Henri is an architect and building envelope specialist with over forty years of experience in the construction industry. He was a pioneer in the solar industry, introduced the installation technique for field-applied closed-cell closed-cavity-fill polyurethane foam and has designed and constructed a net-zero energy research structure in Antarctica. He has four energy-related U.S. patents.
HCF foam experience

1. First spray foam project was in 1971
2. Foam manufacturing from 1973 to 1979
3. Foam contracting and BE consulting from 1979 to 2009
   Developed the method for injecting closed-cell foam on site
   Installed ~ 5 million pounds of foam
4. Foam and BE commissioning from 2009 to present
5. Noteworthy foam projects include:
   1977 net-zero solar project in Boston, The Big Dig, 4 American Ski Grande
   Hotels in the Northeast, Net-zero energy weather station in Antarctica,
   The Guggenheim Museum
6. Two US patents and numerous technical papers related to foam & foam QA
The inside-out method
Case study - S. Londonderry Elementary School (2004)

- **Standard installation requirements:** Spray-applied polyurethane foam (SPF) capability – open walls
- **Specialty installation requirements:** Injected polyurethane foam (IPF) capability – concealed locations behind structural members and between floors
- **Diagnostic and/or QA requirements:** adhesion testing, water testing, foam processing quality verification test capabilities
- **Specialty foam product:** 2.1# SPF and IPF foam formulations
- **Specialty coating:** Thermal barrier required in exposed areas
- **Specialty accessory products:** Drainage membrane, drainage mat in some applications

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The Inside-out method for exterior cavity walls

By way of introduction to this method, it was developed for moisture/mold remediation in an existing brick cavity-wall project where the back-up wall sheathing had become wet due to various air-borne moisture transport mechanisms. Since that project, it has been used in similar retrofit situations that had flashing and drainage plane material failures.

It is applicable to multi-story buildings and to projects with wood-framed construction.
“The inside-out method for exterior brick cavity walls”

Alternative method was developed in 2004 to avoid removing the brick façade to replace the drainage plane, air barrier, and insulation in a New England school.

South Londonderry Elementary
Major remediation project – mold inside the brick cavity wall

Initial cavity wall inspection area. Problems noted included: weep holes blocked, mortar deterioration, failing wall flashing, no vapor barrier on the interior side of the drainage plane.
The original problem: Through-wall air handler units were open to the brick cavity. Mold found in the cavity on the paper-faced drywall sheathing was determined to be the source of mold in the classrooms.
The key to this method is to manage the water that passes through the brick cladding (the rain screen) as you would in new construction, while installing the drainage plane from the inside of the building.

In new construction, the back-up wall is installed and the airtight, vapor tight, and waterproof thermal envelope is installed from the outside before the brick ties are installed and the brick is laid.

In the reverse access scenario, the back-up wall is dismantled from the inside, exposing the back (inside) of the brick cladding. In most cases the through-wall flashing remains in tact.
The goals of a newly installed system are as follows:

Manage water in the cavity wall to prevent water intrusion to the inside.

Provide air leakage control.

Provide vapor control.

Provide adequate insulation within the existing available cavity size.
Specialty Field-Applied Foam Applications

The rules of the inside-out method:

Preparation
1. Clean out the bottom of the brick cavity and make sure the weep holes are open, inside and out.
2. Install protection mesh to protect the weep holes.
3. Do not remove the structural components, including the brick ties and their fasteners.
4. Repair any damaged through-wall flashings.
5. Isolate all through-wall passages from the brick cavity.
   • Windows, doors, louvers, etc.
   • Mechanical penetrations
6. Prime or etch the exterior face of the metal studs or steel structural elements to assure bonding of the SPF.
The existing conditions

Brick and metal studs after removing the wet sheathing and mold. Brick ties were preserved where possible.

Copper through-wall flashing was found at the base of the wall.
**Specialty Field-Applied Foam Applications**

Horizontal section showing the existing brick and framing, the drainage plane location, and the profile of the SPF between the studs.
Specialty Field-Applied Foam Applications

This test was performed to verify the “cure lift” approach to maintaining a capillary break on the brick side. This method relies on the tendency of spray foam to lift during the cooling process if the substrate-side is unrestrained.
Specialty Field-Applied Foam Applications

The rules of the inside-out method:

Drainage plane installation
1. Cut strips of the membrane (and spacer material if used) to fit between the framing members.
2. Install the spacer material against the brick if used.
3. Install the drainage plane membrane starting at the top of the wall (on the top floor if it is a multi-story building).
4. Lap the sections of membrane (if not one piece) to shingle them to shed water from the outside. Use strips of tape to position the membrane if required.
5. Tuck the bottom of the membrane down and to the outside of all through-wall flashings (windows, doors, louvers, relieving angles, etc.)
6. There should be narrow vertical spaces where the brick is exposed at each line of brick ties.

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**Specialty Field-Applied Foam Applications**

Goals – replace the thermal envelope system, maintain the structure, and manage water entering the brick cavity

Install the spacer material against the brick if used.

Install the spacer material to the bottom and on the outside of the flashing.
Goal: Maintain a capillary break behind the drainage plane

The S. Londonderry project used Cedar Breather to assure a capillary break space behind the drainage plane. Subsequent projects successfully use the “cure lift” approach to maintain the capillary break.
Specialty Field-Applied Foam Applications

This building was a one-story structure with brick only on the bottom ten feet. Multi-story structures create floor-level transition problems that this building doesn’t have.

Insulated metal panels

Brick facade

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Existing metal wall panels and wall base flashing above the brick.

Drainage plane hung on clips on the inside of the metal panels.

Drainage plane installed on the outside of the through-wall flashing.
The inside-out drainage plane installation

Install the drainage plane membrane starting at the top of the wall.

Lap the sections of membrane (if not one piece) to shingle them to shed water from the outside. Use strips of tape to position the membrane if required.
Specialty Field-Applied Foam Applications

The rules of the inside-out method:

Spray foam installation

1. Follow all manufacturer installation and quality control requirements. Verify that all processing parameters are within the manufacturer's tolerances. Isolate and ventilate the work zones. Maintain at least 4 ACH during and after the work.
2. Perform strip test shots and verify foam quality.
3. Install the SPF in vertical lines behind the studs to seal around the brick ties and where the drainage plane membranes meet.
4. Seal (flash coat) along flashing transitions and around penetrations (mechanical penetrations, relieving angle supports, etc.).
5. Fill in the wall bays after the picture frame areas are fully set up. Use lift thickness as recommended by the manufacturer.
6. Perform any other required air sealing or insulation measures.
Goal: Install an air and vapor tight insulation system

Install the SPF in vertical lines behind the studs to seal around the brick ties and where the drainage plane membranes meet.

Flash coat the membrane to the through-wall-flashing before building up the insulation thickness.

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Goal: Install an air and vapor tight insulation system

Existing brick
Capillary break
Drainage plane membrane
Existing brick tie
Existing brick tie fastener
Profile of SPF
Existing metal stud

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Goal: Install an air and vapor tight insulation system

Fill in the wall bays after the picture frame areas are fully set up. Use lift thickness as recommended by the manufacturer.
Specialty Field-Applied Foam Applications

Perform any other required air sealing or insulation measures

SPF was used to seal major air leakage at the wall panel-to-roof deck transition

Ready for drywall below. Ready for a 15-minute thermal barrier coating above the ceiling
Specialty Field-Applied Foam Applications

The rules of the inside-out method:

Post-spray foam verifications (before the drywall)
1. Maintain ventilation for the recommended cure and re-occupancy period (usually 24 to 72 hours).
2. Perform water tests on the wall assembly to identify any leakage.
3. Now is the time to make any repairs - before the drywall has been installed!
4. Verify that any through-wall appliances are sealed to the through-wall flashings.
5. Monitor energy performance when possible.
Verification: Owner’s water test used to verify rain screen drainage
Specialty Field-Applied Foam Applications

Finished installation

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Energy Improvement vs. Cost for this project

South Londonderry (renovation area ~ 38,000 sq. ft.)

The energy use for this building has been reported to be 40% lower over the past three years!
Energy improvements by the contractor were about $1.28 per square foot of floor area.

“Most green design is moving capital from the mechanical systems to the building enclosure system. Commercial construction is at the worst, a net zero proposition. We should be able to get a green building and not pay more for it, but this requires a good building enclosure and the mechanical system must be sized properly.”

James Petersen, Petersen Engineering