will sit flush against the inboard side of the window frame. In a later step, the angle will be caulked and screwed to the windows sill frame. Be sure to clean off the burs from the cut ends of the angle. No sense going to a lot of trouble to water proof the window interface to just have a burr cut through your membrane.

Figure 5 – Step 3: Install Back Dam Angle. Manufacture called out self drilling fasteners at every 6". In our case we used 1.5" (3/4" may have been border line acceptable but we needed 1.5" for jamb clips anyway). We also used hex head as they are much easier to install than Robertson or Philips screws, especially when drilling through the aluminium angle. When you cut the angles to the opening width, be sure to trim off the flash/burrs from the angle. This can be easily done with a carpenter's blade.

The next step gets serious about sealing off the opening. This is done by applying a series of self adhered foil face membranes to the sill and then overlapping these at the jamb and head with permeable sheathing membrane. For the sill (and all flat surfaces) it is PARAMOUNT, that you do not use a permeable membrane. There are several manufactures that advocate the use of a permeable membrane at the sill location, and forensic evidence shows this will only lead to wet-up and rot of your sill components. There is plenty of evidence and research both in the building science profession, as well as the building envelope remediation industry, of failures when a permeable membrane has been used at a sill or other horizontal surface.

BUT, it is also imperative that as an installer, you LIMIT the volume and location of non-permeable flashing membrane. The ONLY location it should be generally installed is at horizontal locations with only enough transition to the vertical sheathing to meet the membranes lap requirements (for self adhered membranes like foil face, the required overlap is 2"). The window sill and 'roof' of a buck-out are both horizontal surfaces that need protection. It should only be extended onto the vertical wall surfaces by the required 2".

There are again many examples of rotted assemblies when excessive vapour tight membrane is used around openings. In RDH bulletin#4 - Excessive Use of Self Adhesive Membranes in Standard Wood Frame Construction , the following photos show some of the practices often found on build-sites today and the possible end result. The author states "*When focused on individual details it easy to lose sight of the cumulative effect of self-adhesive membrane used at each detail. For example, if using self-adhesive membrane at all window-to-wall interfaces, as well as penetration details, a high percentage of the wall area can end up being covered with membrane. This is a particularly true with highly articulated facades that utilize a high percentage of glazing. The result is a relatively continuous vapour impermeable surface located on the cold side of the wall, potentially leading to a vapour diffusion related condensation problem*"

Figure 6 – This is not best practice and will usually result in the wetting up of the assembly beneath the blue membrane installed all over the vertical plane of the wall (especially if insulation is placed inboard of this plane). This is a vapour closed membrane, meaning it does not allow moisture that may be in the wall assembly to perspire out to the outdoors (low pressure side in a heating climate). (Photos: RDH Bulletin #4)

At the beginning of this guide we hinted the key was all about the darts, and indeed the next step is to install the first of three darts that are required on each corner of the window buck. Darts are used to seal the pin holes left when you cut and fold membranes around corners. Normally there is only one dart required per corner, but the addition of the outboard bucking adds two more vulnerable locations that need to be sealed in our assembly.

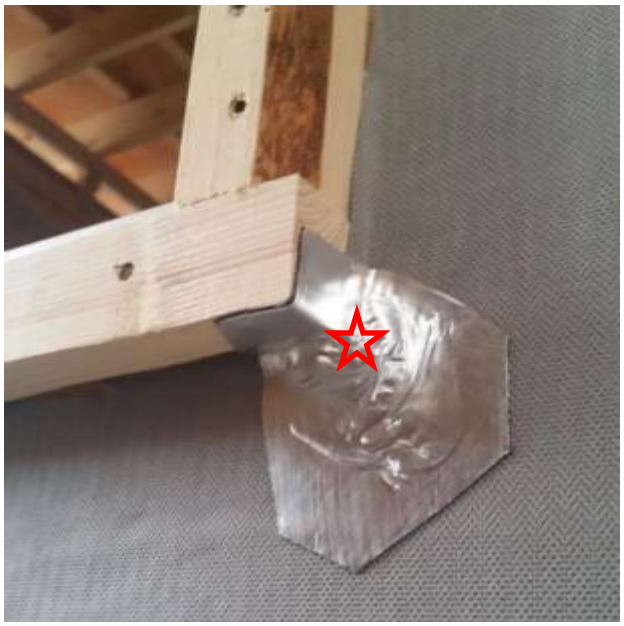

Figure 7 – Step 4: Install dart # 1. This seals the bottom inside corner where the outboard buck and sheathing meet (see star). The special shape of the dart allows you to stretch or 'fan out' the membrane so you do not have any cuts but are able to still seal this complex 3D geometry (inside corners can be fanned out, outside corners will need to be folded). The use of a heat gun (especially in the winter time) will relax the membrane and make it more pliable and easier to form.

Figure 8 - Step 5: Install Dart#2. With the inner corner protected with dart #1, we now need to protect the outboard bottom corner with a second dart. The membrane is cut away from the notch (inset) so that we do not have too much material build-up at this location as there are several more layers to apply.

With the initial two darts installed, we can tackle the main sill membrane that transitions from the sill to the jamb. It is best to detail this transition separately from the main length of sill membrane, as it is just too unwieldy to try and do all at once. Just remember all membranes should generally overlap by 2”.

Figure 9 – Step 6: Install Sill transition membrane at each end of the opening. The membrane extends up the jamb by 2”. The key is the ‘gift wrap fold’ performed at the corner between the sill and jamb. Once the fold is made, it is oriented so that it faces outside of the enclosure. This prevents any path for water to flow past the opening once the jamb is sealed with backer rod and calking. The use of a Tuk tool will greatly aid in this task. Finish folding and sealing the membrane around the bottom and side of the buck. Notice the outline of dart 1 can clearly be seen beneath in the top left inset.

Figure 10 – Step 7: Install Dart #3. This last dart protects to final corner of this sill assembly.

With the sill corner membrane installed, we provide extra protection by continuing the non-permeable membrane up the jamb by 4” lapping over all previously placed membranes.

Figure 11 – Step 8: Install base of jamb membrane which is also non-permeable and extends up jamb 4”

With the sill corners now detailed, we can proceed with installing the jamb and head membranes. We like to place the main sill membrane at the end of the process so we can lean our ladder on the sill to do the head without danger of damaging the sill membrane.

Figure 12 – Step 9 & 10: Install permeable sheathing membrane at jamb and head. The jamb membrane overlaps the foil face at the bottom and extends down just to the top of the back angle. It wraps from the inside of the opening, around the buck, and onto the plywood face about a foot or so. The head membrane wraps from inside the opening to the top of the vertical face of the buck. The head membrane also wraps down the jambs by 4". Seams are then sealed with the multi-band tape.

Just like the sill, the top of the buck also has to be protected with non-permeable foil face membrane. This is the general practice required for all horizontal surfaces that will see storm water. We start the process by installing the three darts to protect the three corners, again making sure we do not create too much build-up at the inside corner. We then install a corner membrane that provides the require 4" lap-out onto the plywood above and beside the buck-out (4" is the minimum lap of the permeable sheathing membrane).

Figure 13 - Step 11: Install three darts at top corners of buck

Figure 14 – Step 12: Install Head Corner Transition Membrane

With the corners all detailed we can now install the main head, and then main sill membrane.

Figure 15 – Step 13: Head membrane just partially wraps around onto the bottom of the buck. We do not want to completely cover the permeable membrane we previously installed, to allow the wood at the head of the rough opening to drain and dry if it is ever wetted (see bottom inset). Membrane covers the vertical face and top of buck before transitioning onto the plywood and extending up a 4"

With the head detailed, we can now finish off the sill. We like to start by wrapping the sill membrane over the top of the back dam angle and securing it before forming it into the inside and then outside corners of the exterior buck.

Figure 16 – Step 14: Install main length of sill membrane. Wrap membrane over top of back dam angle to secure to top of angle prior to forming around buck. Once secure start forming around base of angle and around top of buck. Start in middle and work outward toward the corners to reduce 'wrinkles'. In the far right photo you can clearly see the min 2" overlap between the various membrane plies at the sill.

With the main sill membrane installed, we now only need to add a second sill membrane that will provide a primary drainage path for any water that penetrates through the window assembly and deflects this water to the outside face of the exterior insulation. This is a critical detail for all insulation but especially rigid foams that have been proven to absorb water over time (eps or xps)

Figure 17 – Step 15: Install secondary sill membrane that will deflect any water penetration to the outside face of the exterior insulation. Only a couple of inches of the backing paper is removed at this time to fasten at the sill horizontal surface. The rest of the membrane will be 'glued' to the insulation much later in construction

The window rough opening preparation is now complete and we are ready for the installation of the window (documented under a separate guide). We will finish off with a few tips.

1) To speed up installation and ensure a consistent well detailed penetration, we mock up the required foil face membrane shapes using a less adhesive membrane like the Delta Vent SA. This allowed us to fold and unfold, and add in patches until we achieved the right shape for each membrane course. Once this was complete, the origami of membranes was unfolded and the shapes were traced onto a piece of plywood and cut out on the band saw. Even the cut lines (for folding) were cut in to the template. This allowed all the corner shapes and darts to easy be cut out (we do several windows worth at once). Just remember to turn the template upside down to cut out the shapes for the opposite side of the opening.

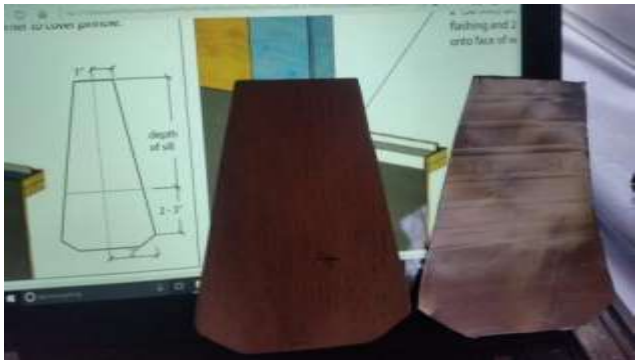

Figure 18 – The dart shape is extracted from pg 32 of [Delta Vent SA Guide]

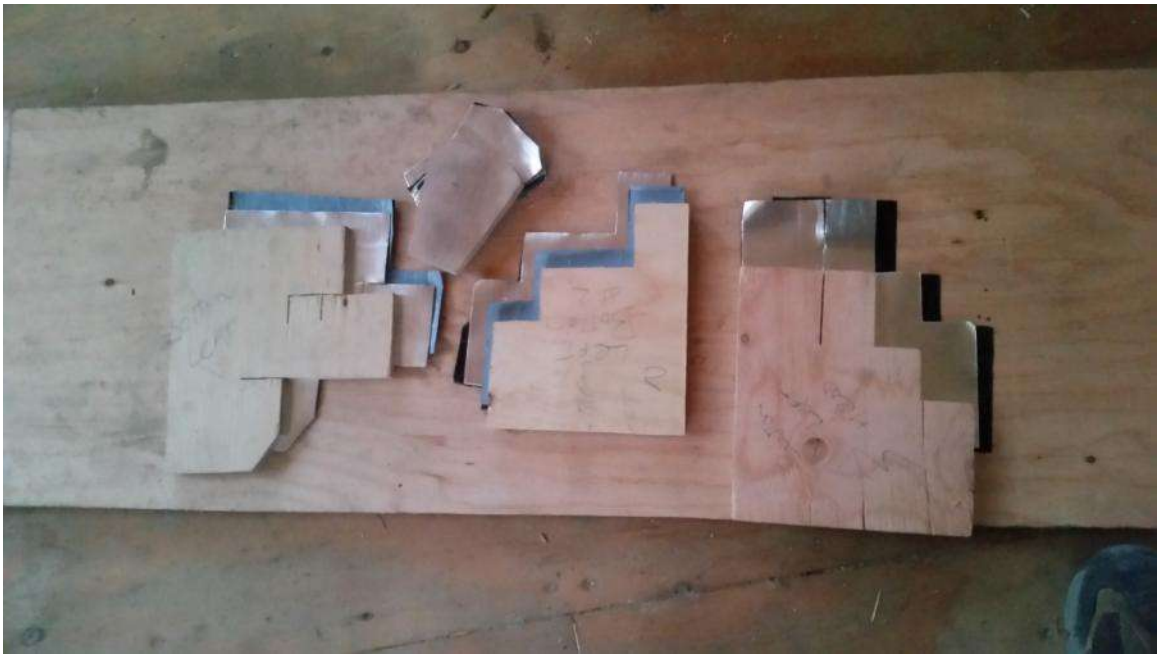

Figure 19 - Templates to cut-out the four corner membrane shapes

The beauty of membranes cut from templates, is that they have nice square cut-outs making the alignment on the buck corners very easy, fast, and accurate.

2) Use a heat gun in colder weather to warm both the foil face membrane and the wall components. It will aid in forming the membrane and helping the membrane to adhere to the substrate. Limit heat on permeable membrane such as Delta Vent SA, as it has a much lower melting point.
3) Final tip recommend by one of the instructors at the BCIT 3060 Building Envelope Lab, is to use a Tuk tool (officially called an EZ TUK 3-1/2 in. Wide Carpet Tucker) to form the membrane tightly into the corners. It also helps when adhering the membrane to the substrates.

Figure 20 – Tuk tool allows you to form the membrane tight into all corners.