Treating Spray Foam After A Flood Event and Using Spray Foam Before A Flood Event to Reduce Risk

By Joseph Lstiburek, B.A.Sc., M.Eng., Ph.D., P.Eng.

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Flood Water

Flooding happens all over North America, not just on coastlines and adjacent rivers. Serious rain events, localized less than ideal ground water management, urban areas with less than ideal civil engineering infrastructure and failure of sewage line and fresh water infrastructure can all lead to flood events. Additionally, more buildings are being constructed in flood zone areas. Flooding also tends to be a seasonal event.

Flooding poses a risk of ingress of contaminants and sudden flood water surge during a flood event can lead to structural damage. Spray foam insulation can mitigate damage associated with contaminants and flood water surge. Also, wood frame assemblies constructed with spray foam insulation move less during the drying process – warping and bowing of assemblies is reduced.

How to Clean

The most serious problem with flood damaged buildings is the damage that is done by dirty water. It is called "black water" or Category 3 water. It includes sewage, bacteria, fungi and other contaminants.

"Black water" is very different from "clean water" or Category 1 water. Category 1 water is easy to address. It comes from broken water supply lines, sink and tub overflows. The approach is to dry the wet spot. The key issue is to dry the wet spot before the wet spot becomes overwhelmed with mold. The time period for drying to occur is several days….not weeks…to get it dry. Category 1 water can be addressed by dehumidification with stand-alone dehumidifiers and fan powered air distribution.

Between Category 1 water and Category 3 water is Category 2 water or "grey water," including spillage from dishwashers, urine in toilet bowls and sump pump failures. This typically requires professional cleaners where spillage events are large.

A flood event is a "black water" Category 3 extreme event.

Much of the interior materials need to be disposed of or professionally cleaned and dried. In most cases all carpets, fabrics, soft furniture, cardboard boxes are thrown away. It is typically not worth the effort to professionally have these types of materials cleaned…except when they are family heirlooms.

In most flood restoration work, the interior gypsum board is removed and disposed of. Water sensitive cavity insulation such as fiberglass batts, cellulose and mineral wool is typically removed and discarded. Spray foam (SPF) cavity insulation does not typically have to be removed if it is able to dry and is cleaned. Closed cell SPF (2 lb/ft3 density) does not absorb or hold much water and is easier to address than open cell (0.5 lb/ft3 density) that can absorb and hold water and must be dried quickly after a flood event. Both closed cell and open cell SPF need to be cleaned after a flood event.

Closed cell SPF (2 lb/ft3 density) can reduce inward drying of wood based exterior sheathings such as plywood or oriented strand board (OSB). Such sheathings primarily dry outwards when closed cell SPF is used as cavity insulation. Outward drying of sheathings and stud framing typically occurs through most cladding systems by design. Vapor open water resistive barriers (wrbs) and drained claddings systems promote outward drying and are commonly used. Outward drying is desirable with all assemblies.

After a flood event, assess the building for damage, clean all the surfaces, including spray foam surfaces, with water and detergent, sanitize them with a bleach solution, rewash them and rinse and then dry. There are cleaning standards recognized by EPA*. This is referred to as the "check" and "wash, rinse and dry" step.

The key is to get temporary power to run a dehumidifier within a day or two. It is not necessary to have the a/c operating. In most cases too much power is needed to operate the a/c with temporary power. Maintain relative humidity below 80 percent. The temperature can float. Relative humidity matters much more than temperature in the control of mold and the drying process. The windows should remain closed and the dehumidifier should run continuously. Several powered circulation fans should be operated to mix the air.

How to Build

My recommendations regarding the use of SPF discussed below are not limited to flood zone areas. They are universal to all buildings and apply to all regions. Buildings constructed with SPF perform better thermally and structurally. Unvented roof assemblies constructed with SPF perform much better during hurricane events than vented roof assemblies. They do not "blow off" due to "attic pressurization". Unvented roof assemblies constructed with SPF perform much better during wild fire events than vented roof assemblies as ash and embers do not enter unvented roof assemblies. Buildings constructed with these approaches are significantly more resilient, more durable, more energy efficient and more sustainable.

There are several approaches to constructing flood resistant buildings using SPF. Structures should be elevated above the site Base Flood Elevation (BFE) (Figure 1) and the first floor should be constructed out of moisture insensitive materials such as concrete block or pre-cast concrete. Upper floors can be constructed from wood frame (Figure 2). Either open cell or closed SPF can be used above the Base Flood Elevation (BFE).

If structures are not elevated and not constructed with concrete block or pre-cast concrete, do not use wood sheathing (Figure 3). Use non water sensitive exterior sheathings such as extruded polystyrene (XPS) or glass fiber faced polyisocyanurates. The racking resistance should be provided with metal cross bracing. Some racking resistance can also be provided with closed cell SPF. All surfaces are coated on the interior prior to installation of the interior gypsum board with a water repellant material such as acrylic latex paint.

Horizontal trim is typically installed half way up interior surfaces for flood events where flooding does not rise above the trim level (Figure 4). Note the crown molding gap and the baseboard gap to facilitate drying.

The SPF should not completely fill the frame wall cavities thereby providing an air space that facilitates drying after a flood event. Again, note that wetted gypsum board should be considered "sacrificial" in that it cannot be readily cleaned, sanitized and dried after wetting by Category 3 water. After a flood event, wetted gypsum board should be cut away from wall assemblies above the wetting line. The air gap behind the remaining upper level of gypsum board allows for air circulation and drying of the remaining surfaces.

Slabs should be elevated. Closed cell SPF is recommended. Coat everything with a water repellant material such as acrylic latex paint. Implement the "wash, rinse and dry" approach as soon as is practical after a flood event.

Crawlspaces in flood zones should be vented and constructed with closed cell SPF (Figure 5)

In basement construction, closed cell SPF (2 lb/ft3 density) can be used on the interior of concrete and concrete masonry unit (CMU) foundation walls with a metal stud wall interior "stand-off" (Figure 6).

How to Rebuild

In a flood damaged building, remove all of the interior gypsum board, cavity insulation and discard and remove exterior sheathing and cladding. If a brick veneer is present, the sheathing is removed from the interior.

With a brick veneer assembly clean out the debris at the bottom of the wall cavity. Cut the flashing out and completely expose the concrete in the seat of the slab edge of the foundation. Drill weep holes through the bottom

course of brick. Drill them from the outside. Provide a weep opening every other vertical joint in the first course of brick. Also remove the existing brick ties.

Apply a fluid applied flashing to the bottom of the wall (Figure 7). The intent is to turn the bottom plate of the existing frame wall into a pan flashing. The fluid applied flashing should completely cover the top of the bottom plate and seal upwards around each stud. The fluid applied flashing should extend downwards along the exterior face of the bottom plate and seal to the seat in the concrete supporting the brick veneer.

Install a drainage mat with a filter fabric directly against the interior of the brick veneer with the filter fabric facing inwards (Figure 8 and Figure 9). Install closed cell SPF against the drainage mat. The SPF needs to extend into the the stud cavity filling approximately 3 inches thick in order to provide racking resistance. Coat all of the interior surfaces with a water repellant coating such as acrylic latex paint prior to the installation of the interior gypsum board. This helps ensure that these surfaces are easily cleanable in flood events.

Brick ties can be replaced with new brick ties installed from the inside screwed to the side of the studs and to the back side of the brick through the drainage mat prior to the installation of the spray foam.

Windows and doors need to be removed from the wall assembly and water control provided at the window openings and the door openings. Fluid applied flashing reinforced with mesh tape should be used. Then install new windows and doors.

* (https://www.epa.gov/sites/production/files/2014-08/documents/flood-related_cleaning_report.pdf). Then go to the S500 Standard and Reference Guide for Professional Water Damage Restoration, Institute of Inspection Cleaning and Restoration (IICRC).

Notes for Figures

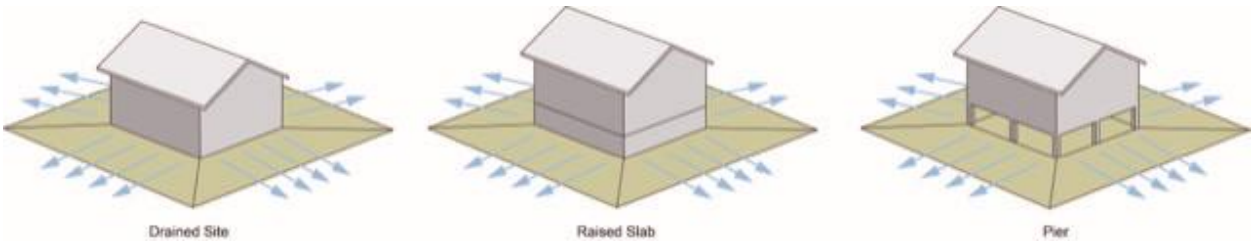

Figure 1: Elevate the Structure - All flood risk is reduced where the building floors are located above the base flood elevation (BFE) and where the slope of the land directs water away from the building. Raised slab and elevated pier foundations tend to be more robust and lower risk than slab foundations and crawlspace foundations.

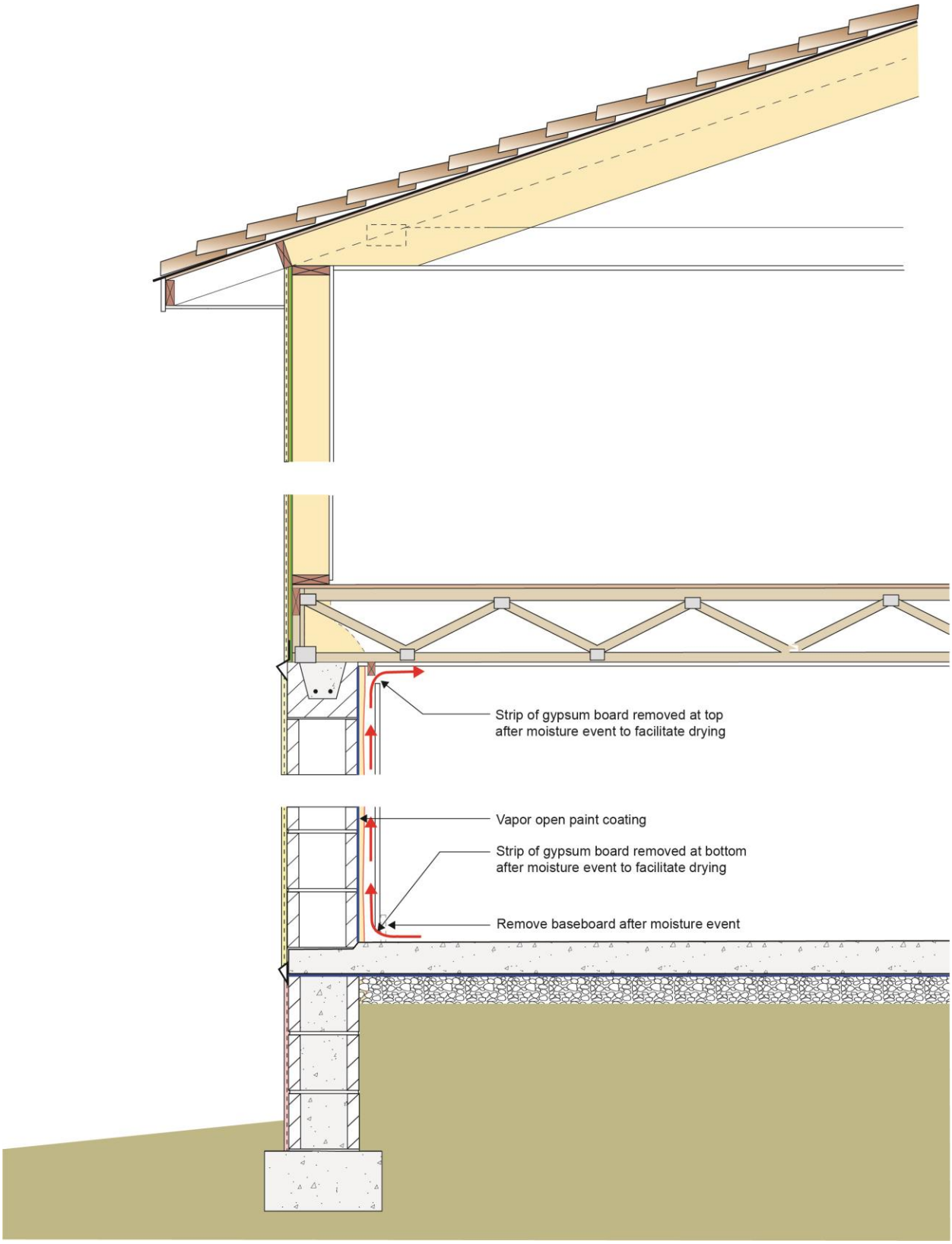

Figure 2: Construct Using Moisture Insensitive Materials - First floor should be constructed out of moisture insensitive materials such as concrete block or pre-cast concrete. Upper floors can be constructed from wood frame.

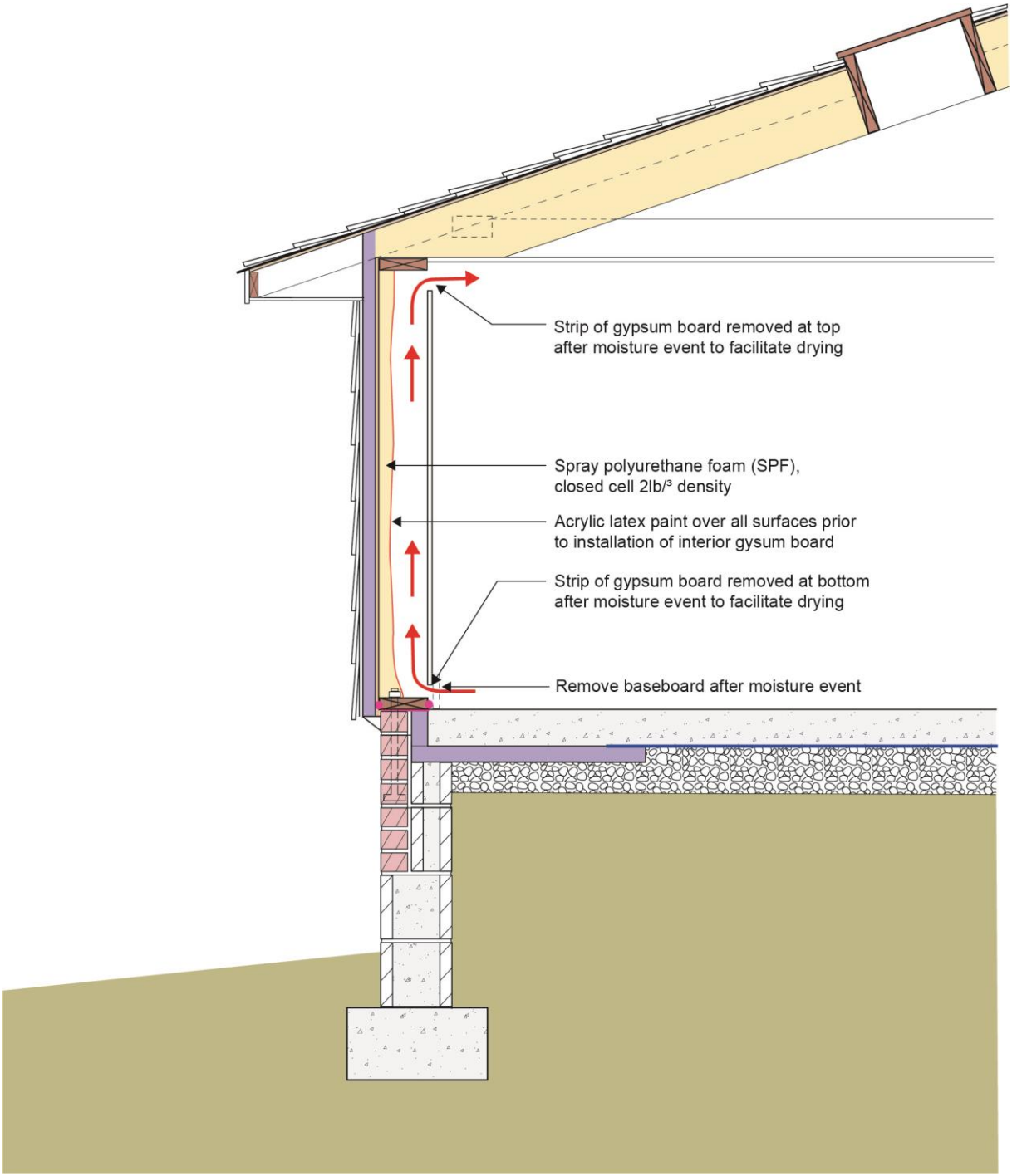

Figure 3: Wood Frame Slab on Grade - No wood sheathing. Only XPS sheathing. The racking resistance comes from metal cross braces coupled with closed cell SPF. Everything is painted on the interior prior to installation of the interior gypsum board. There is horizontal trim half way up the wall on the interior. Note the crown molding gap and the baseboard gap to facilitate drying.

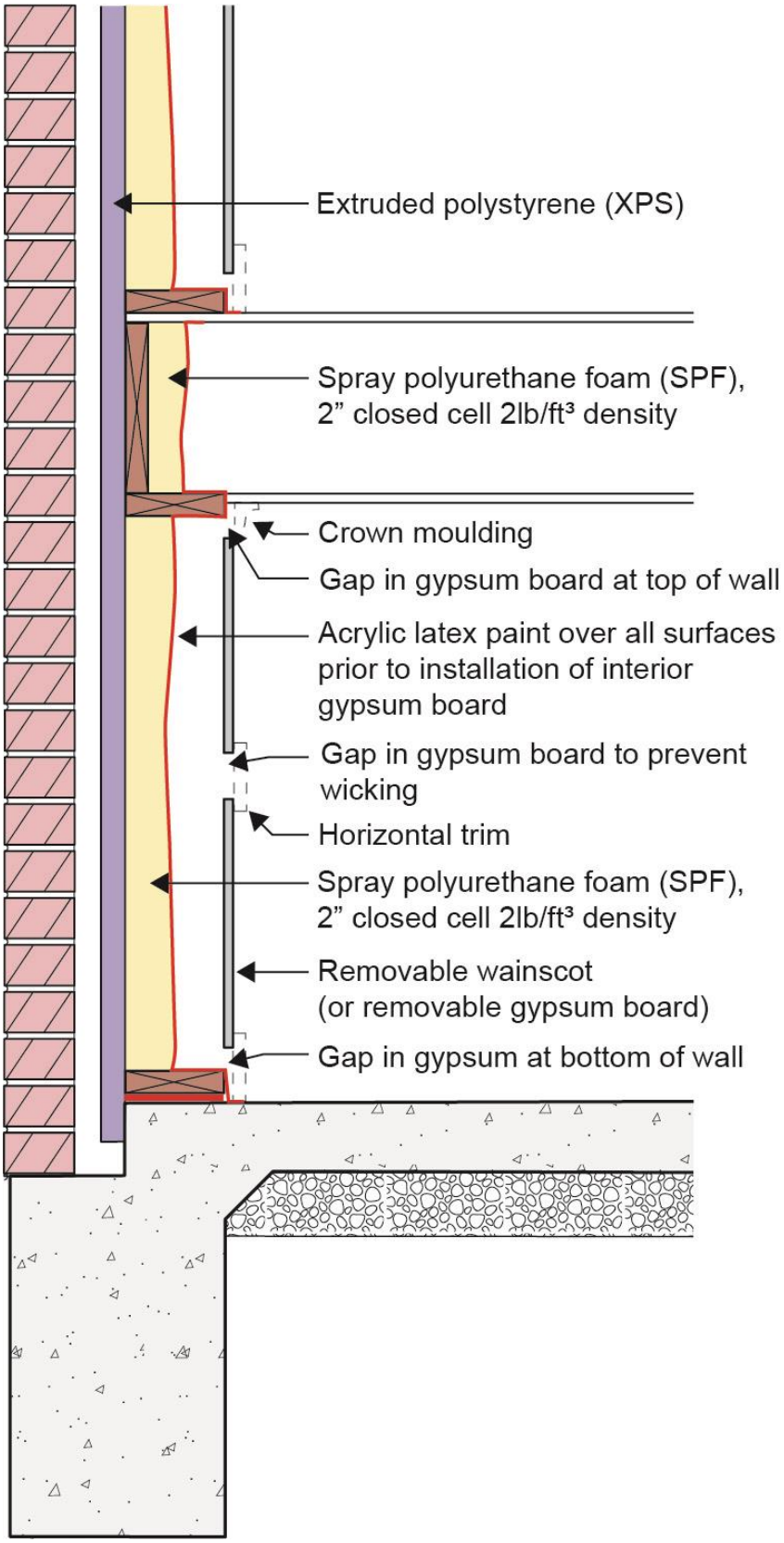

Figure 4: Elevated Slab With Wood Frame - Elevate the slab and use wood frame. No wood based sheathing. Closed cell SPF (2 lb/ft^3 density). Coat everything with a water repellant coating such as acrylic latex paint.

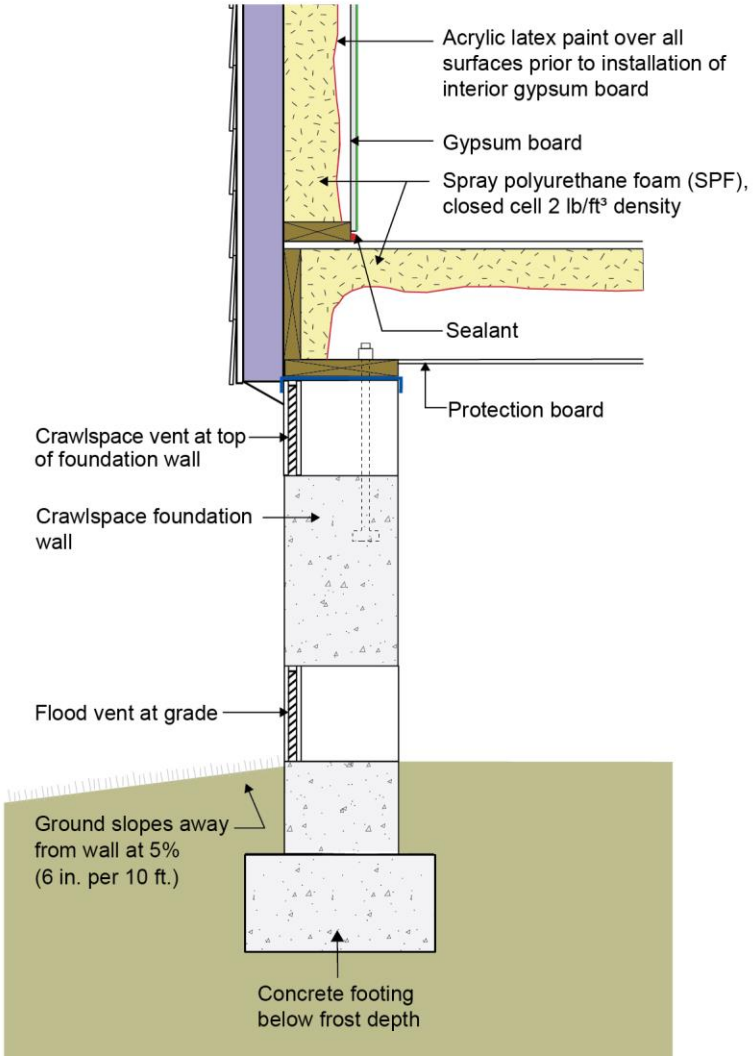

Figure 5: Crawlspace - Crawlspaces in flood zones should be vented and constructed with closed cell SPF

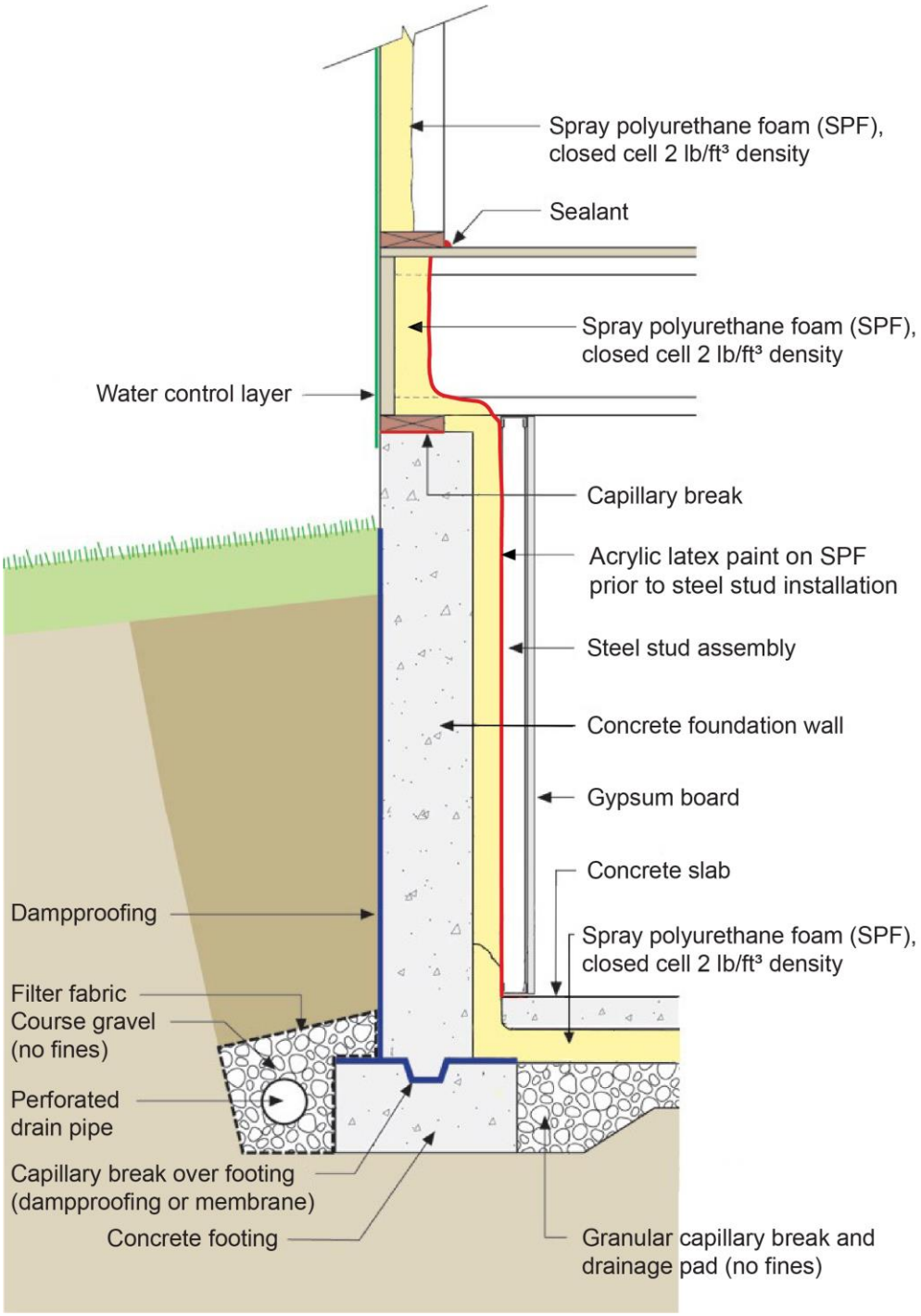

Figure 6: Basement - In basement construction, closed cell SPF (2 lb/ft^3 density) can be used on the interior of concrete and concrete masonry unit (CMU) foundation walls with a metal stud wall interior "stand-off".

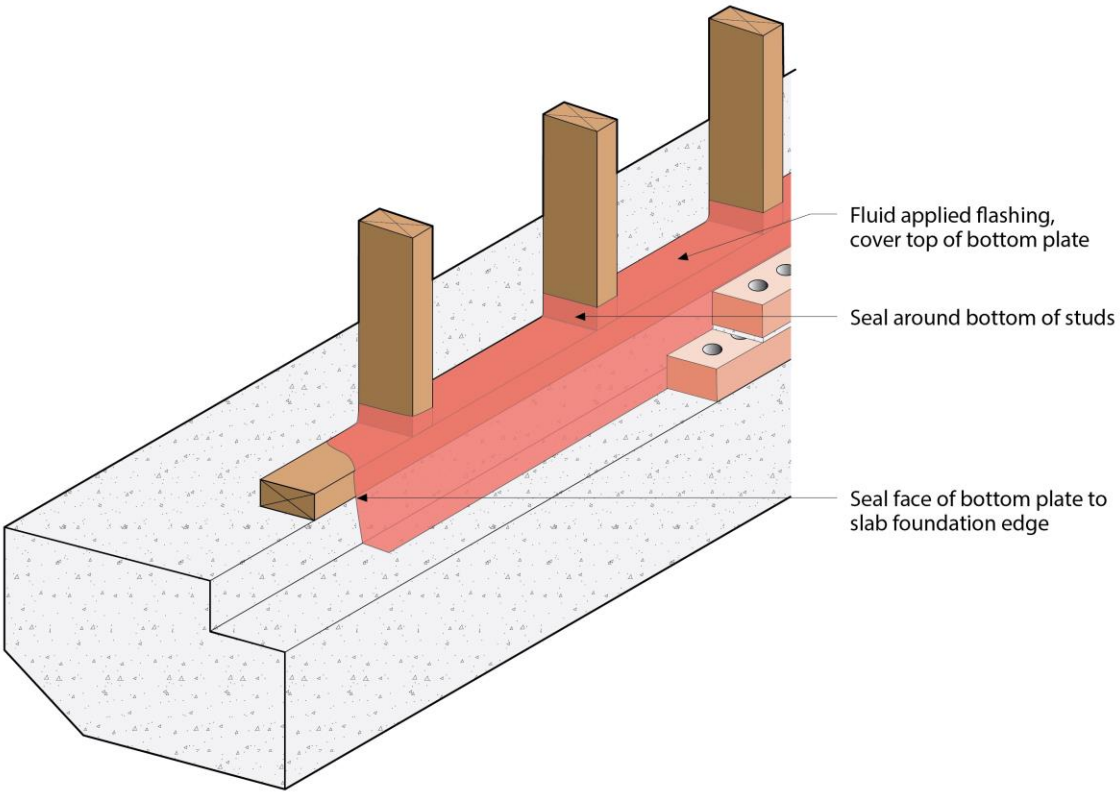

Figure 7: Fluid Applied Flashing - The intent is to turn the bottom plate of the existing frame wall into a pan flashing. The fluid applied flashing should completely cover the top of the bottom plate and seal upwards around each stud. The fluid applied flashing needs to extend down the exterior face of the bottom plate and seal to the seat in the concrete supporting the brick veneer.

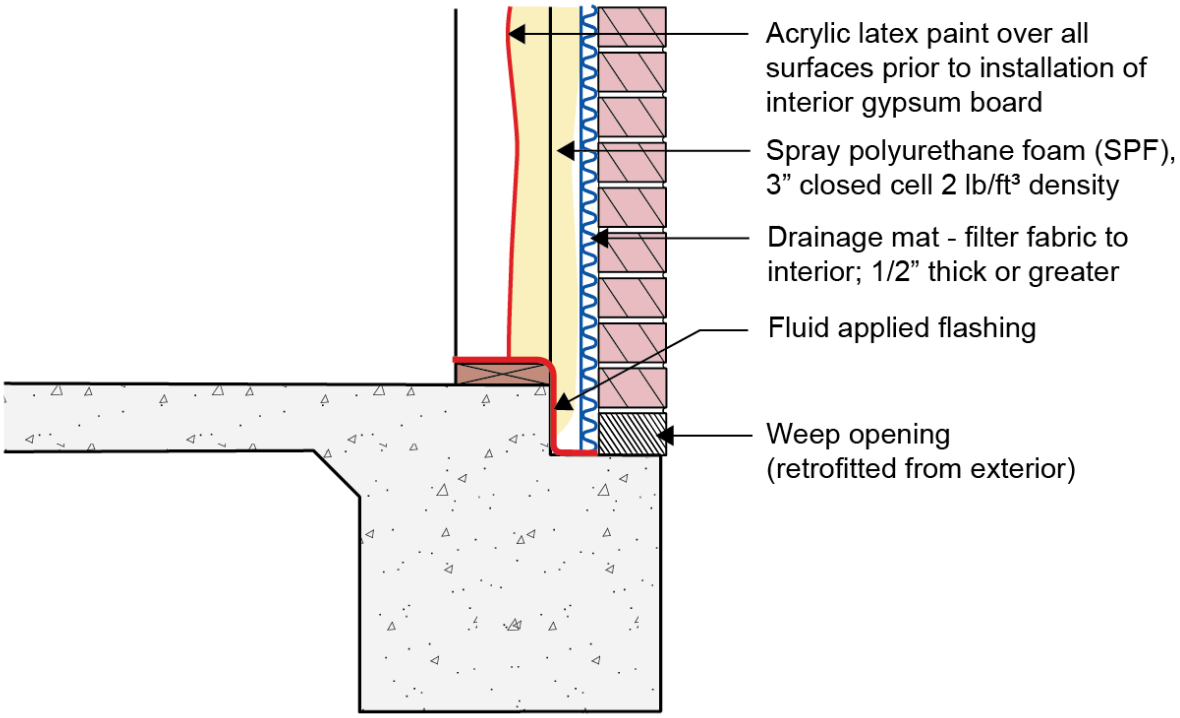

Figure 8: Drainage Mat – A drainage mat with a filter fabric is installed directly against the interior of the brick veneer…with the filter fabric facing inwards.

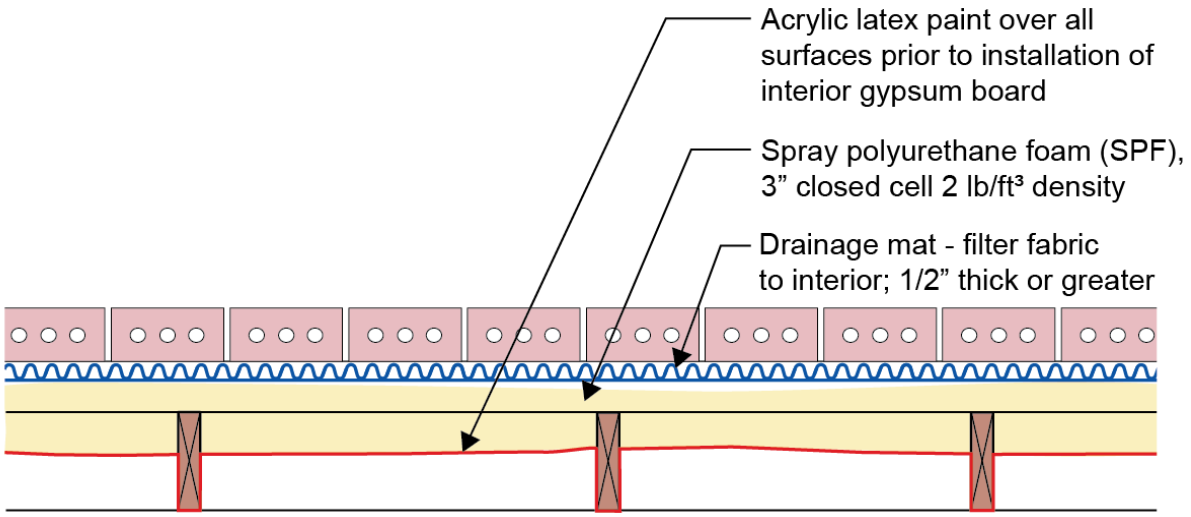

Figure 9: More Spray Polyurethane Foam - The SPF needs to extend into the stud cavity approximately 3 inches in order to provide racking resistance. Coat all of the interior surfaces with a water repellant coating such as acrylic latex paint prior to the installation of the interior gypsum board.