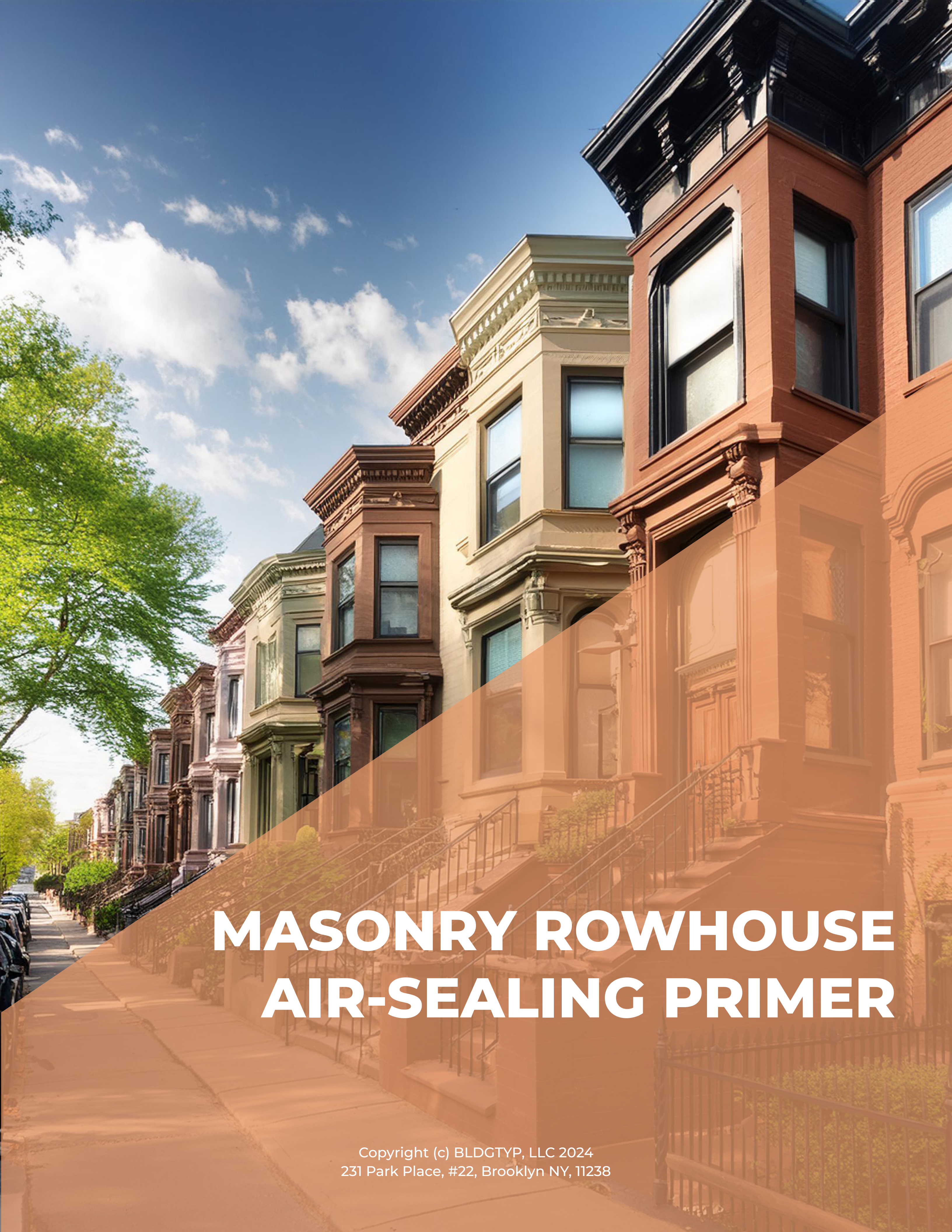


MASONRY ROWHOUSE AIR-SEALING PRIMER

231 Park Place, #22, Brooklyn NY, 11238

Air-sealing is a critical component of any modern high-performance building design. Air-sealing involves creating a continuous barrier that prevents uncontrolled air leakage into, and out of, the building envelope. This practice is crucial for several reasons:

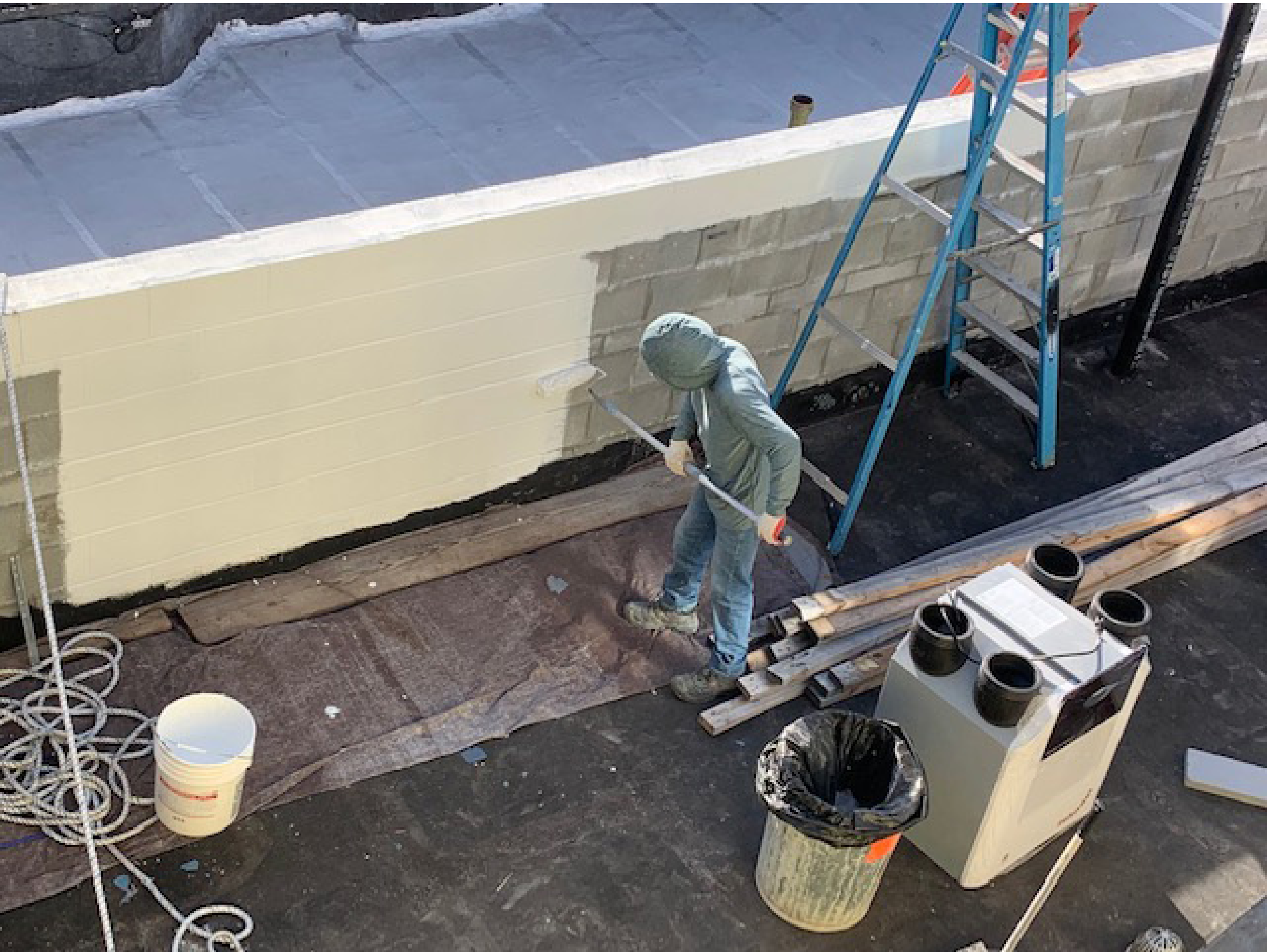
1. **Building Durability:** By controlling the flow of air, air-sealing helps manage moisture levels within the building structure. This reduces the risk of mold growth, wood rot, and other moisture-related problems that can compromise the structural integrity and longevity of the building.

2. **Energy Efficiency:** Air-sealing reduces the amount of conditioned air (heated or cooled) that escapes the building, leading to lower energy consumption and reduced utility bills. By minimizing air leakage, the HVAC system works more efficiently, which also extends its lifespan.

3. **Comfort:** Proper air-sealing eliminates drafts and cold spots, creating a more consistent indoor temperature and enhancing occupant comfort. It also helps in maintaining appropriate humidity levels, contributing to a healthier indoor environment.

4. **Indoor Air Quality:** Air-sealing prevents the infiltration of outdoor pollutants, allergens, and moisture, which can negatively impact indoor air quality and occupant health. This is particularly important for occupants with respiratory issues, allergies, or other sensitivities.

5. **Environmental Impact:** Enhanced energy efficiency through air-sealing contributes to lower greenhouse gas emissions, supporting broader environmental goals and sustainability initiatives.

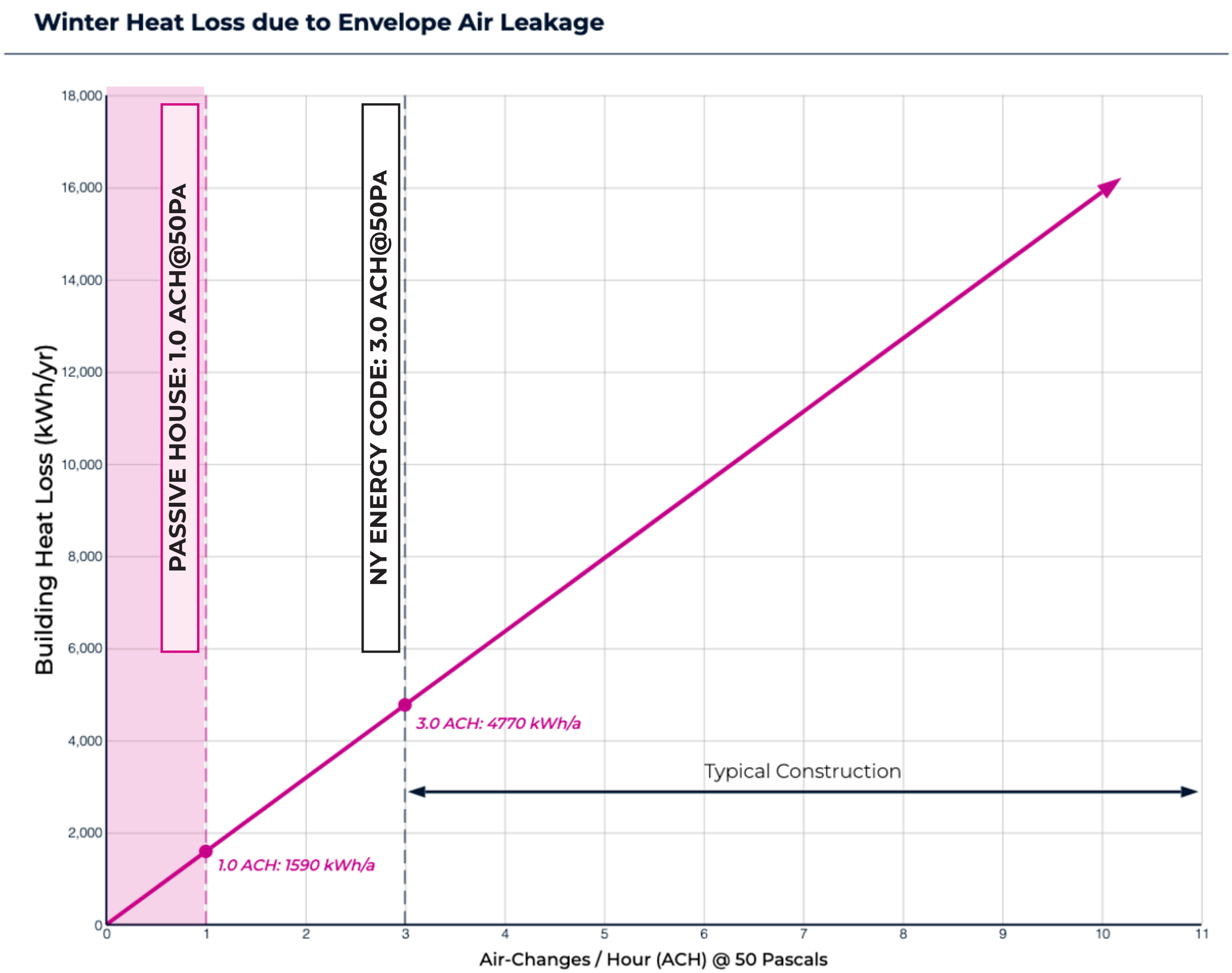


Air-tightness is recognized within both the energy codes and voluntary green-building standards as one of the core pillars of sustainable construction. Building codes have become more and more stringent over time and it is likely that within the near future they will begin to require values approaching standards like Passive House. Currently, in NYC, the air-tightness limits of residential buildings are:

1. **NYC ENERGY CODE (2020):** Section R402.4.1.2 specifies that all residential buildings required to meet the limits of the energy code will have a tested air-tightness value of less than 3.0 air-changes per hour (AHC) @50 pascals of pressure (50Pa).

2. **Passive House Retrofits:** Passive House retrofit projects to the PHI 'EnerPHit' level have a maximum allowable air-leakage of 1.0 ACH @50Pa.

3. **Passive House New Constructions:** Passive House new-construction limits all Certified homes to a maximum air-leakage of 0.6 ACH@50Pa.



ACH@50Pa ? *Airtightness in often measured in the number of "Air-Changes-per-Hour" (ACH). This is a measurement of the number times, in an hour, that all of the air in a building is exchanged due to leakage through the envelope. This is often evaluated at 50 Pascals of pressure (50Pa) for consistency.*

AIR-SEALING: METHODS

Air-sealing an existing masonry structure can be achieved through various methods, including liquid-applied air-sealing and the use of specialty membranes.

Liquid-Applied Air-Sealing

1. **Sealants:** Applied directly to gaps, cracks, and joints in the masonry. These sealants can be silicone, polyurethane, or acrylic-based and provide a flexible, durable barrier against air leakage.

2. **Spray Foam:** Expanding spray foam is used to fill larger gaps and cavities. It expands to fill voids and hardens to provide the base layer for subsequent airtightness products. Spray foam alone should not be relied upon for durable airtightness.

3. **Brush- or Roller-Applied Coatings:** Liquid coatings are applied using brushes or rollers to create a continuous air barrier over the surface of the masonry. These coatings can be elastomeric or other high-performance materials designed to adhere to masonry surfaces.

Membranes

1. **Self-Adhered Membranes:** These are peel-and-stick sheets that are applied directly to the masonry surface. They create an airtight and watertight seal, typically used around windows, doors, and other penetrations.

2. **Sheet Membranes:** Large rolls of membrane material are mechanically fastened or adhered to the masonry surface. These membranes often require additional detailing at seams and penetrations to ensure an airtight seal.

Each of these methods has its specific applications and advantages, and often a combination of techniques is used to achieve optimal air-sealing in an existing masonry structure. For most typical masonry rowhouse buildings, the most common recommended strategy includes:

- **Cellar:** For the cellar, if the existing floor slab is being replaced, install new continuous sub-slab air and moisture-vapor barrier sheeting. 10 or 20 mil plastic sheeting, taped at all seams and penetrations is a good solution for this location.

- **Masonry Walls:** For the typical masonry walls, a new liquid-applied air-sealing membrane should be installed on the INTERIOR side, directly on the masonry.

- **Roof/Ceiling:** Roofs should have a sheet-membrane airtight layer installed on the underside of the roof joists. This membrane should be taped and sealed at all penetrations, and should also function as a vapor-retarding layer to manage potential condensation risk at the roof sheathing. Alternatively, roofs may be treated with closed-cell foam in order to provide similar air-sealing and moisture-vapor control though a separate, dedicated airtight layer should still be used.

Sequencing of the work is crucial when applying airtightness in building construction. Proper sequencing ensures that each stage of the air-sealing process is completed in the correct order to maintain the integrity of the airtight barrier. Here are key points to consider when planning for air-sealing in a masonry rowhouse:

Importance of Sequencing

1. **Preventing Rework and Damage:** If air-sealing is not done in the correct sequence, subsequent construction activities can damage the airtight barrier, leading to leaks and the need for rework. For example, installing airtightness measures before structural components like ledgers and columns are in place can lead to these elements compromising the seal when they are added later.

2. **Ensuring Continuity:** Sequencing allows for the airtight layer to be completed in small, manageable sections before other building elements are installed. This step-by-step approach ensures that each section is properly sealed and checked for continuity, making it easier to identify and address any gaps or weaknesses.

3. **Access and Detailing:** Certain areas may become inaccessible once additional construction elements are in place. Sequencing ensures that critical areas are sealed before they are obstructed by other components, ensuring a thorough and effective airtight barrier.

Sequencing Steps

1. **Planning and Coordination:** Before construction begins, develop a detailed plan that outlines the sequence of air-sealing activities. Coordinate with all trades involved to ensure they understand the importance of following the sequence and the impact of their work on the airtightness layer.

2. **Initial Air-Sealing:** Begin by sealing areas that will be difficult to access later, such as around structural details (ledgers, columns, beams) and penetrations (pipes, ducts, electrical conduits). These initial steps create a baseline airtight layer that can be built upon.

3. **Installing Structural Details:** Once the initial air-sealing is complete, install structural elements like ledgers and columns. Ensure these components are integrated with the airtight layer, using appropriate sealants and materials to maintain continuity.

4. **Intermediate Air-Sealing:** After structural elements are in place, continue air-sealing around these components. Pay special attention to connections and transitions, ensuring that the airtight barrier remains continuous.

5. **Final Air-Sealing:** Complete the air-sealing of the remaining areas, including walls, floors, ceilings, and any remaining penetrations. Conduct thorough inspections to ensure the entire building envelope is sealed properly.

6. **Verification and Testing:** Perform air leakage tests, such as a blower door test, to verify the effectiveness of the air-sealing. Address any identified leaks promptly to maintain the integrity of the airtight barrier.

AIR-SEALING: 'RED-LINE' TEST

The so called 'red-line' test is a critical design review step used to ensure the continuity of the airtight boundary in a building. The design team should complete this step during the detailing phase for EACH building:

1. **PRINT Drawings:** Start with either a plan or section drawing of the building. Print it out; the red-line test is best done by hand, NOT in the computer.

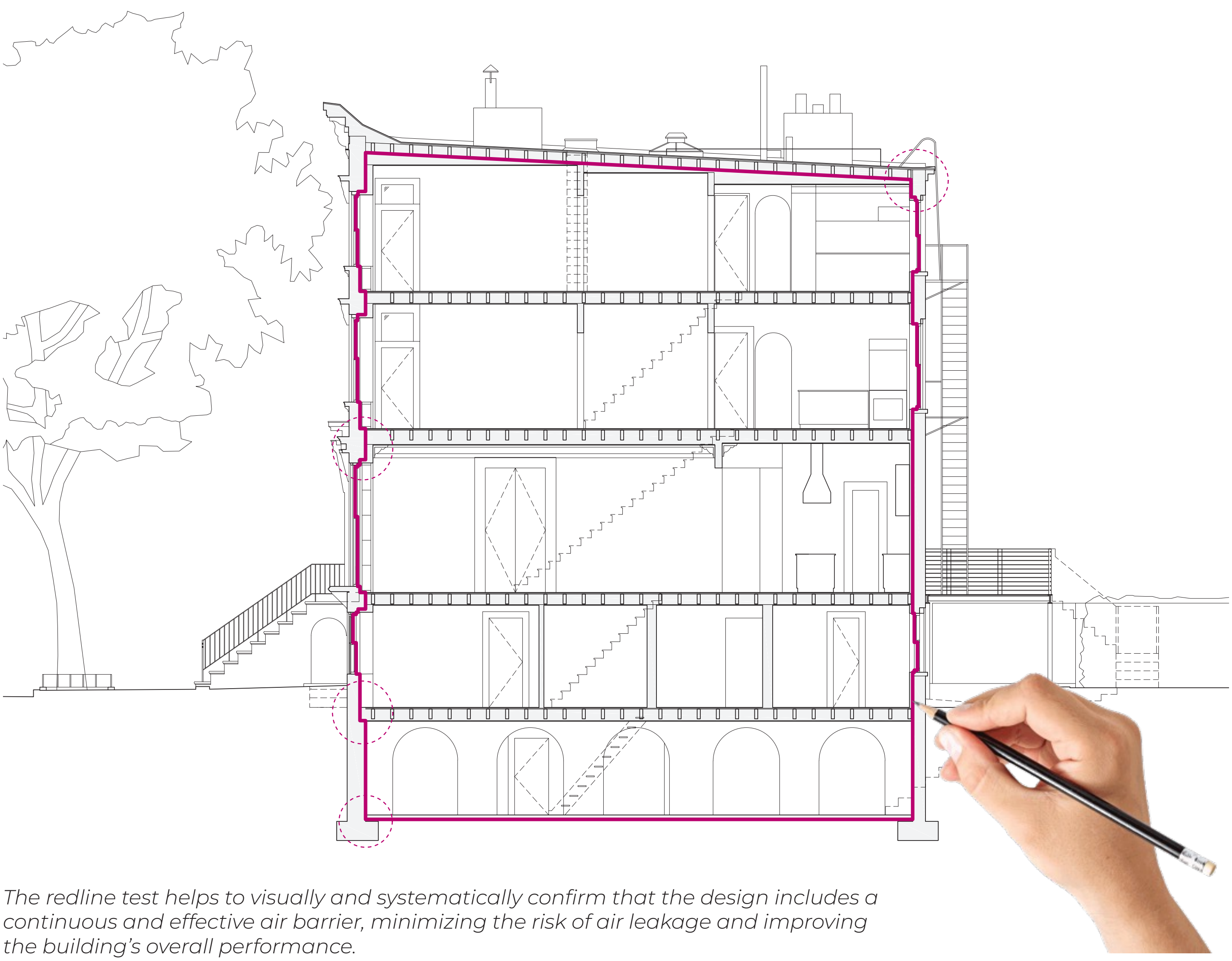
2. **Trace the Airtight Boundary:** Using a red pen or red marker, trace the intended airtight boundary continuously around the entire building envelope on the drawings.

3. **Check for Continuity:** As the line is drawn, carefully check to ensure that it forms an unbroken loop without any gaps or voids. The line should connect all parts of the building that need to be airtight, including walls, floors, roofs, windows, doors, and penetrations.

4. **Identify Problem Areas:** Look for any areas where the line cannot be drawn continuously, such as intersections, changes in material, or complex architectural details. These areas indicate potential weak points in the airtightness and should be re-designed to be airtight.

5. **Detail The Solutions:** Develop and document solutions for any identified gaps or voids. This may involve detailing specific air-sealing methods or materials to be used in those areas.

6. **Review and Revise:** Repeat the process as necessary, reviewing and revising the drawings to ensure a complete and continuous airtight boundary in all plans and all sections.



The redline test helps to visually and systematically confirm that the design includes a continuous and effective air barrier, minimizing the risk of air leakage and improving the building's overall performance.

AIR-BARRIER APPLICATIONS

FLOORS
WALLS
ROOFS / CEILINGS
AEROSEAL

FLOORS: SHEET MEMBRANE

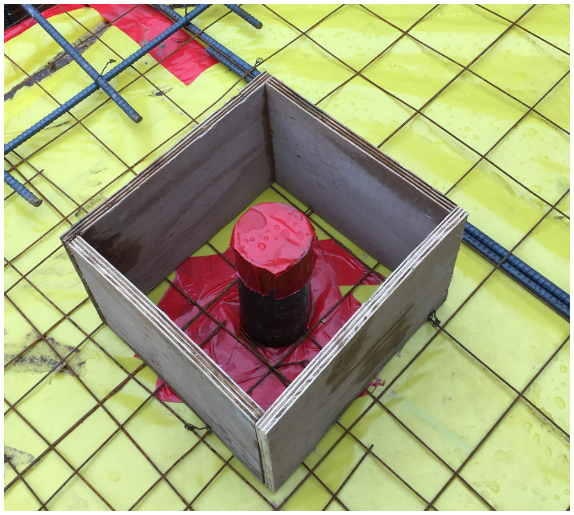
The floor of a masonry rowhouse should be air-sealed using a continuous air and moisture-vapor impermeable sheeting. This sheeting, which is included in most modern flooring applications for controlling moisture, can double as the air-barrier IF it is detailed properly and sealed carefully at all the edges, seams, overlaps, and penetrations.

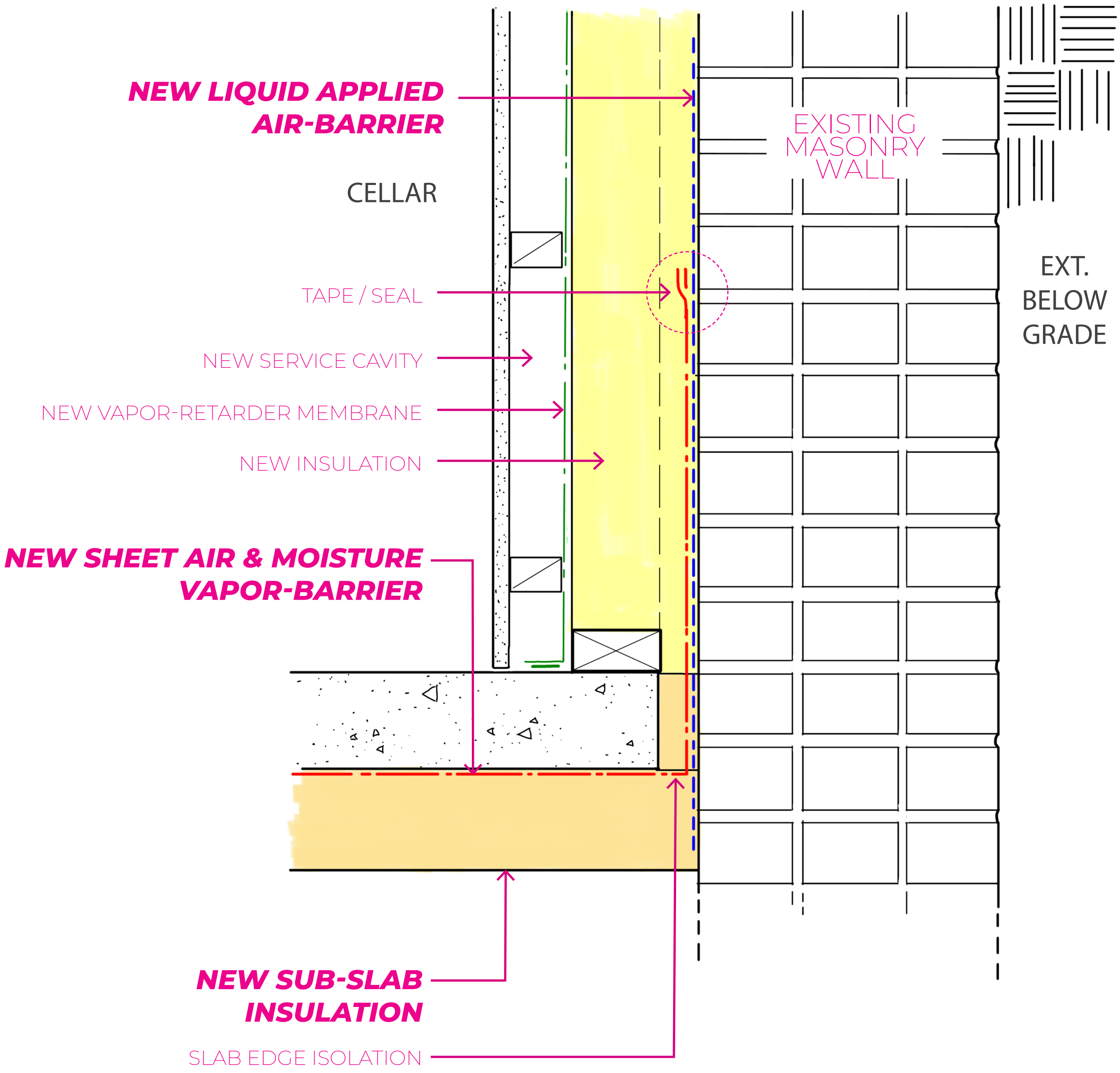
1. **Location:** This plastic sheeting should be installed above any sub-slab insulation, in direct contact with the concrete floor slab itself. This will help to avoid any moisture issues with the finish flooring.

2. **Sealing:** Follow all manufacturer instructions when sealing the sheeting edges and penetrations. Use only approved sealants, adhesives ,and tapes.

3. **Penetrations:** All penetrations through this plastic sheeting must be carefully taped and sealed. While the sheeting can work well as a vapor-retarder even when left un-sealed, for it work as a full air-barrier all gaps must be closed and sealed.

4. **Edges:** All the edges of the floor, ensure the plastic sheeting turns up the side walls a minimum of 18:" and is sealed well to the wall. This is important to ensure against any air leakage at the joint between the floor and the wall.




NEW LIQUID APPLIED AIR-BARRIER
CELLAR
EXISTING MASONRY WALL
TAPE / SEAL
EXT. BELOW GRADE
NEW SERVICE CAVITY
NEW VAPOR-RETARDER MEMBRANE
NEW INSULATION
NEW SHEET AIR & MOISTURE VAPOR-BARRIER
NEW SUB-SLAB INSULATION
SLAB EDGE ISOLATION

WALLS: LIQUID APPLIED

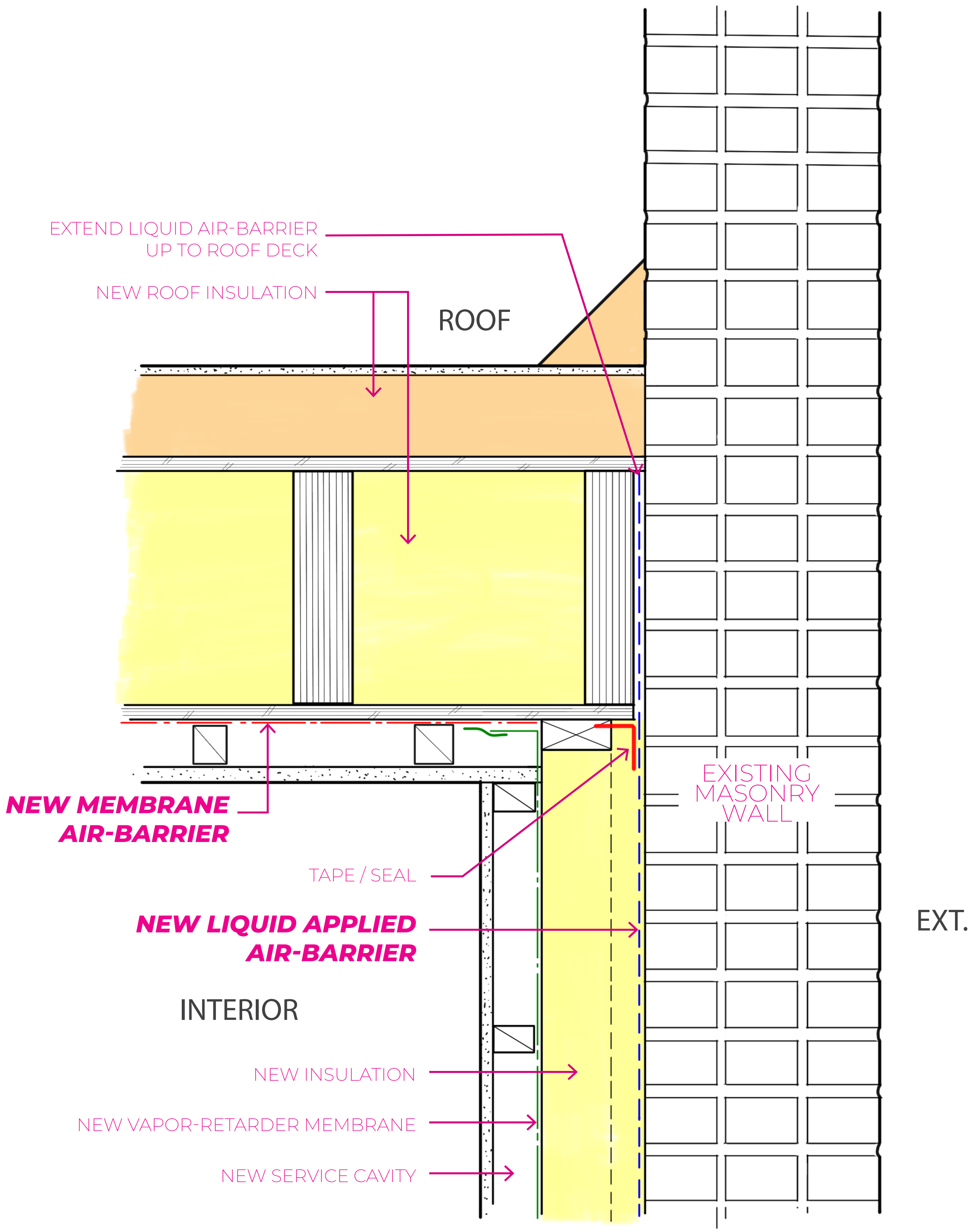
Applying an interior-side liquid airtightness material to an existing masonry rowhouse involves careful preparation and systematic application to ensure a continuous air barrier. Here's a brief overview of the process:

Applying the Liquid Airtightness Material:

1. **Front and Rear Walls:** After the surface has been properly cleaned and prepared (see the following section), begin applying the liquid airtightness material to the front and rear walls. Use a brush, roller, or sprayer and follow all manufacturer instructions to ensure an even, continuous coat. Pay special attention to edges, corners, and around any penetrations (e.g., windows, doors, and utility openings) to ensure a complete seal.

2. **Party Walls:** Apply the liquid airtightness material to the party walls, following the same method. Ensure that the application extends to all edges and corners, and that it integrates seamlessly with the front and rear wall coatings. While air-sealing partywalls does not help significantly to reduce energy consumption, it is crucial to air-seal these surfaces in order to control pests, dust, smoke, odors, noise, and other airborne contaminants from moving between neighboring buildings.

3. **Seal Transitions and Penetrations:** Carefully seal all transitions between walls, floors, and ceilings, as well as any penetrations. Use additional sealant or liquid material to ensure a continuous, unbroken air barrier.


EXTEND LIQUID AIR-BARRIER
UP TO ROOF DECK
NEW ROOF INSULATION
ROOF
NEW MEMBRANE
AIR-BARRIER
EXISTING
MASONRY
WALL
TAPE / SEAL
NEW LIQUID APPLIED
AIR-BARRIER
EXT.
INTERIOR
NEW INSULATION
NEW VAPOR-RETARDER MEMBRANE
NEW SERVICE CAVITY

WALLS: VISCONN LIQUID APPLIED

RECOMMENDED PRODUCT

Pro-Clima VISCONN
https://475.supply/products/visconn

Liquid-applied air barrier for robust connections. For use as WRB, flashing for pitched windows sills, and other detailing. VISCONN® can be brushed, rolled, or sprayed as a liquid film and dries to form a seamless, elastic, airtight and vapor-variable membrane.

- Time-saving airsealing of difficult junction because of airless spray/brush application
- PHI-Certified airbarrier - for interior with vapor-variable properties
- IFT Rosenheim certification as airtight/waterproof joint sealing for insulated window frame rough opening gaps
- For use as WRB on exterior behind rainscreens when shielded from long term UV exposure
- Excellent values in the hazardous substance test, has been tested according to the AgBB evaluation scheme / ISO 16000
- Use appropriate safety protection when using airless sprayer
- Available in two color options: one that is blue when wet and dries black to confirm drying, one that is white when both wet or dry

Substrates:
- Apply to walls, ceilings and floor surfaces, such as masonry, CMU, wood sheathing, fiberboard, joists or joist bays
- Reliably fills gaps of 1/8”. Deeper joints and thick coats result in longer cure times.
- Highly porous/uneven materials require 2 or more coats for reliable coverage/airsealing
- It may be necessary to apply more than one coat in the case of uneven or rough subsurfaces
- Can be plastered/painted over, Pro Clima® adhesive tapes can be bonded onto it (and can be sprayed over all TESCON/CONTEGA Pro Clima® tapes)

VISCONN FIBRE:
- Fiber-reinforced mix to provide additional support at the joints and intersections between materials.

WALLS: SURFACE PREPARATION

Preparing an existing brick wall to receive a liquid-applied airtightness layer involves several key steps to ensure the surface is suitable for creating a continuous and effective air barrier. Here is a summarized process:

1. **Inspection and Assessment:** Begin by thoroughly inspecting the brick wall for any damage, cracks, or voids. Identify areas that need repair or special attention.

2. **Cleaning:** Clean the wall surface to remove dirt, dust, loose debris, and any existing coatings that might interfere with the adhesion of the liquid-applied layer. Use pressure washing or brushing as appropriate.

3. **Repairs:** Repair any damaged areas. This includes:

    - Fill any cracks or voids with appropriate masonry repair materials such as mortar or patching compounds. Allow the repair materials to cure properly.
    - Replace any loose or damaged bricks and ensure they are securely mortared in place.

4. **Parging:** Apply a continuous parge coat to the entire surface of the wall. Parging involves applying a thin layer of mortar over the brickwork to create a smooth, even surface. This helps to fill in minor imperfections and provides a uniform substrate for the liquid-applied air-sealing layer.

5. **Curing:** Allow the parge coat to cure completely. The curing time will depend on the type of mortar used and environmental conditions. Proper curing ensures that the parge coat provides a stable and durable surface.

6. **Surface Preparation:** Ensure the parge coat is clean and dry before applying the liquid-applied airtightness layer. Any remaining dust or moisture can affect adhesion.

By following these steps, the brick wall will be properly prepared to receive the liquid-applied airtightness layer, ensuring a durable and effective air barrier.

WALLS: JOIST POCKETS

Sealing wood joists through a liquid-applied layer involves careful preparation and application to ensure a continuous and effective air barrier. Here is a summarized process:

1. **Inspection and Assessment:** Inspect the wood joists for any damage or rot. Identify areas that need repair or special attention.

2. **Cleaning:** Clean the wood joists thoroughly to remove dirt, dust, and debris. Use a brush or vacuum to ensure all surfaces are clean.

3. **Sanding:** Sand the surfaces of the wood joists lightly to create a smooth and even substrate. This helps improve the adhesion of the sealant and liquid-applied layer.

4. **Priming (if needed):** If the wood is porous or the sealant manufacturer recommends it, apply a primer to the wood joists. Allow the primer to dry according to the manufacturer's instructions.

5. **Flexible Sealant Application:** Carefully apply a flexible sealant to all edges and joints where the wood joists meet other building elements (e.g., masonry walls, floors). Ensure a continuous bead of sealant to fill any gaps and prevent air leakage.

6. **Liquid-Applied Layer:** Once the sealant is cured, apply the liquid-applied airtightness layer over the entire surface of the wood joists. Use a brush, roller, or sprayer to ensure complete coverage.

7. **Detailing:** Pay special attention to detailing around penetrations, edges, and intersections with other materials. Ensure a seamless transition between the liquid-applied layer and adjacent surfaces.

8. **Curing:** Allow the liquid-applied layer to cure completely as per the manufacturer's instructions. Ensure proper ventilation and environmental conditions for optimal curing.

By following these steps, wood joists will be effectively sealed with a liquid-applied layer, creating a continuous air barrier and enhancing the building's overall airtightness.

Note the initial sealing of the joists to the masony wall. A second application of a permanently elastic joint-sealer will ensure long-term durability of this connection as the building moves over time.

WALLS: JOIST LEDGER

An alternative detail which makes air-sealing easier and is allowed in some circumstances is to use a ledger in place of joist-pockets for each floor joist. In this scenario, a single continuous structural element with joist-hangers is used to provide support for the floor.

1. **Prepare the substrate:** Repair, re-point, and re-surface the masonry as required to provide sufficient structural support for the ledger.

2. **Apply liquid air-sealing material to the ledger zone.** If the rest of the wall is ready for air-sealing, continue the application across the entire surface. If additional steps are required before the wall can be air-sealed, apply the air-seal to the area around the ledger only. Extend the material 12-18” out from the edge of the ledger in all directions in order to allow for connection later.

3. **Apply the ledger:** Follow all structural requirements and directions for anchorage or bearing of the ledger.

4. **Install the Floor Joist:** Use joist-hangers to install the floor joists without penetrating the air-sealing layer.

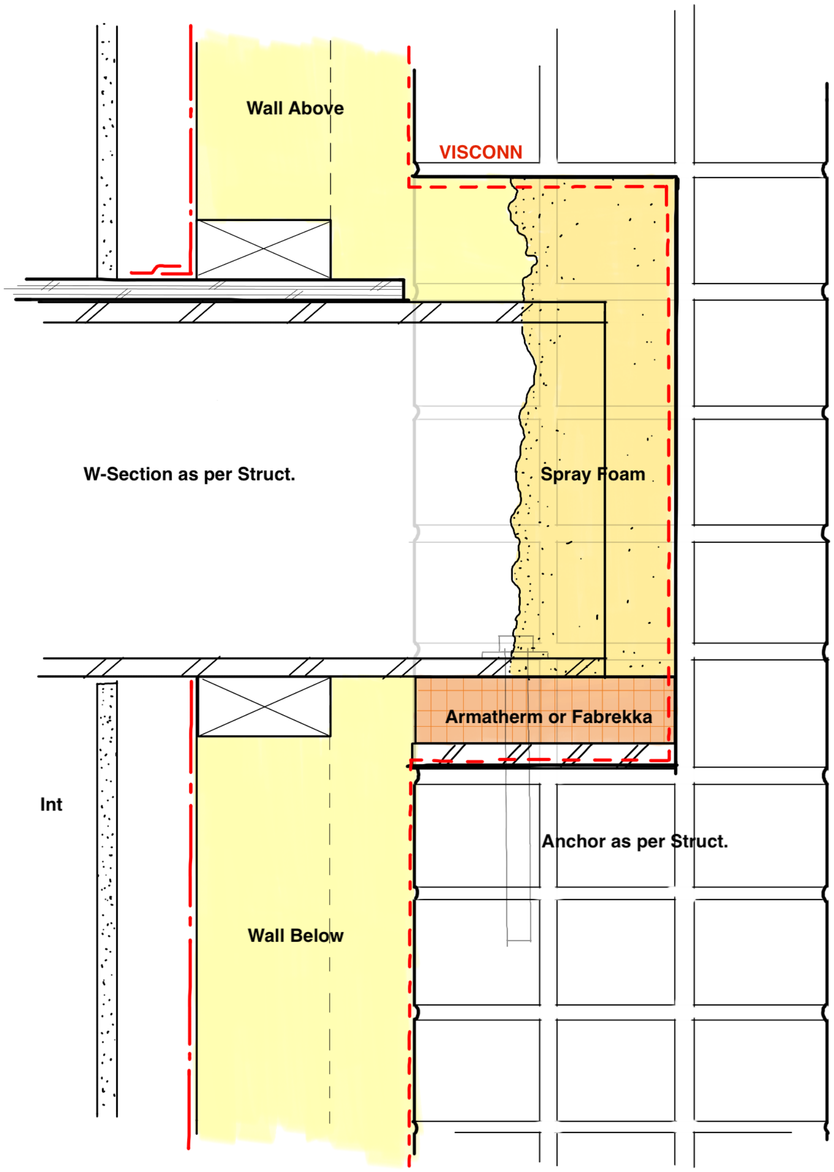
Apply the liquid air-seal material to the ledger zone and ensure that it extends far enough on all sides that it can be continued across the wall in later steps.

Install the structural ledger and the floor joists. Note that in the case shown here, the ledger is supported by two beams which do pocket into the masonry and which are carefully sealed at all edges. See the next section for beam-pocket details.

WALLS: BEAM POCKETS

Where beams must pocket into the masonry for structural support, it is critical to prepare the pockets with proper air-sealing before the beams are installed. If the beams pocket into a wall which is exposed to the exterior (front, rear, light-wells, etc...), then additional steps are recommended to ensure against thermal bridging and condensation risk as well.

Prepare the pocket by ensuring that it is solid masonry on all sides and repair / replace any missing or damaged masonry. Coat the entire pocket with liquid air-seal material before installing the beam. Ensure the liquid air-seal material extends out onto the face of the wall far enough to allow connection in later steps.



WALLS: VAPOR-RETARDER MEMBRANE

Any wall surfaces which are exposed to the exterior (front, rear, extension walls, light-well-walls, etc...) and experience cold exterior conditions should have an additional moisture vapor-retarding membrane later installed on the interior face. This moisture vapor-retarder will ensure against any interior-side moisture forming condensation and mold on the cold brick face.

In all scenarios, this moisture vapor-retarder should be designed in such a way that it protects the masonry from interior-side moisture during winter, while allowing for the masonry to dry effectively. For this reason, for NYC rowhouse we recommend the use of so called ‘smart’ vapor-retarder products which will allow for this variation in moisture-vapor movement. During winter, these ‘smart’ vapor-retarders effectively stop the flow of any moisture-vapor, while in the spring and summer they change behavior and allow for moisture-vapor to migrate through, allowing drying to the interior during these seasons.

All vapor-retarder layers should be installed on the ‘inside’ face of the walls and protected by a ‘service cavity’ layer made from battens or strapping. All seams and overlaps of the membrane should be taped and sealed with compatible products, and all connections with elements like concrete, steel, or masonry should be installed to allow for the movement of the building over time.

WALLS: INTELLO PLUS MEMBRANE

RECOMMENDED PRODUCT

Pro-Clima Intello Plus
https://475.supply/products/intello-plus

Air barrier, smart vapor retarder, and dense-pack reinforcement all in one. INTELLO Plus® is the keystone to long-lasting airtightness and intelligent vapor control in walls and roofs.

- Vapor Variable: Low Class II vapor retarder in winter (<0.13 Perm), protects against condensation, and maximum vapor openness in summer (13.2 Perm) to facilitate rapid drying to the interior in summer. Protects the assembly during construction high humidity periods (>70% RH) with a DIN 68800-2 compliant, Hydrosafe value of 1.6 perms
- Works with wide range of insulation materials, including Gutex wood fiber and cellulose dense-pack, Havelock wool, stone wool, fiberglass, and many others. The semi-translucent material allows dense packed blown-in insulation to be inspected after installation
- PHI Certified Class A Passive House Component
- Living Building Challenge Compliant — Red List Free
- Pro Clima Intelligent Airtight system (TESCON VANA tape, ROFLEX gaskets etc) allows for fast, reliable installation

Properties:
- Material: polyethelyene copolymer protected by PP covers
- Tensile strength: has mesh reinforcement for durable blown-in insulation
- Permeability: VAPOR VARIABLE from 0.13 to over 13 perm – best in class (factor 100)
- Class A material per ASTM E84 test (0 FS, 35 SDI)
- Air permeance per ASTM E2178 0.00005cfm/ft2 (0.0025 L/s*m2)
- UV/weather Resistance: if direct UV/weather exposure is expected - use INTELLO X

WALLS: “SERVICE CAVITY”

For all walls which include a moisture-vapor-retarder we recommend using a “service cavity” in order to provide room for MEP elements, protect the membrane layer from damage, and minimize the number of penetrations through the membrane.

1. **Design and Planning:** During the design phase, plan for the service cavity to be located on the inboard side (interior side) of the smart vapor-retarder membrane. Typically, this cavity is created by installing furring strips or framing members on the interior side of the membrane.

2. **Construction:**
   - **Install the Smart Vapor-Retarder Membrane:** Secure the membrane to the structural framing, ensuring it covers the entire wall surface and is properly sealed at edges, seams, and penetrations.
   - **Create the Service Cavity:** Attach vertical or horizontal furring strips or a secondary set of framing members to the interior side of the membrane. The depth of the cavity can vary but typically ranges from 1 to 2 inches (25 to 50 mm).

3. **Running Services:**
   - **Electrical and Plumbing:** Install electrical wiring, outlets, switches, and plumbing pipes within the service cavity, keeping all penetrations within this space.
   - **HVAC and Other Services:** Run HVAC ducts, data cables, and other services within the cavity, ensuring they do not breach the primary air and vapor barrier.

4. **Finishing:** Once all services are installed, cover the service cavity with drywall or another interior finish material. This layer serves as the final interior surface and can be easily removed for future access to the services without disturbing the underlying vapor-retarder membrane.

ROOFS: SHEET MEMBRANE

All roof surfaces should be sealed with a smart vapor-retarder membrane installed on the underside of the floor joists. This continuous air-barrier membrane should be carefully taped and sealed with compatible products, and should be protected through the use of a drop-ceiling or service-cavity deep enough to provide room for all lighting, plumbing, or HVAC ducting and equipment to be installed without penetrating the membrane layer.

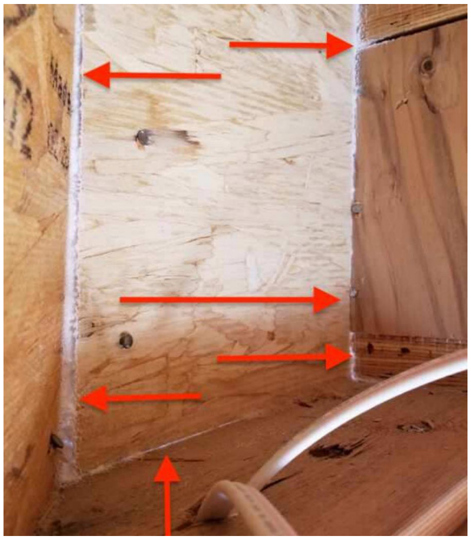
RECOMMENDED PRODUCT

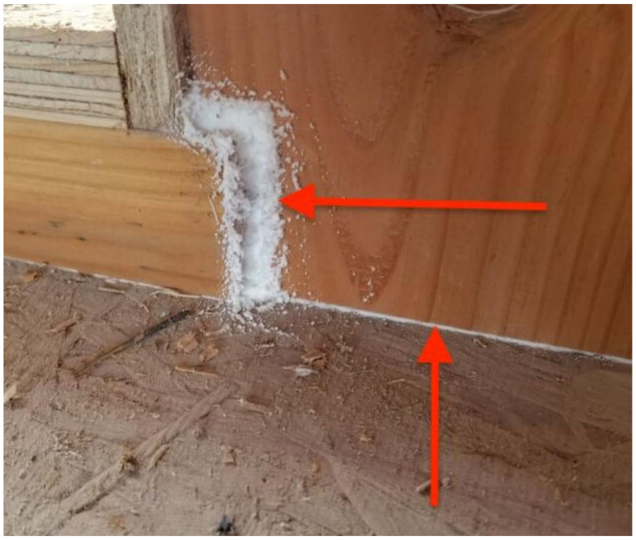
AeroBarrier
https://aeroseal.com/

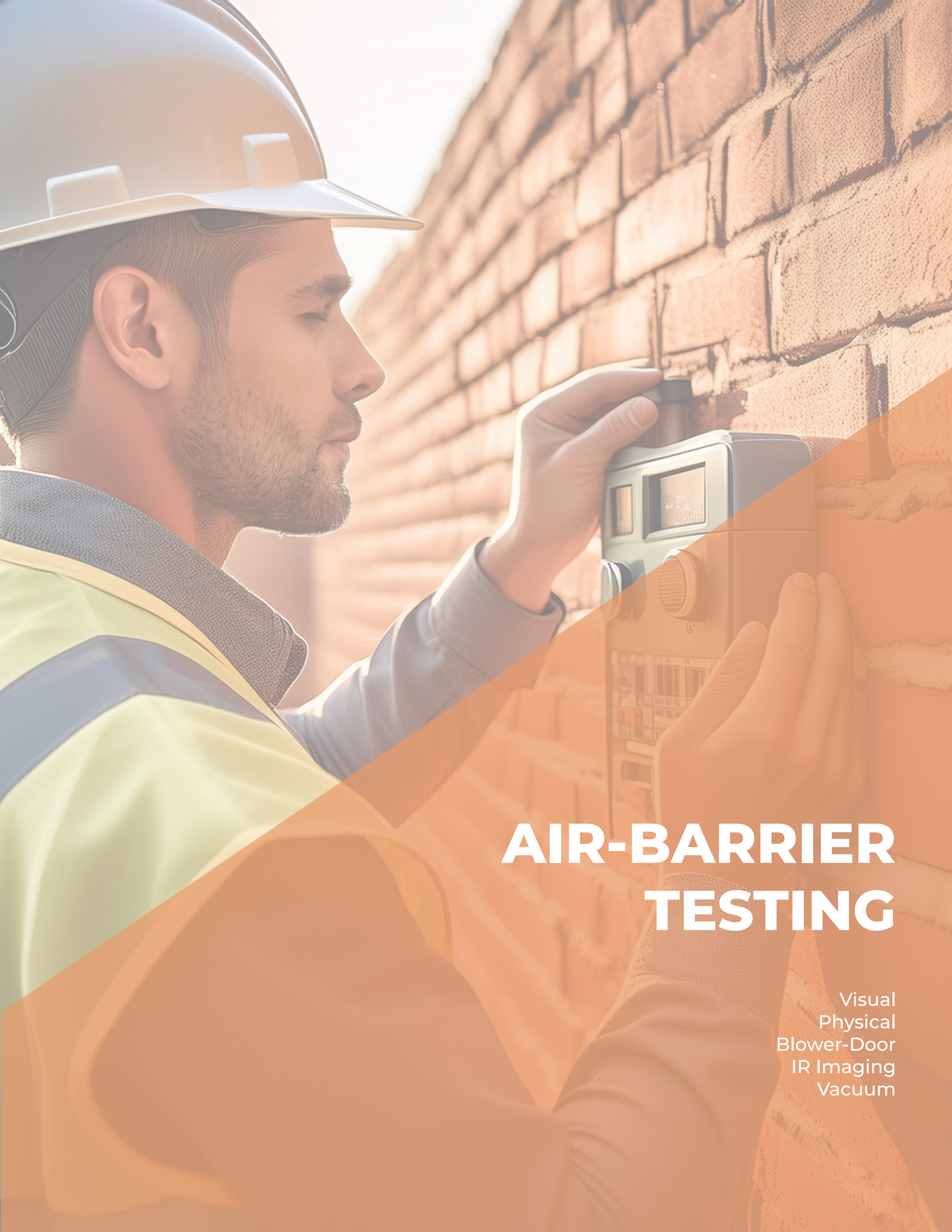
The dedicated air barrier layers described in previous sections will provide durable long-term airtightness for all walls, roofs, and floors. However; in many retrofit projects some areas may be inaccessible or hard to seal due to existing conditions or otherwise impractical to expose in order to accomplish perfect air sealing throughout the entire building. In cases where air sealing results are uncertain, we recommend having a backup plan in place.

AeroBarrier provides whole-building air sealing using an aerosolized polymer that automatically "finds" air leaks and seals them. We recommend consulting early in the build with an **AeroBarrier** installer so that they can be included in the project schedule should their services be required.

NYC Region Installer:
Lawrence Lindner
845-416-4933
LL@phairseal.com
www.PHAirseal.com







AIR-BARRIER TESTING

Visual
Physical
Blower-Door
IR Imaging
Vacuum

Testing for air-tightness is crucial for achieving whole-building airtightness in high-performance buildings. It verifies construction quality, identifies leak points, ensures compliance with performance standards, enhances energy efficiency, controls moisture, and improves occupant comfort and health.

1. **Verification of Construction Quality:** Air-tightness testing ensures that the building has been constructed according to the design specifications. It identifies any gaps, cracks, or flaws in the building envelope that may have been overlooked during construction.

2. **Identification of Leakage Areas:** The tests help locate specific areas where air leaks occur, such as around windows, doors, and penetrations. Identifying these weak points testing allows for targeted repairs and sealing, ensuring a continuous air barrier.

3. **Ensuring Performance Standards:** High-performance buildings aim to meet stringent energy efficiency and indoor air quality standards. Air-tightness testing verifies that the building meets these standards, which is critical for certifications like Passive House, LEED, and others.

4. **Enhanced Energy Efficiency:** By ensuring that the building envelope is air-tight, the test helps reduce energy loss due to air leakage, leading to lower heating and cooling costs and improved overall energy efficiency.

5. **Moisture Control:** Air leaks can lead to moisture intrusion, which can cause condensation, mold growth, and structural damage. Air-tightness testing helps prevent these issues by ensuring a robust barrier against air and moisture infiltration.

6. **Occupant Comfort and Health:** A well-sealed building provides a more comfortable indoor environment by eliminating drafts and maintaining consistent temperatures. It also improves indoor air quality by preventing the infiltration of pollutants and allergens.

TESTING: VISUAL INSPECTIONS

1. **Preparation:**
   - **Review Plans and Specifications:** Familiarize yourself with the building's design, air-sealing requirements, and specified materials.
   - **Checklists:** Use standardized checklists to ensure all critical areas and details are inspected.

2. **Inspection Areas:**
   - **Building Envelope:** Inspect the entire building envelope, including walls, roof, and foundation, focusing on joints, seams, and transitions.
   - **Penetrations:** Check around windows, doors, electrical outlets, plumbing, and HVAC penetrations for proper sealing.
   - **Connections and Interfaces:** Examine connections between different materials and assemblies, such as where walls meet the roof or foundation.

3. **Materials and Application:**
   - **Sealant Application**: Ensure that sealants are applied continuously and evenly without gaps or voids.
   - **Membranes and Tapes:** Check that vapor barriers, air barriers, and tapes are properly installed, with edges securely adhered and overlaps correctly sealed.
   - **Insulation:** Verify that insulation is installed without gaps or compression, and that it fits snugly around obstacles.

4. **Common Problem Areas:**
   - **Corners and Edges:** Pay special attention to corners, edges, and intersections where air leakage is more likely.
   - **Complex Details:** Carefully inspect around complex architectural details such as bay windows, dormers, and roof-wall junctions.

5. **Corrective Actions:**
   - **Identify Deficiencies:** Document any areas where the air-sealing or material installation is inadequate.
   - **Repair and Re-inspect:** Ensure that identified deficiencies are repaired and re-inspected to confirm proper sealing.

6. **Documentation:**
   - **Record Findings:** Maintain detailed records of the inspection findings, including photos and notes of any issues and corrective actions taken.
   - **Quality Assurance:** Use the inspection records as part of the overall quality assurance process to verify that the building meets the design and performance standards.

No special tools or equipment are needed to find many of the most glaring air-sealing issues. Simple visual inspections and walk-throughs can find many of the most common issues. In the case here, the air-seal tape has a large gap which will result in a substantial leak.

TESTING: PHYSICAL INSPECTIONS

Simple physical inspections can be a very effective method of assessing the durability of any air-sealing application. Inspectors can scrape, pull, or tug on air-sealing materials to ensure that they will not be easily damaged of removed. Durable air-sealing which will last for the life of the building should easy be able to withstand such simple tests without degradation.

Liquid Applied Layers: Try and scrape off the application using a fingernail - while some product may come off, large areas should not delaminate or be able to be removed. If the product easily falls away from the substrate, mitigation or re-application methods may need to be taken.

Tapes: All airseal tapes, if properly installed, should not be able to be easily remove or pulled off the substrate. Many air-seal tapes are acrylic which require pressure in order to activate the long-term adhesive. If the installer does not execute this pressure-activation the tape will fail to adhere and will need to be removed and new tape re-applied.

Liquid applied air and water barrier on the exterior of a concrete wall. Note that with little more than a fingernail the product was able to be removed from the concrete, indicating poor adhesion and improper application.

Air-seal taping from wall to window which was not properly adhered. Acrylic air-seal tape often requires pressure to activate the adhesive and if not installed properly will be easy to physically pull off. This tape needs to be cut-back or removed, and new tape installed properly.

TESTING: BLOWER DOOR

A **blower-door test** is a valuable diagnostic tool used to assess and improve the air-tightness of buildings. It measures the air leakage rate and identifies specific leakage points, contributing to better energy efficiency, comfort, and indoor air quality.

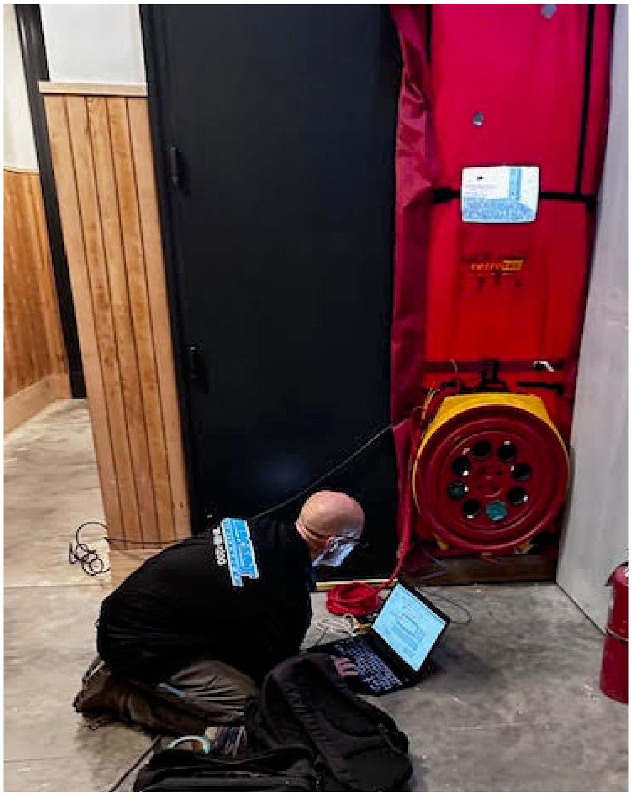
Preparation:
1. Close all exterior doors, windows, and openings.
2. Open all interior doors to ensure the pressure difference is consistent throughout the building.
3. Seal any intentional openings, such as vents and flues.

Setting Up the Blower Door:
1. Install the blower door frame and fan in an exterior door, typically the main entrance.
2. Attach a manometer (pressure gauge) to measure the pressure difference between the inside and outside of the building.

Conducting the Test:
1. Turn on the blower door fan to depressurize the building, creating a pressure difference (usually 50 Pascals).
2. Measure the air leakage rate by determining the airflow required to maintain the pressure difference.

Identifying and Addressing Leaks:
1. Locate areas where air leaks occur, such as around windows, doors, electrical outlets, and penetrations.
2. Seal identified leaks using appropriate materials like caulk, weatherstripping, or spray foam.

Post-Test:
1. Retest the building if necessary to confirm that the air leaks have been effectively sealed and that the building meets the desired air-tightness standards.



TESTING: IR IMAGING

Infrared Imaging (IR) is a non-invasive diagnostic technique that uses infrared cameras to detect temperature variations on building surfaces. In cold climates, IR imaging is particularly useful for testing building air-tightness due to the significant temperature differences between the indoor heated space and the cold outdoor environment.

How It Works:

- **Infrared Cameras:** These cameras capture thermal images by detecting infrared radiation (heat) emitted from surfaces.
- **Temperature Variations:** The images show temperature differences, with warmer areas appearing in brighter colors and cooler areas in darker colors. In most applications, blue or purple indicate ‘cold’ surfaces, while ‘warm’ surfaces will show up as red or yellow.

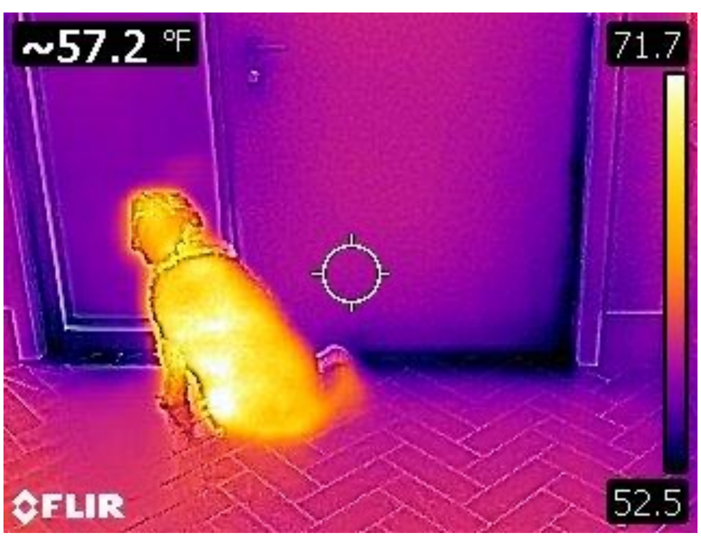
Testing Process:

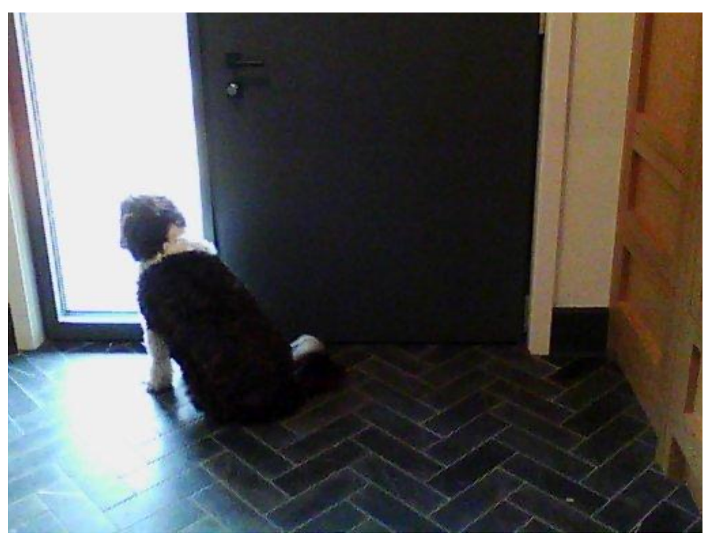
- **Set Up:** Conduct the test during cold weather when there is a substantial temperature difference between the inside and outside of the building.
- **Blower Door Test:** Often combined with a blower door test, which depressurizes or pressurizes the building to amplify air leakage.
- **Thermal Scanning:** Use the infrared camera to scan interior and exterior surfaces of the building envelope, looking for thermal anomalies that indicate air leaks.

Identifying Air Leaks:

- **Hot Spots and Cold Spots:** In a cold climate, warm indoor air leaking out will appear as hot spots on the exterior surfaces, while cold outdoor air infiltrating will appear as cold spots on interior surfaces.
- **Problem Areas:** Common areas of concern include windows, doors, roof-wall junctions, electrical outlets, and any penetrations through the building envelope.

In most uses, ‘cold’ surfaces show up as blue or black color. Note in the image here the dark puddles around the base of the door. This indicates a cold-air leak at the door sill which can be fixed through adjusting the hinges such that the door closes tightly on all sides.





TESTING: VACUUM TESTING

In a 'Vacuum test' a suction device with a large transparent cone is used to perform localized de-pressurization of various surfaces. By coating the surface with a soap solution prior to de-pressurization, the tester will be able to visibly identify any air leakage areas (visible bubbles will form at the leakage site).

Once identified, the leakage areas can be repaired or sealed as appropriate. Vacuum testing is not recommended for the entire structure, but is most useful in a few scenarios:

1. During 'mockups' or initial applications where the installers are deciding on the exact application methods for a specific project's materials. Installing a small area of air-seal and then testing to ensure the application worked before proceeding to install the entire building.

2. Leak Tracing: If zones are known to have air leaks but the exact locations are not known, this type of testing can be an effective method of identifying failure points.

ADDITIONAL RESOURCES

https://475.supply
475 has a large number of videos, articles, blog-posts, and manufacturer resources for Pro-Clima products. Their 'knowledge resources' include excellent manuals for applying air-barriers in a variety building types and construction materials.

https://www.youtube.com/@PassiveHouseAccelerator
and
https://www.youtube.com/@ReimagineBuildings
The PH-Accelerator / Reimaine-Buildings channels maintain an enormous catalog of videos focused on high-performance construction, with a special focus on many NYC projects.

https://learn.be-exchange.org
On-demand learning resources with a special focus on the NYC market, real-estate, and high-performance construction.

https://buildingscience.com
Research and development corporation dedicated to high-performance construction. An enormous catalog of literature covering every aspect of building-science, applications, and materials.

https://www.smallplanetsupply.com
Supplier of various air and water control products as well as other equipment and materials suitable for high-performance construction.

https://source2050.com
Online marketplace for various products related to high-performance construction including a variety of air-sealing products and solutions.

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