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The Sponsors of Energize Connecticut, and in partnership with Connecticut Passive House, are pleased to offer *Passive House & All-Electric Homes Initiative* to support workforce development and help transform the energy efficiency and building construction industries in Connecticut.

CTPH

CONNECTICUT PASSIVE HOUSE

For more information, please visit EnergizeCT.com/passive-house
or email PassiveHouseTrainingCT@icf.com

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Take energy efficiency to a new level

Residential New Construction Passive House Multi-family buildings with five units or more

PASSIVE HOUSE INCENTIVE STRUCTURE FOR MULTI-FAMILY (5 UNITS OR MORE)				
Incentive Timing	**Activity**	**Incentive Amount**	**Max Incentive (Per Unit)**	**Max Incentive (Per Project)**
Pre-Construction	Feasibility Study[1]	Up to 100% of Feasibility Study Costs	N/A	$5,000.00
	Energy Modeling[2]	75% of Energy Modeling Costs (Before 90% Design Drawings)	$500.00	$30,000.00
		50% of Energy Modeling Costs (90% Design/50% Construction)	$250.00	$15,000.00
Post Construction	Certification[3]	Up to 100% of Certification Costs	$1,500.00	$60,000.00

1. Feasibility Study will require documentation in the form of a Feasibility Study report and invoice from the Passive House Consultant
2. Incentives will only be awarded prior to 50% Construction Drawings for Passive House projects. No incentives will be granted after 50% Construction Drawing set.
3. Certification may be either through PHIUS, PHI, or EnerPHit certification offerings.

Next steps you can take...
Contact your Energy Efficiency Representative or

Go to EnergizeCT.com or call 1-877-WISE USE for more details.

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	LEVEL 1		LEVEL 2	
	Single Family (Detached Dwellings)	Multifamily (Attached Dwellings)	Single Family (Detached Dwellings)	Multifamily (Attached Dwellings)
Total UA Alternative Compliance or HERS Index Score †	Total UA ≥ 7.5% better than 2021 IECC or HERS Index Score ≤ 55		Total UA ≥ 15% better than 2021 IECC or HERS Index Score ≤ 45	
Heat pump for space heating ††	Required		Required	
Space Conditioning Connectivity & Controls †††	Optional		Required	
Heat pump for water heating	Required	Optional	Required ††††	
Hot Water Distribution †††††	Required		Required	
Envelope Infiltration Rate (ACH)	ACH50 ≤ 2.5	CFA > 850ft2: ACH50 ≤ 4.0 CFA < 850ft2: ACH50 ≤ 5.0	ACH50 ≤ 2.0	CFA > 850ft2: ACH50 ≤ 3.0 CFA < 850FT2: ACH50 ≤ 4.0
Duct Leakage Rate (CFM)	2021 IECC code minimum requirements		All ductwork must be located in conditioned space	
Balanced Ventilation Systems	Optional		Required HRV/ERV (≥70% SRE / ≥40% TRE)	
Induction Cooking	Optional		Required †††††	Optional
Electric Vehicle Readiness †††††††	Required		Required	

ALL-ELECTRIC HOME INCENTIVE STRUCTURE		
	Level 1	Level 2
Single Family	$7,500	$10,000
Single Family Attached	$3,000	$5,000
Multifamily	$1,500	$2,500

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Compartmentalization Air Sealing – Masonry / Steel Stud

Since 1972, Steven Winter Associates, Inc. has been providing research, consulting, and advisory services to improve the built environment for private and public sector clients.

Our services include:

- Energy Conservation and Management
- Decarbonization
- Sustainability Consulting
- Green Building Certification
- Accessibility Consulting

Our teams are based across four office locations:
New York, NY | Washington, DC | Norwalk, CT | Boston, MA

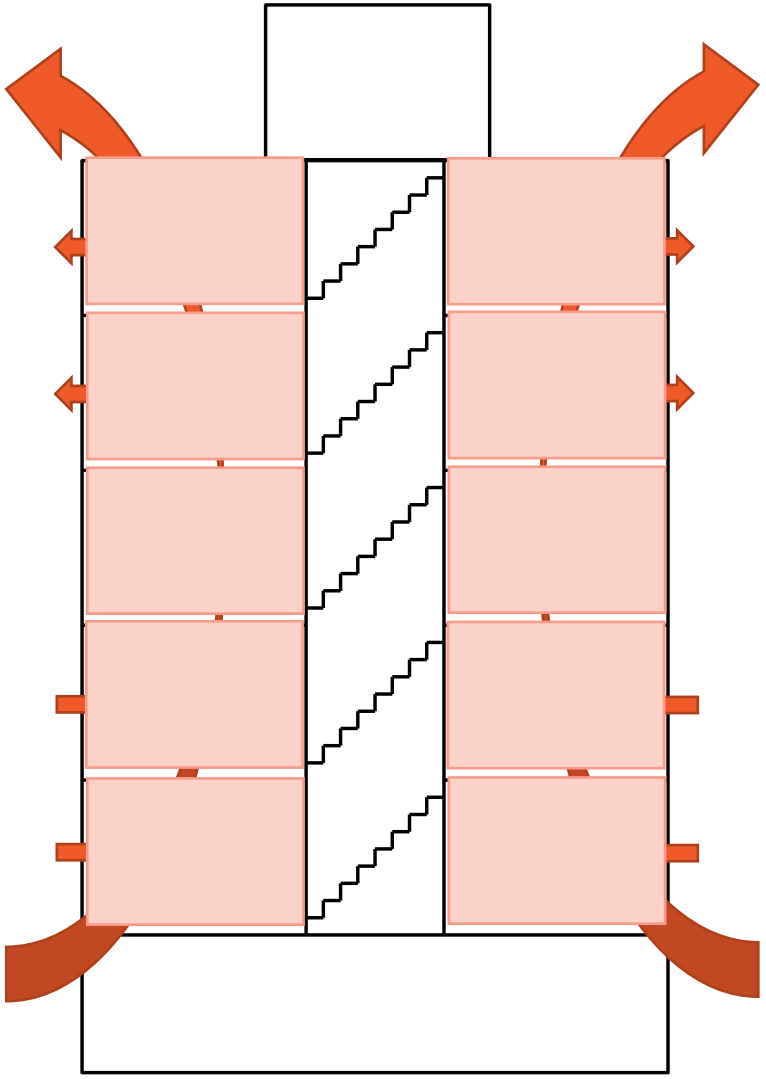
For more information, visit
www.swinter.com

Why air seal?

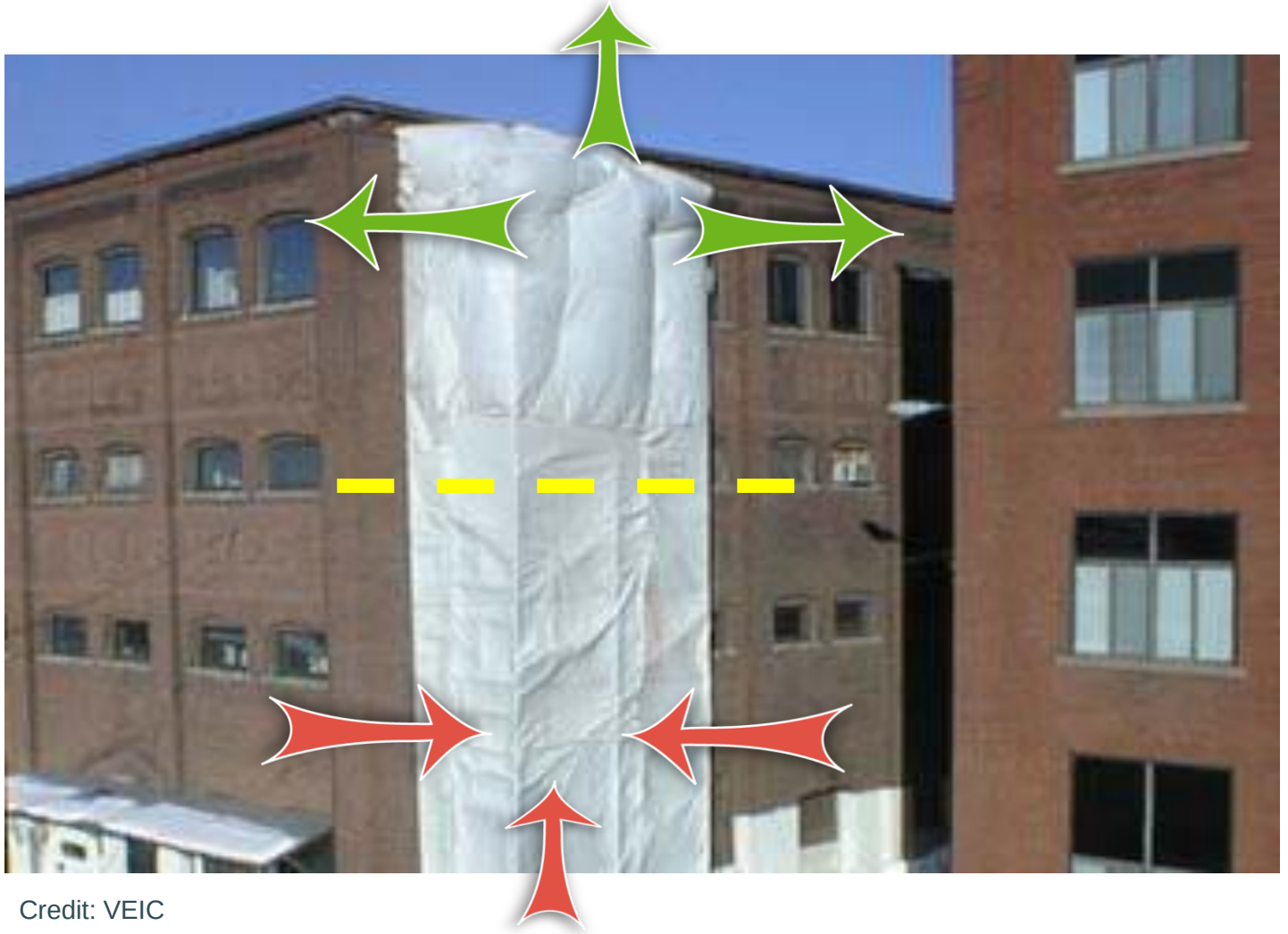
Air Seal to…Save Energy.

Credit: greenbuildingadvisor.com

Air Seal to…Overcome Stack Effect

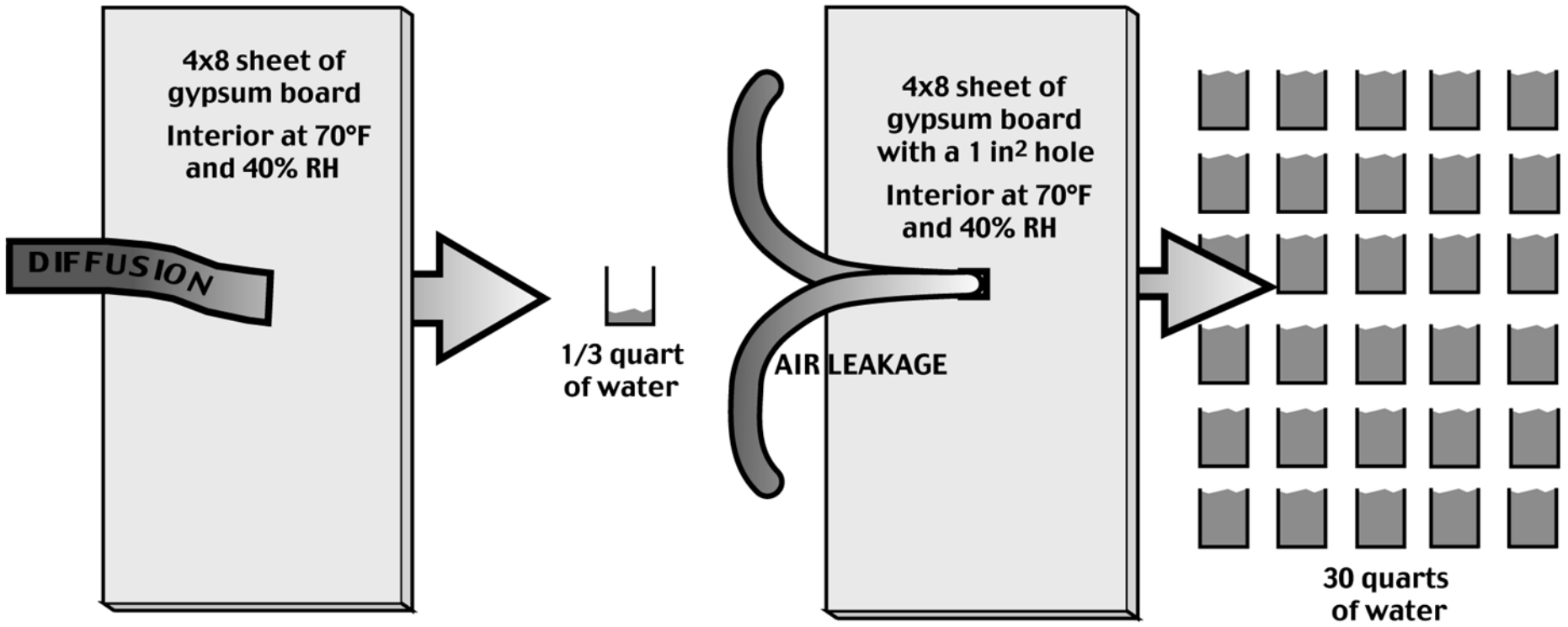


Air Seal to…Overcome Stack Effect



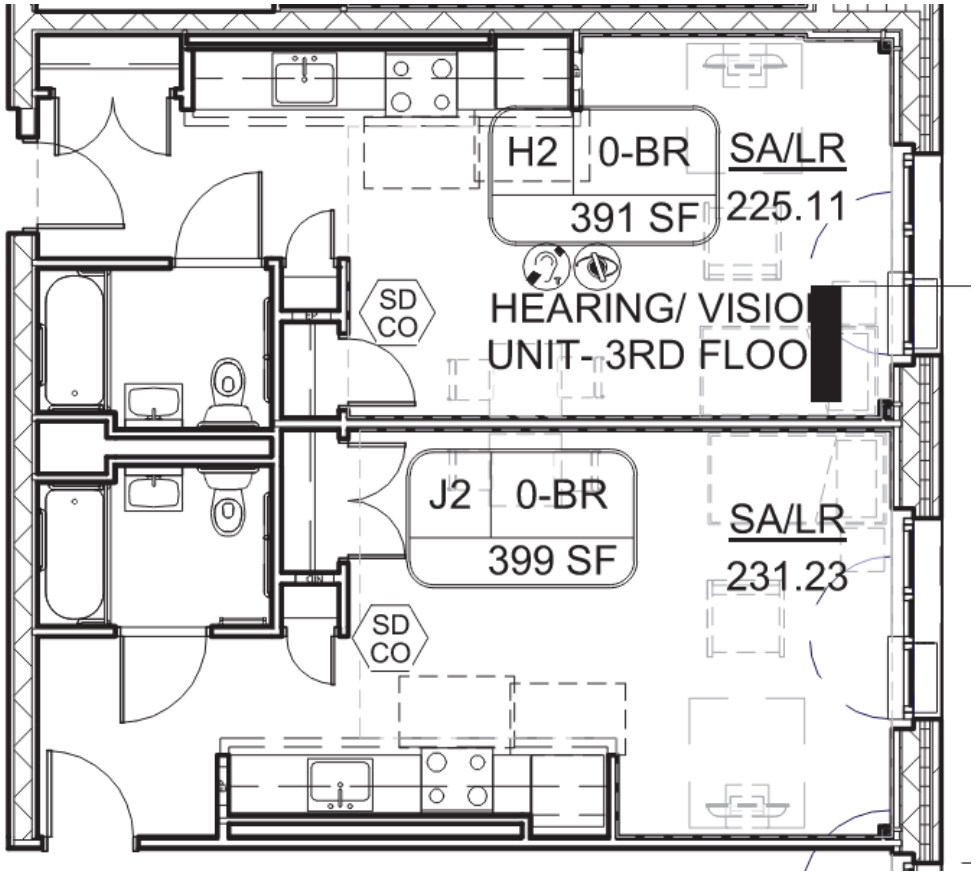
Credit: VEIC

Air Seal to…Reduce Moisture Drive



Credit: Southface

Air Seal to…Control Sound / Smell Transfer

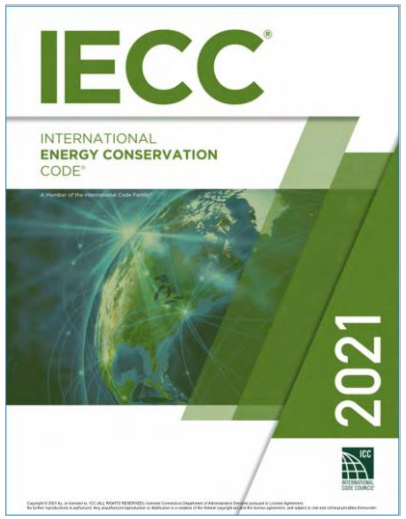


Air Seal to…Stop Flame/Smoke Spread

Air Seal to…Improve Occupant Comfort

Air Seal to…Stop Pest Migration

Air Seal to…Satisfy Code / Certifications



PHIUS
Passive House Institute US

ENERGY STAR

U.S. GREEN BUILDING COUNCIL
LEED
USGBC

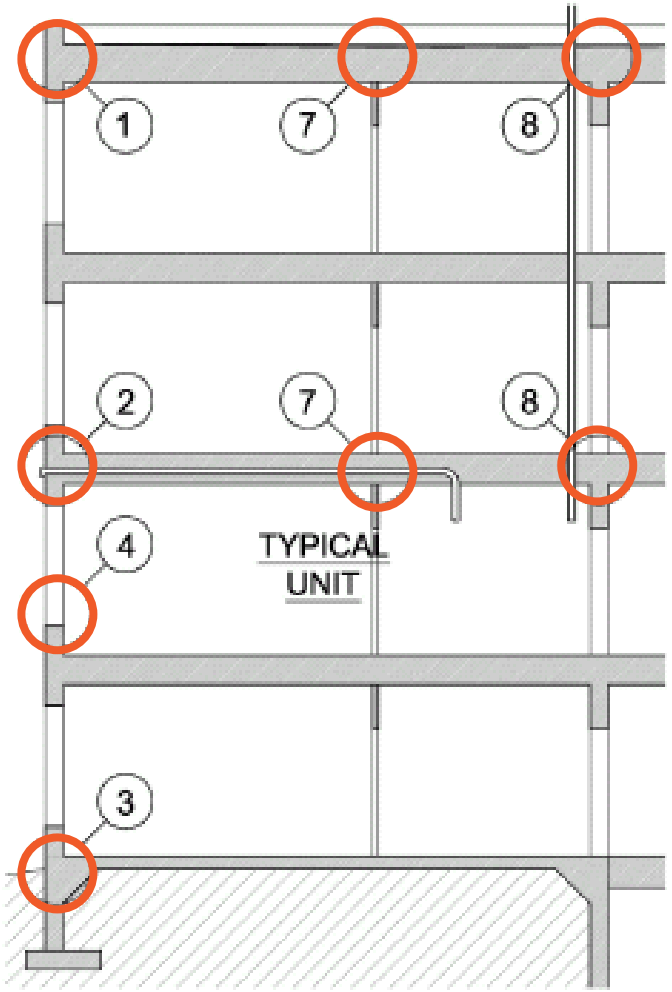
How and where does air leakage occur?

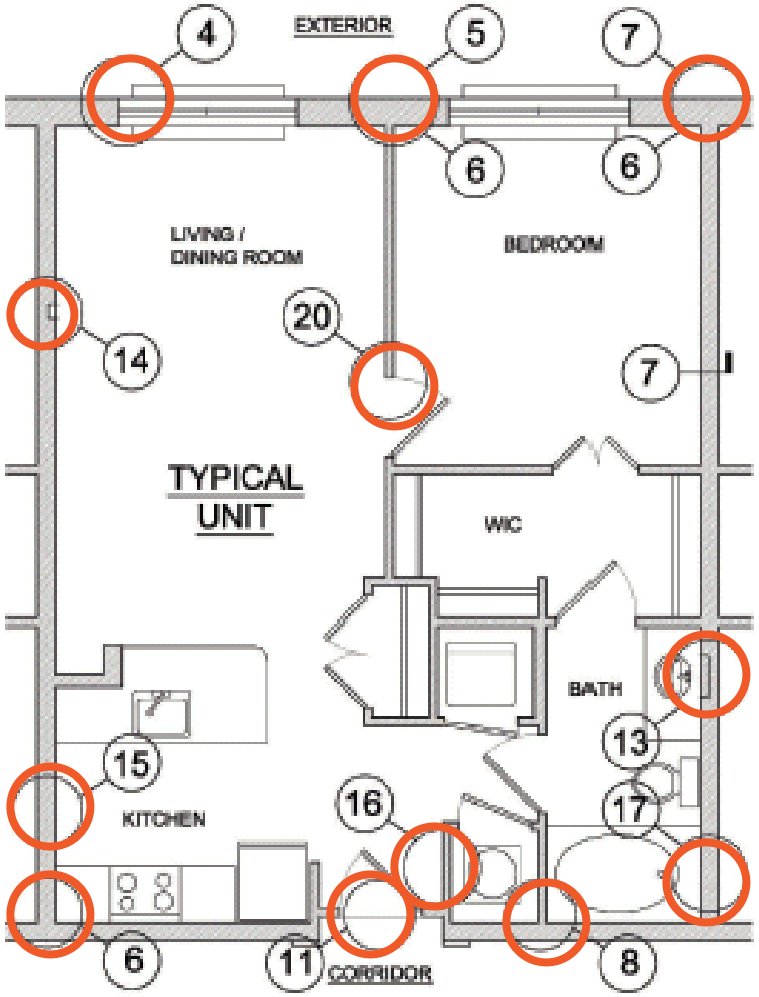
How Does Air Leakage Occur?

Air leakage requires 2 things:

1. An opening
   - Cracks
   - Small holes
   - Large holes
   - Permeable material
2. A driving force
   - Wind
   - Stack effect
   - Mechanicals

Where Does Air Leakage Occur?

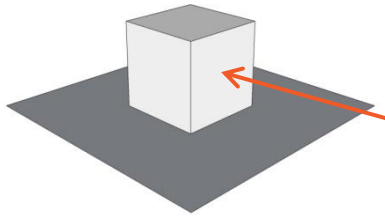




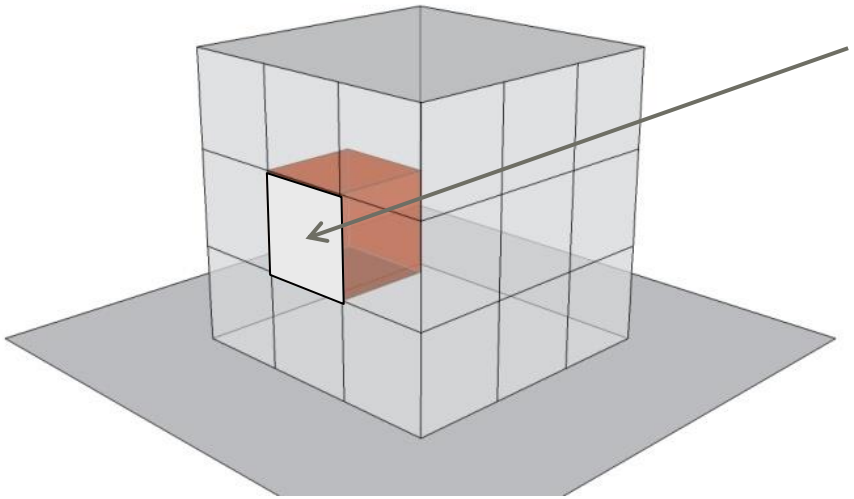
All of these areas!

How can we control leakage and provide sufficient air sealing?

Where Leakage Occurs… Ambient vs. Adiabatic



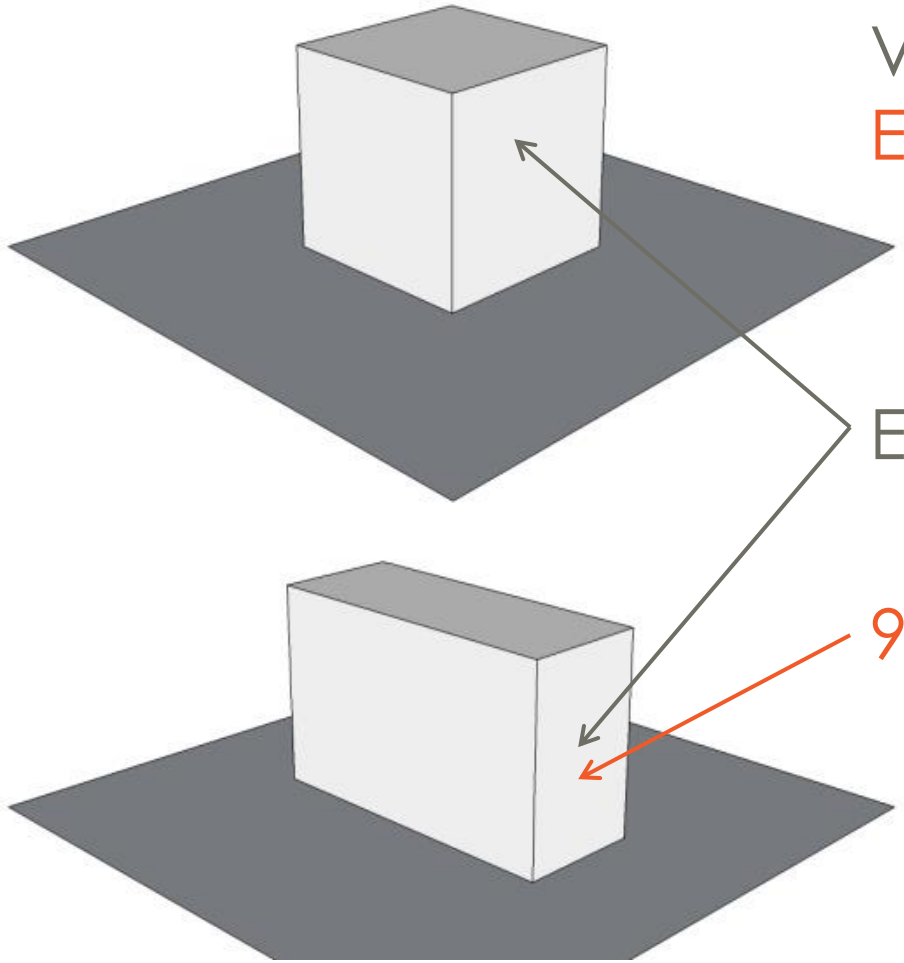
Detached: ~100% ambient exposure



Attached: 16% ambient exposure

All air leakage matters!

How to control leakage… Minimize enclosure area



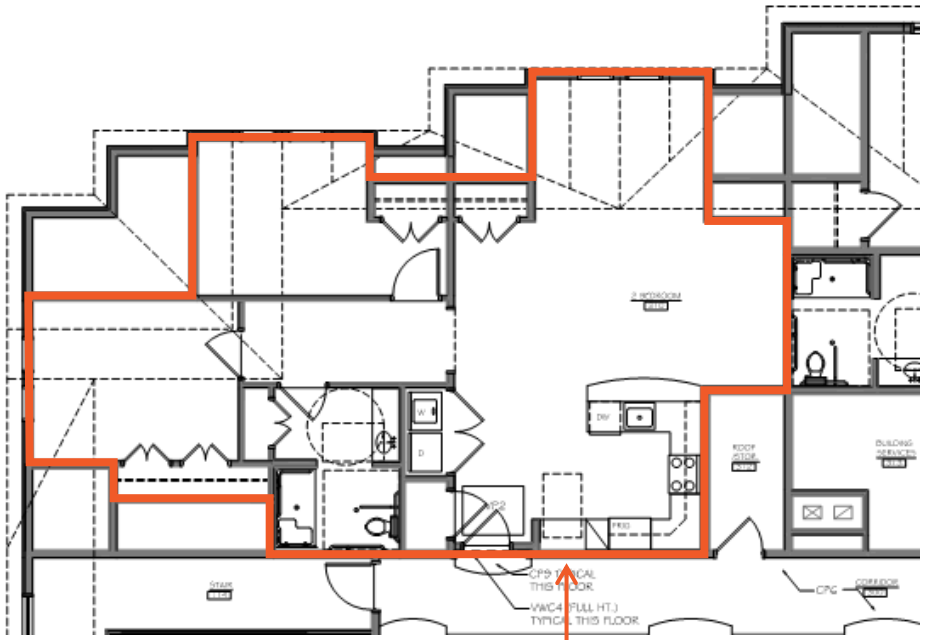
Testing metric:

Volume (ACH50) vs.
Enclosure area (CFM50/SF)

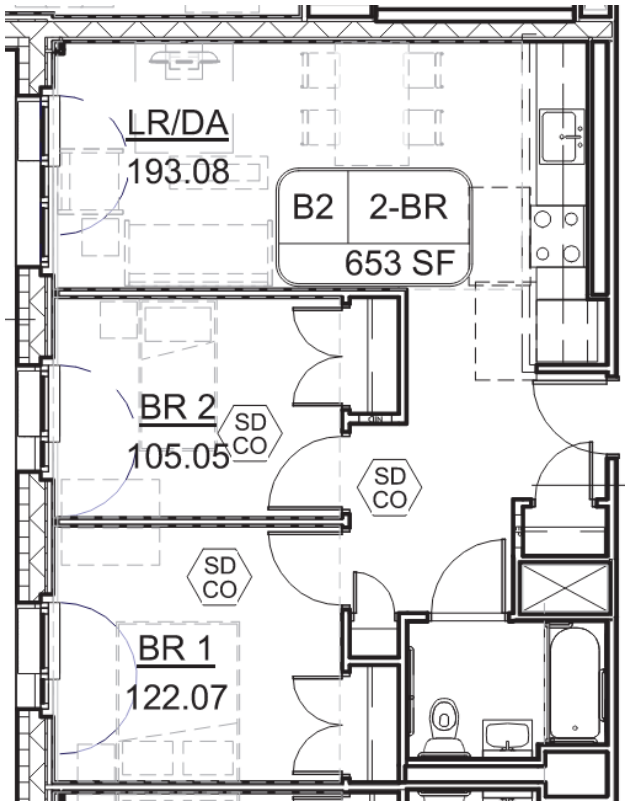
Equal volume & floor area

9% more enclosure area

Simplify enclosure area

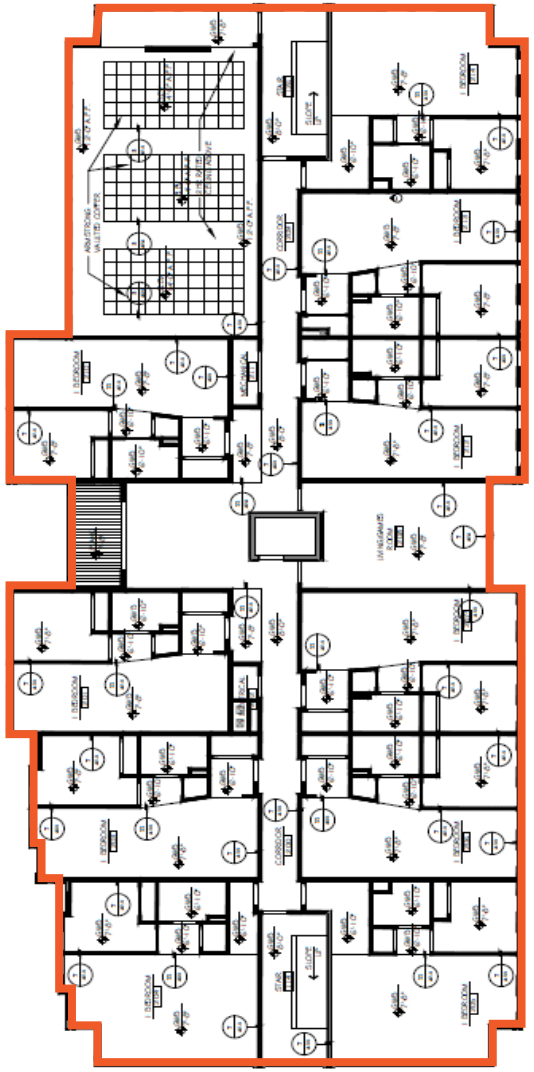


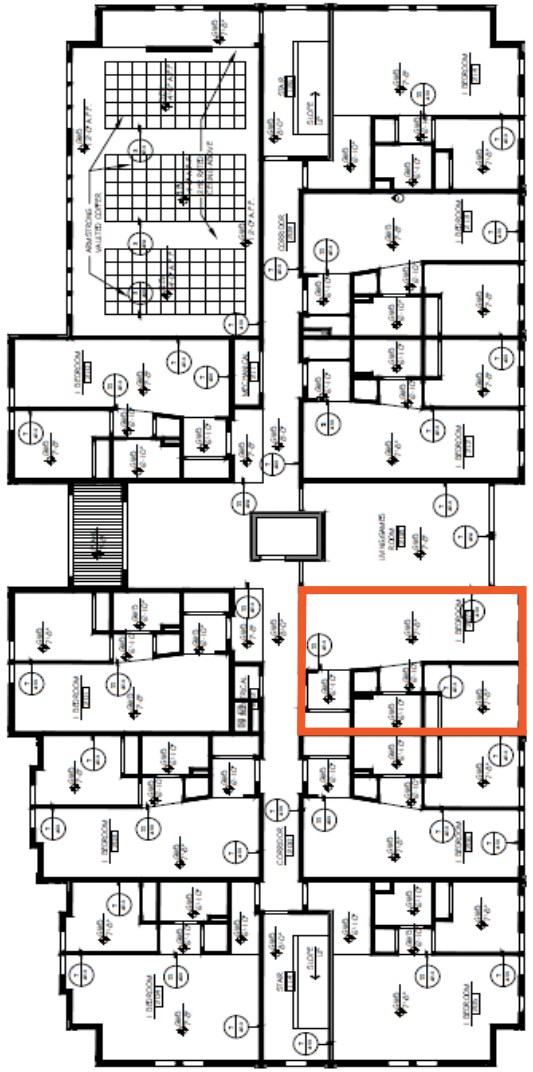
18 corners



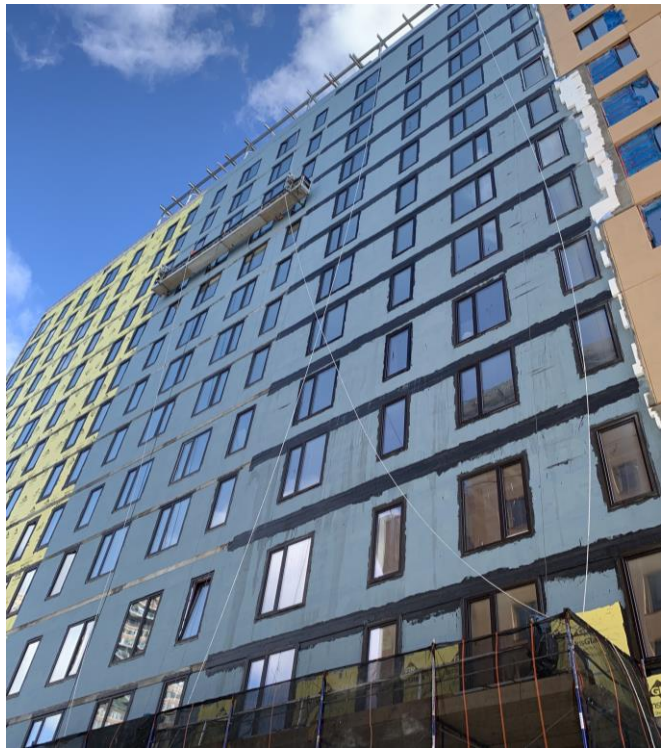
4 corners

Know the priorities



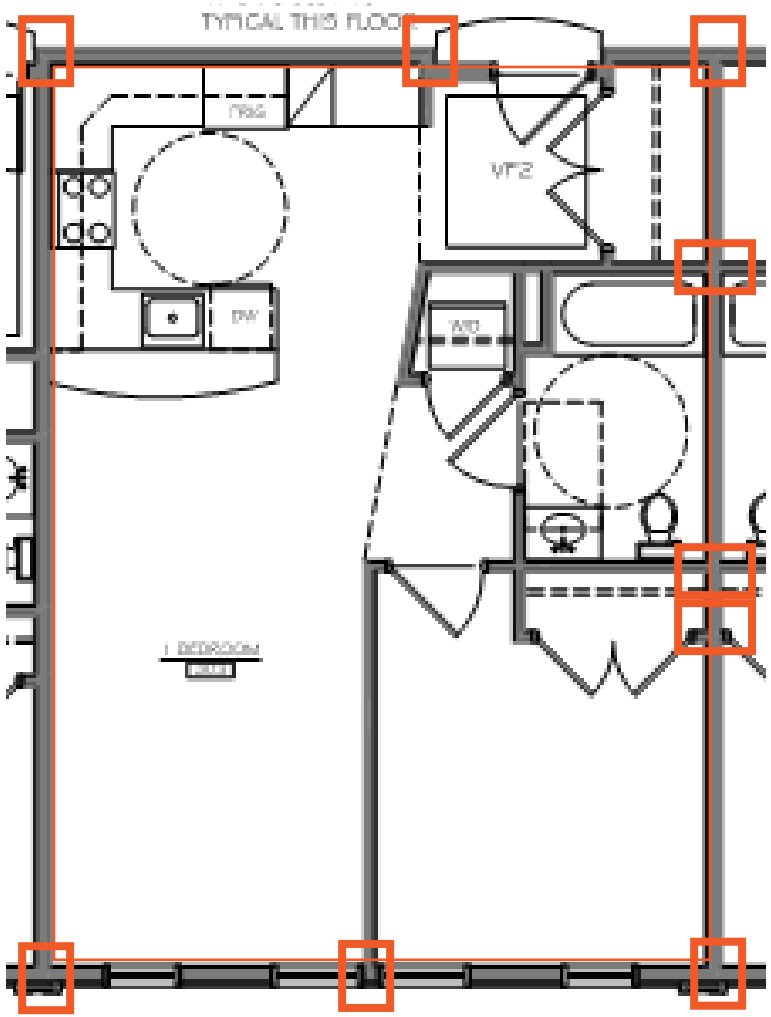


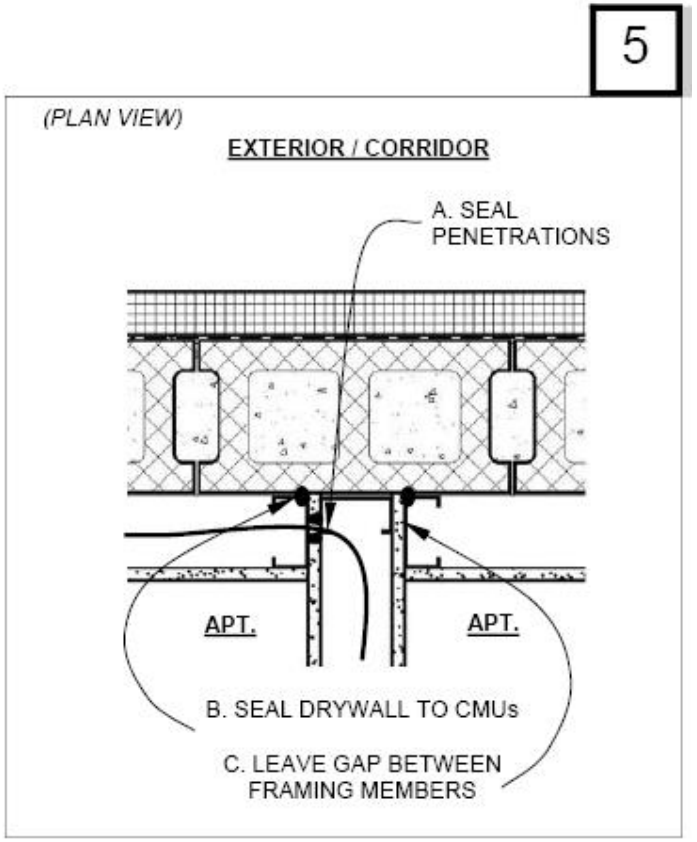
Know the approach



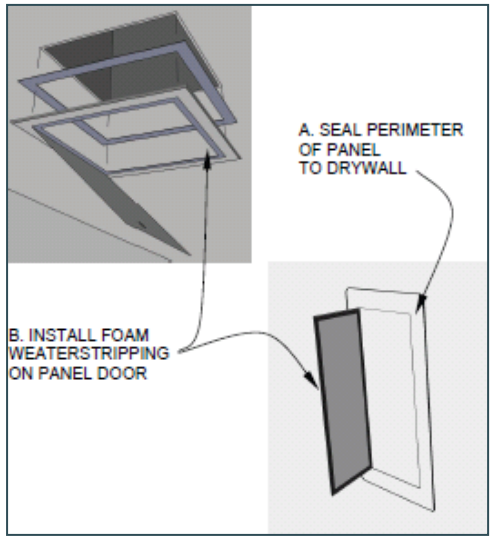
Think Like Water

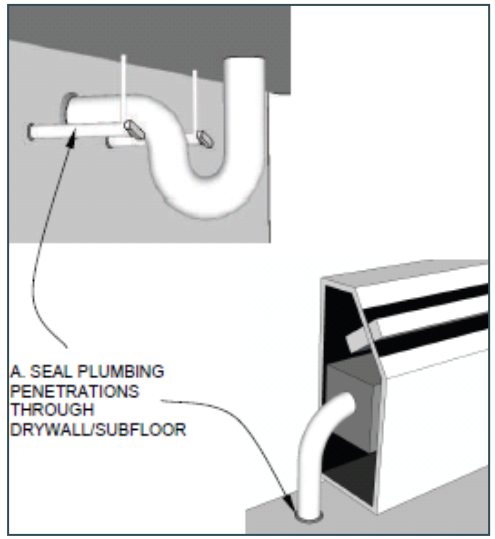
Seal Perimeter of Unit

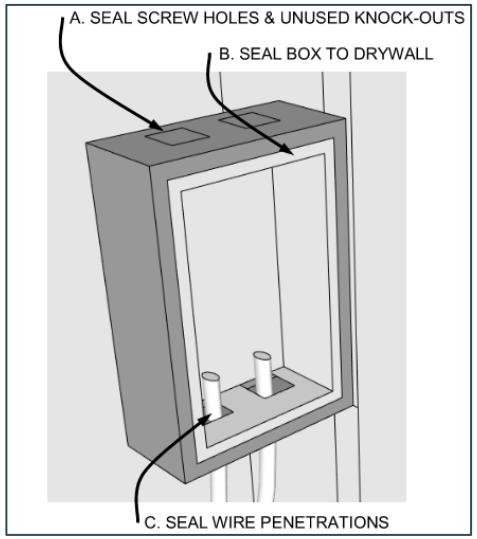


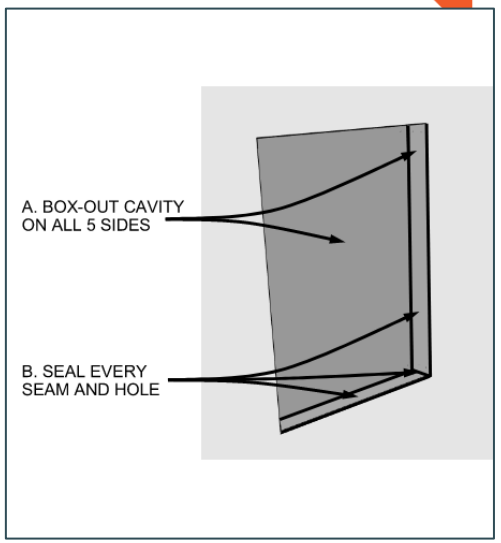


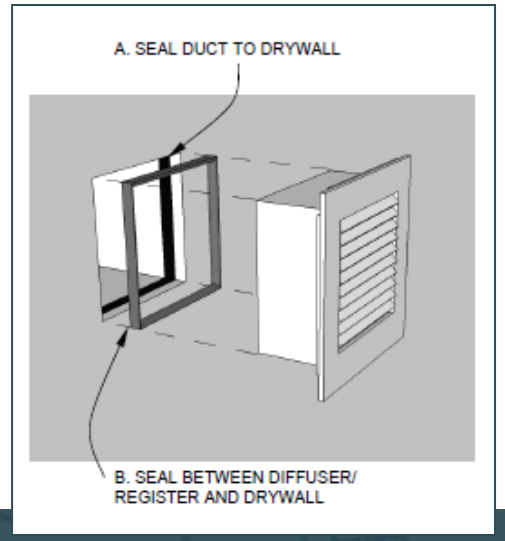
Seal Drywall Enclosure

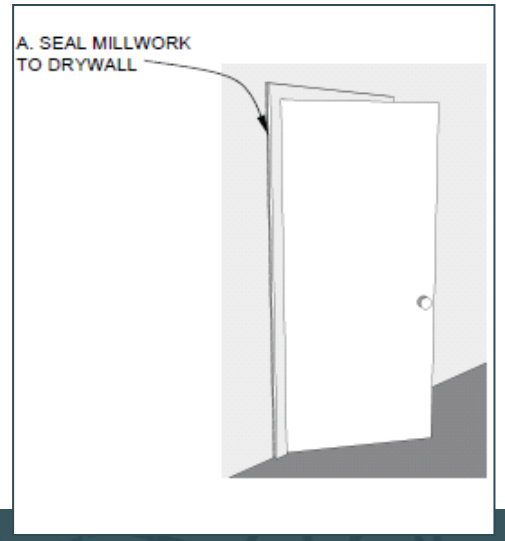


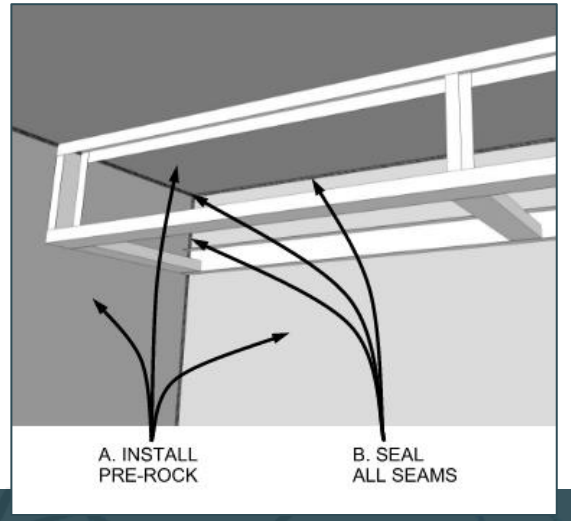


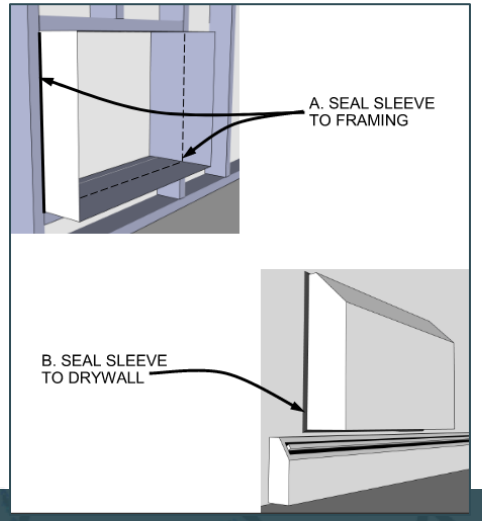












Drawings / Specifications

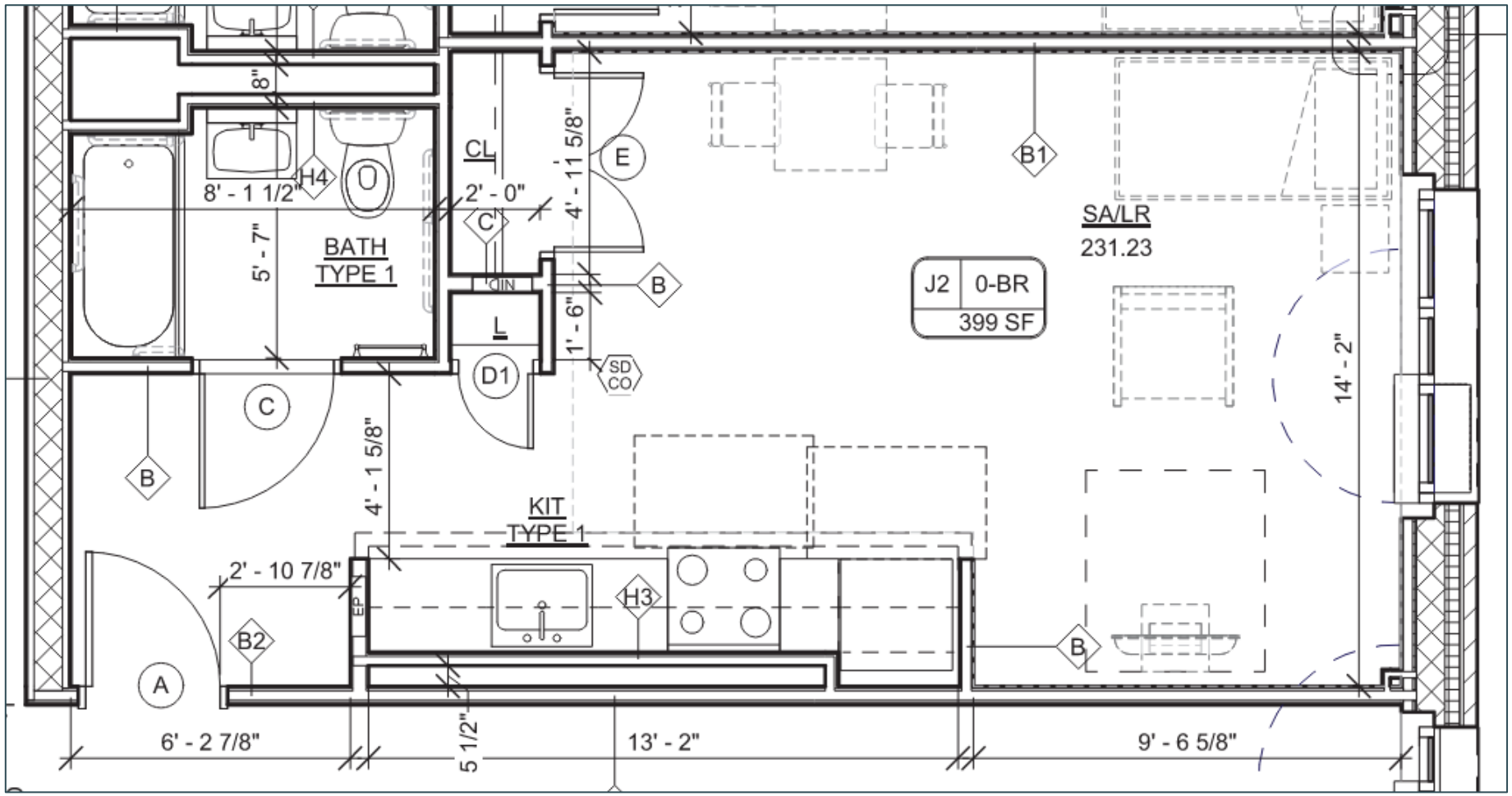
- Choose details/specs specific to each project
- Max. 0.30 cfm/SF of enclosure - or as required by compliance path
- Be specific
  - Gaps <1/4” - use caulk; gaps >1/4” use – foam (with some caution)
  - Use appropriate sealants (e.g. low-VOCs, high-temp, low-expanding, fire-rated, etc.)
  - Clean out cracks before applying sealant (e.g. compressed air, vacuum, damp cloth, etc.)
- Consider ‘new’ products (high performance tapes, Aerobarrier)

Take Responsibility on Site – "Air Boss"

- The more eyes on the air barrier system, the better.
- Need dedicated person on site from the GC, essentially an envelope super to stay on top of the Air Barrier system
- The installers will be "graded" at the end through blower door testing

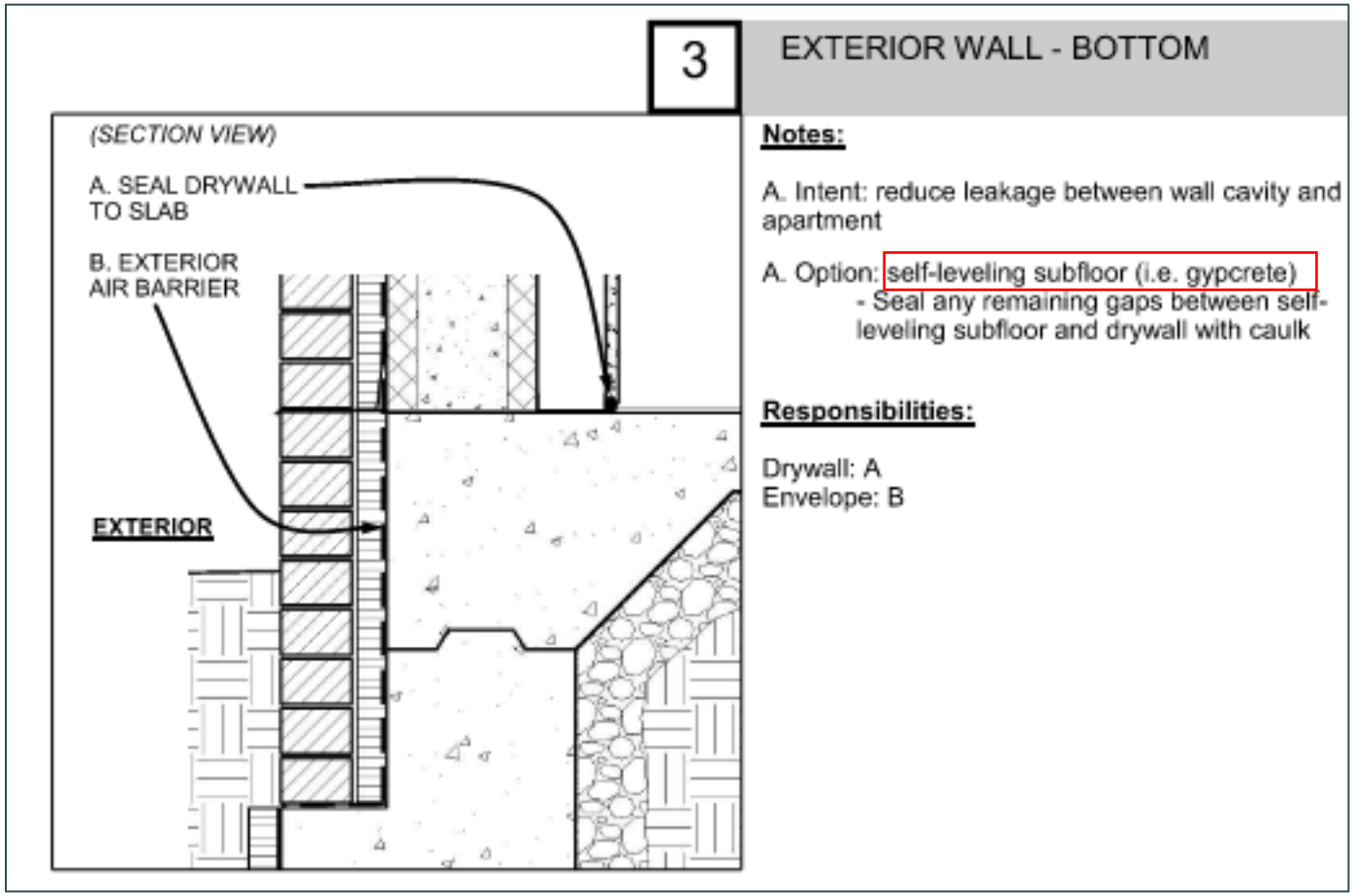
Design Exercise

Define the Enclosure

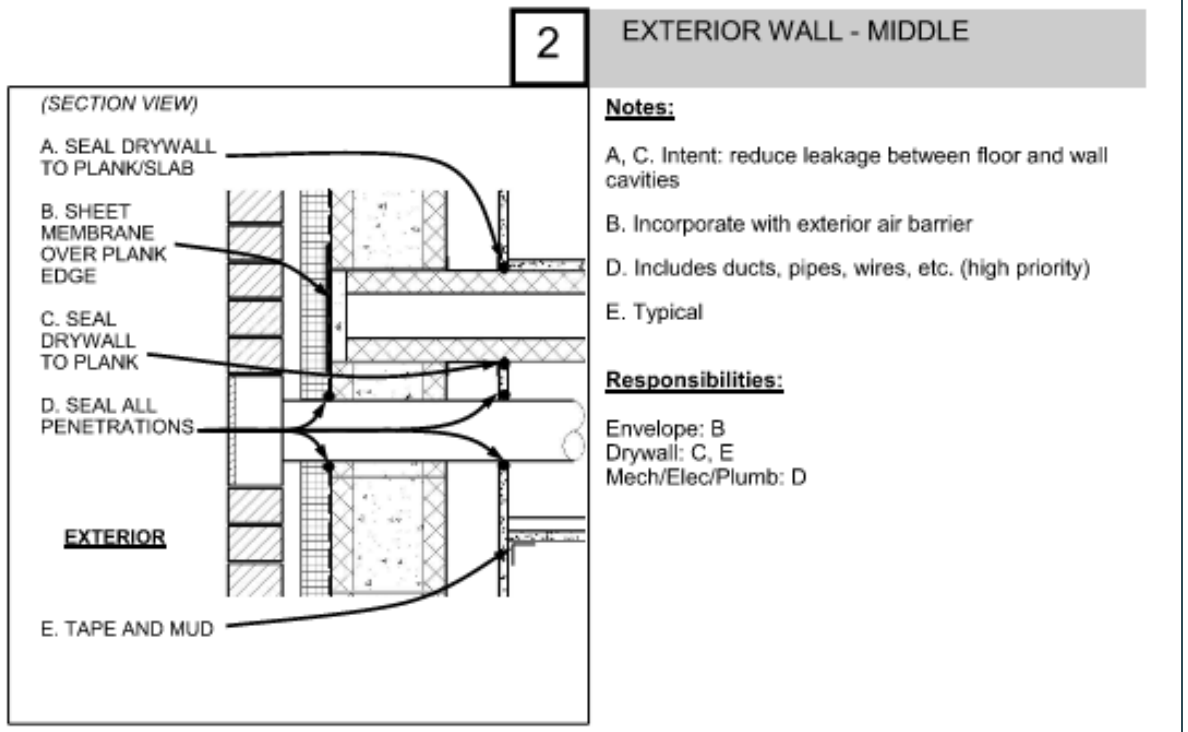


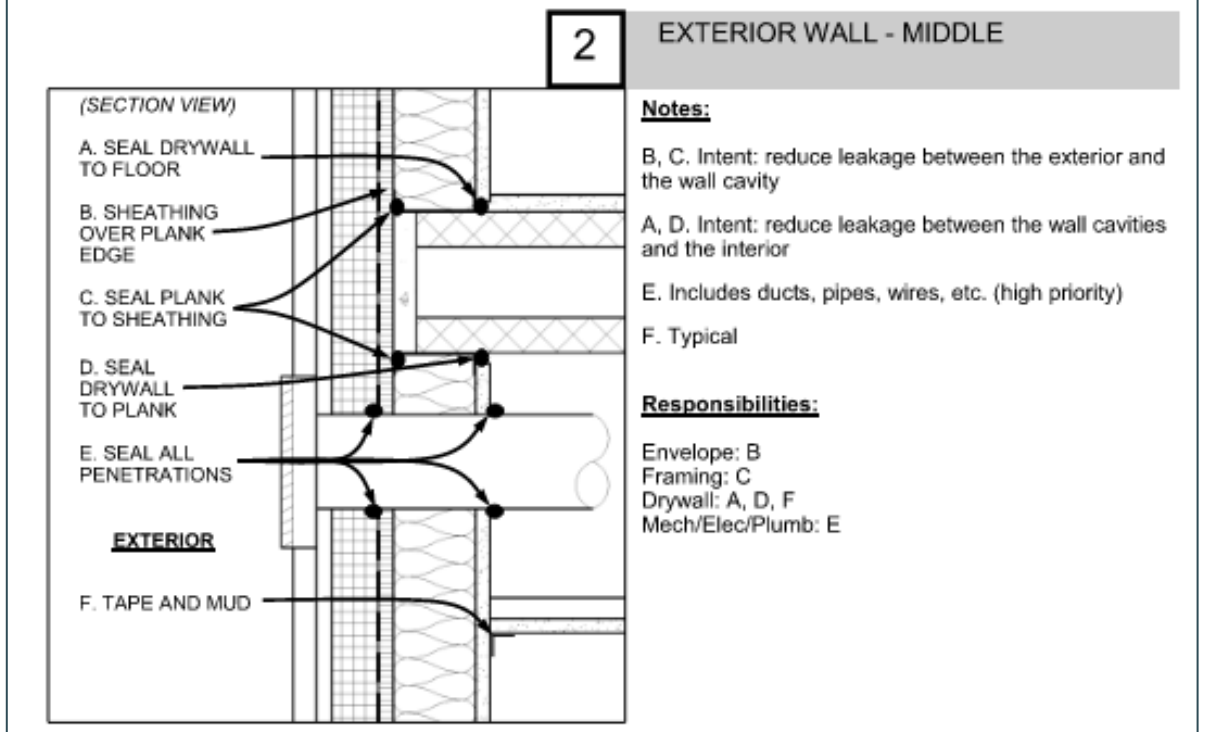
- Exterior Wall
- Corners
- Interior partitions
- Zeroing in on any / all drywall penetrations

Seal Bottom of Wall – Masonry / Steel Stud

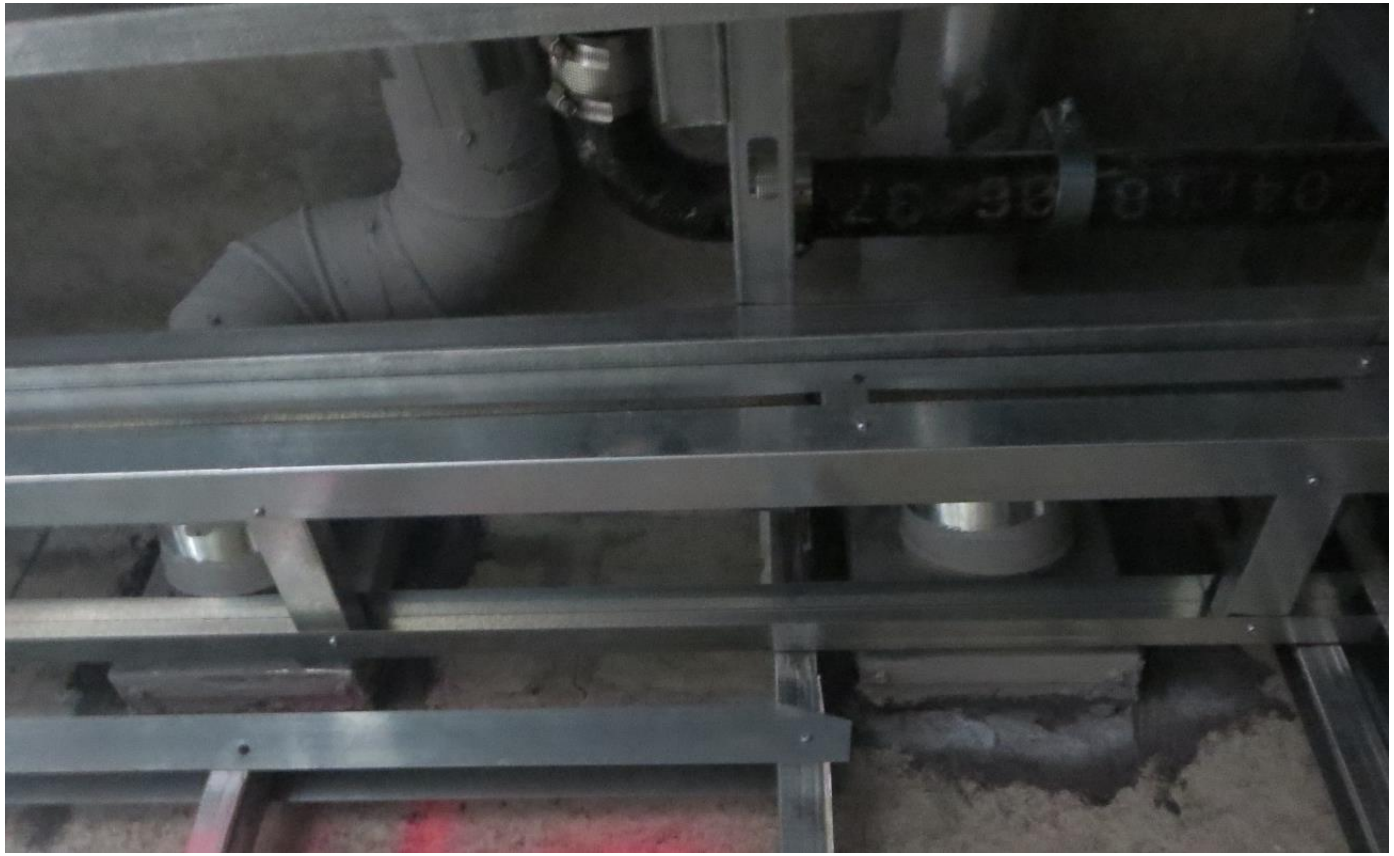


Seal Middle of Wall – Masonry / Steel Stud

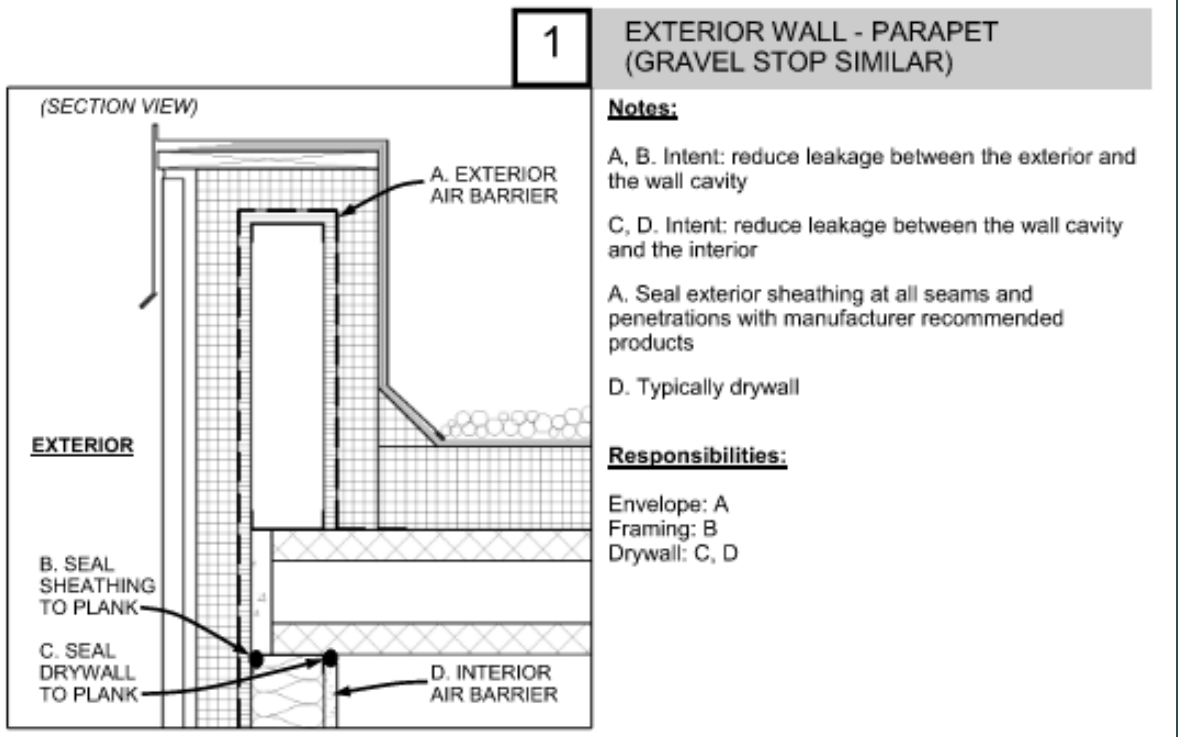


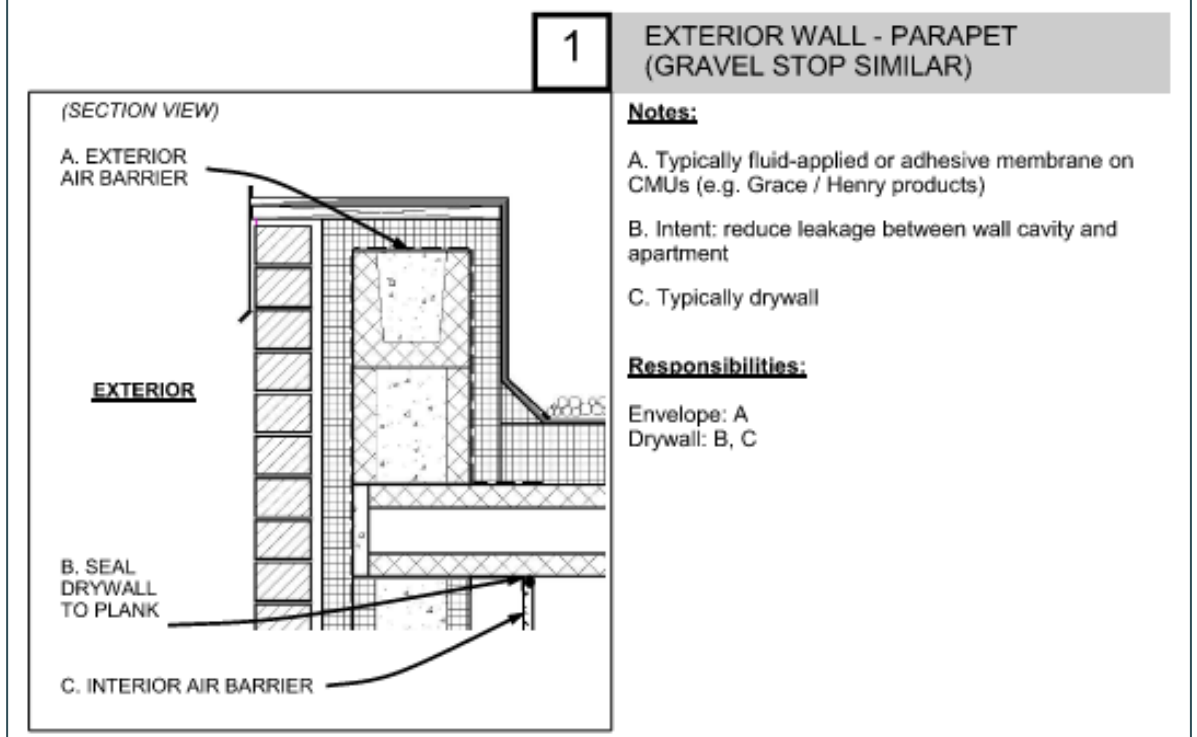


Seal Middle of Wall – Masonry / Steel Stud



Seal Top of Wall – Masonry / Steel Stud

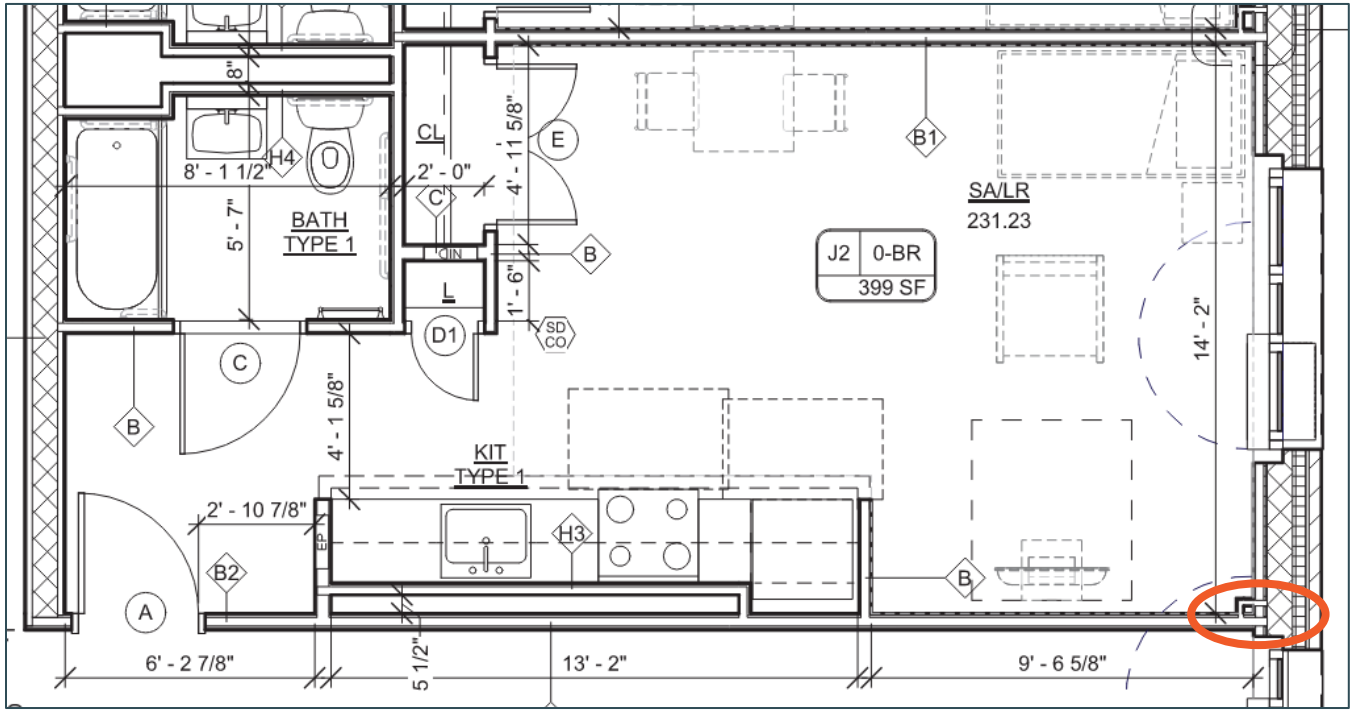


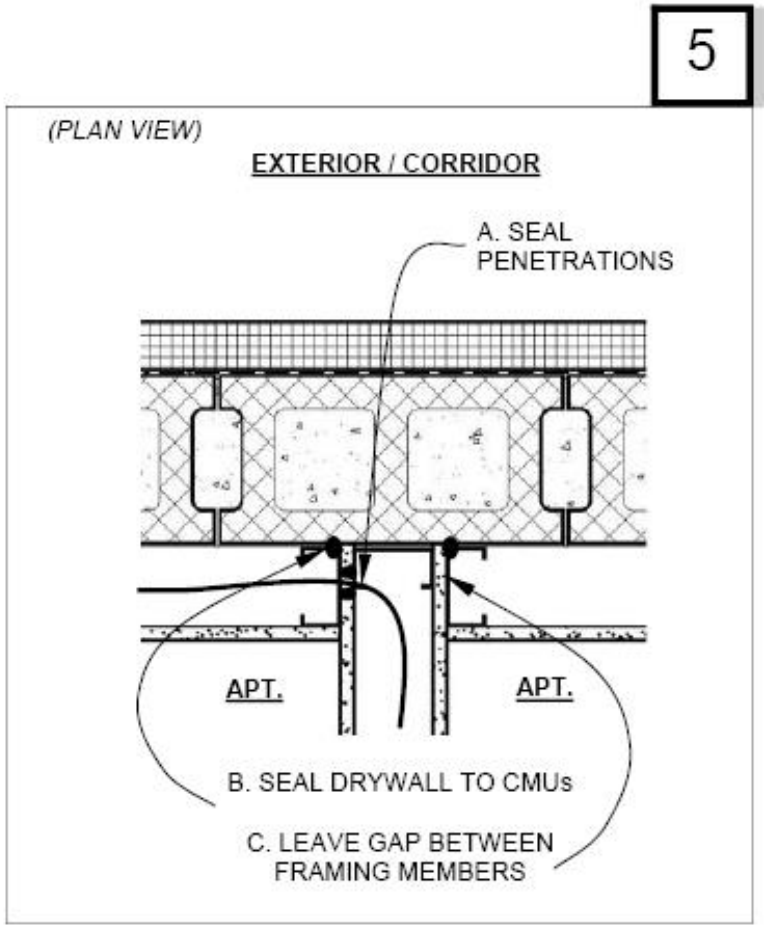


Seal Top of Wall – Masonry / Steel Stud

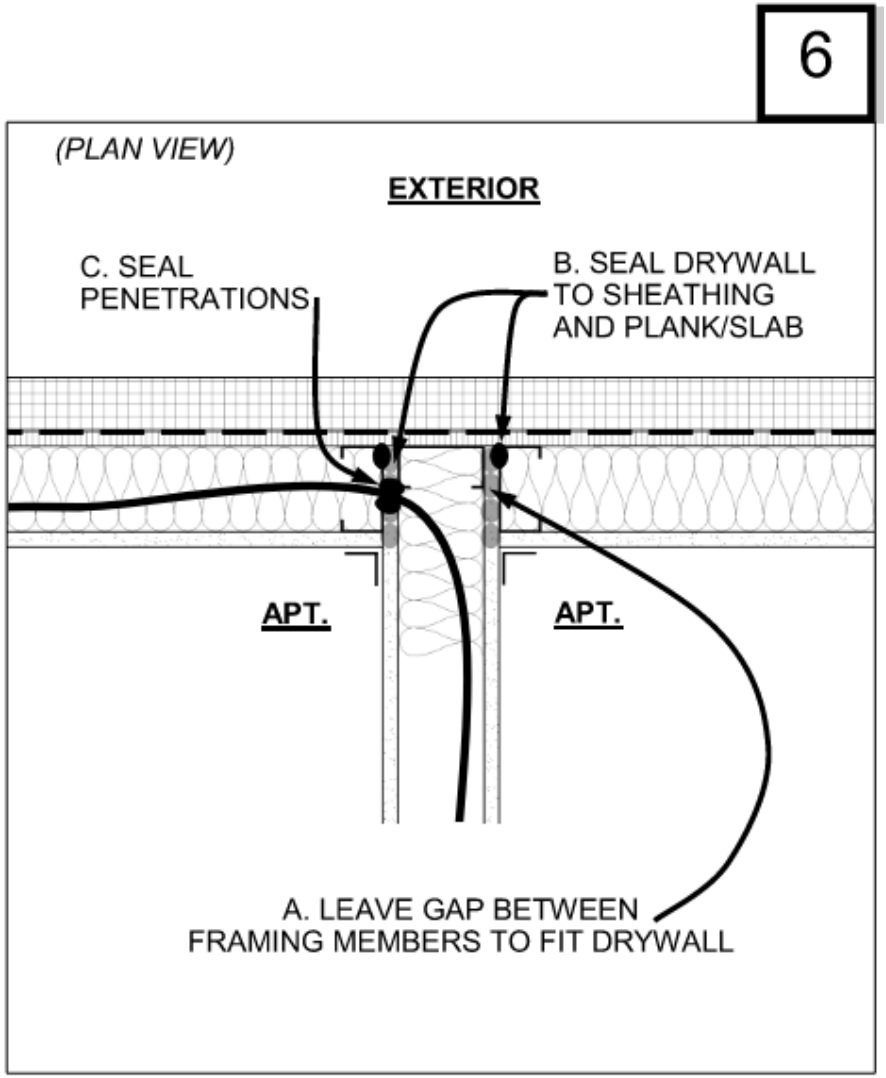
Windows – Masonry / Steel Stud

Isolate Partitions – Masonry

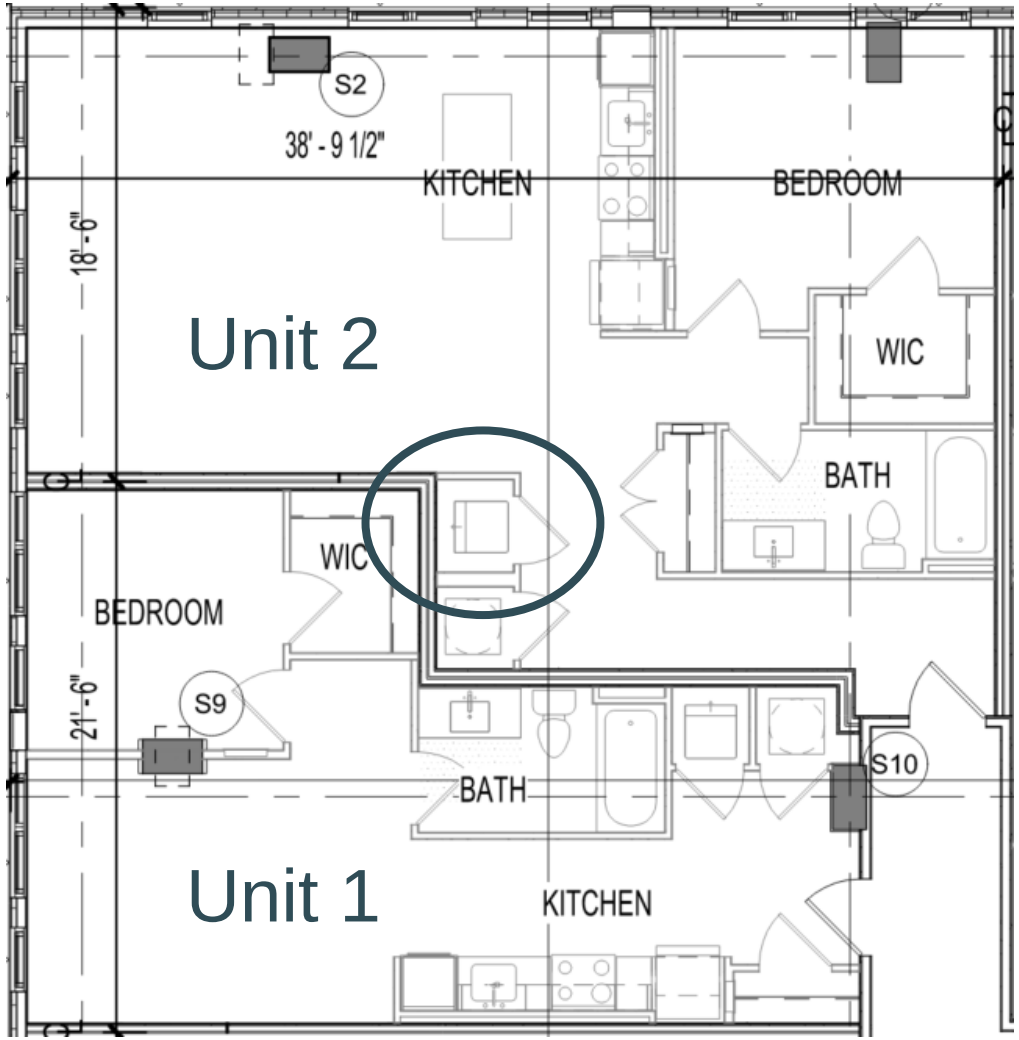


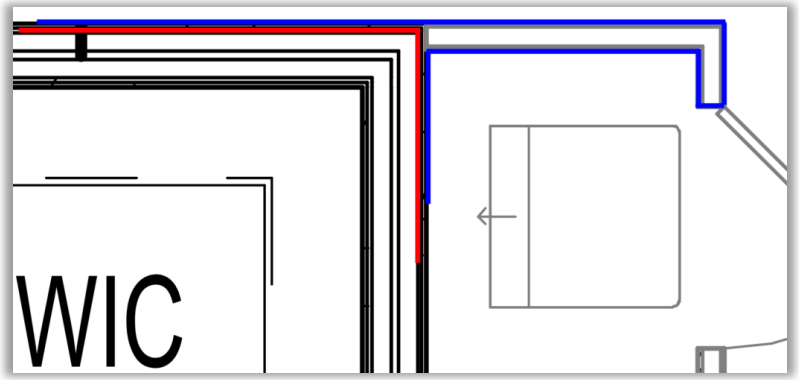


Isolate Partitions – Steel Stud



Isolate Partitions

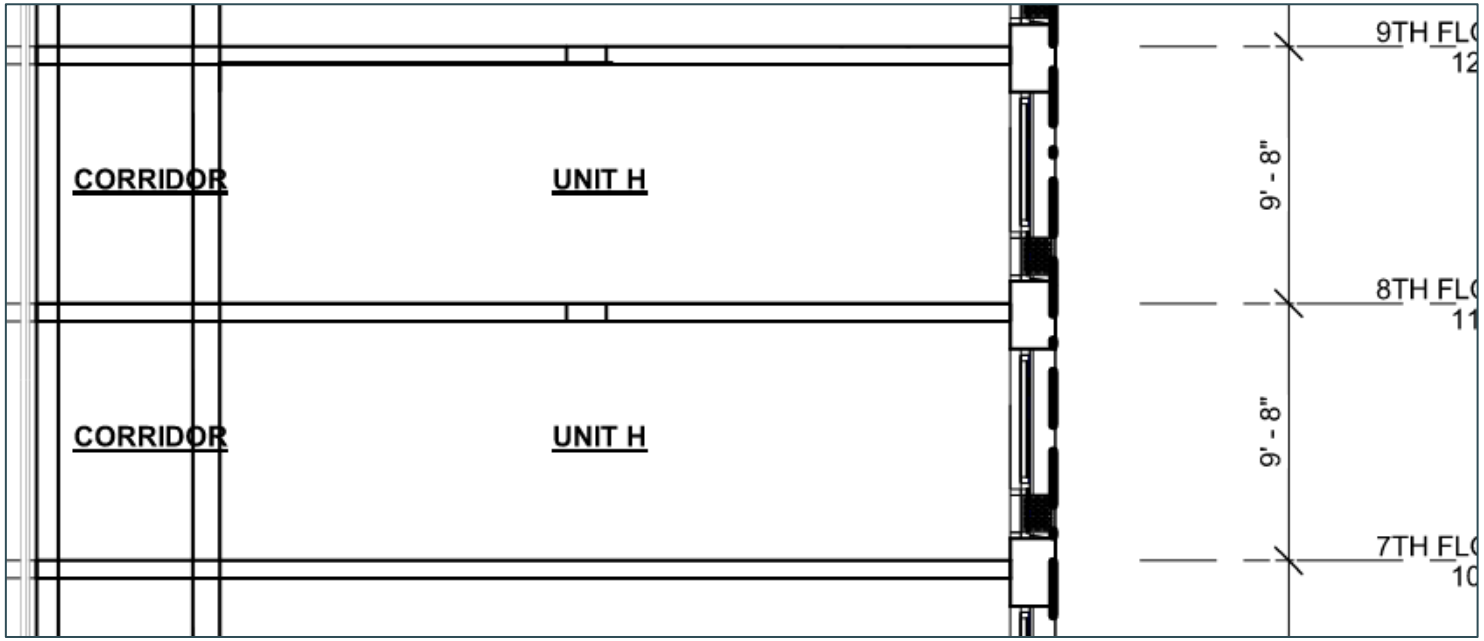


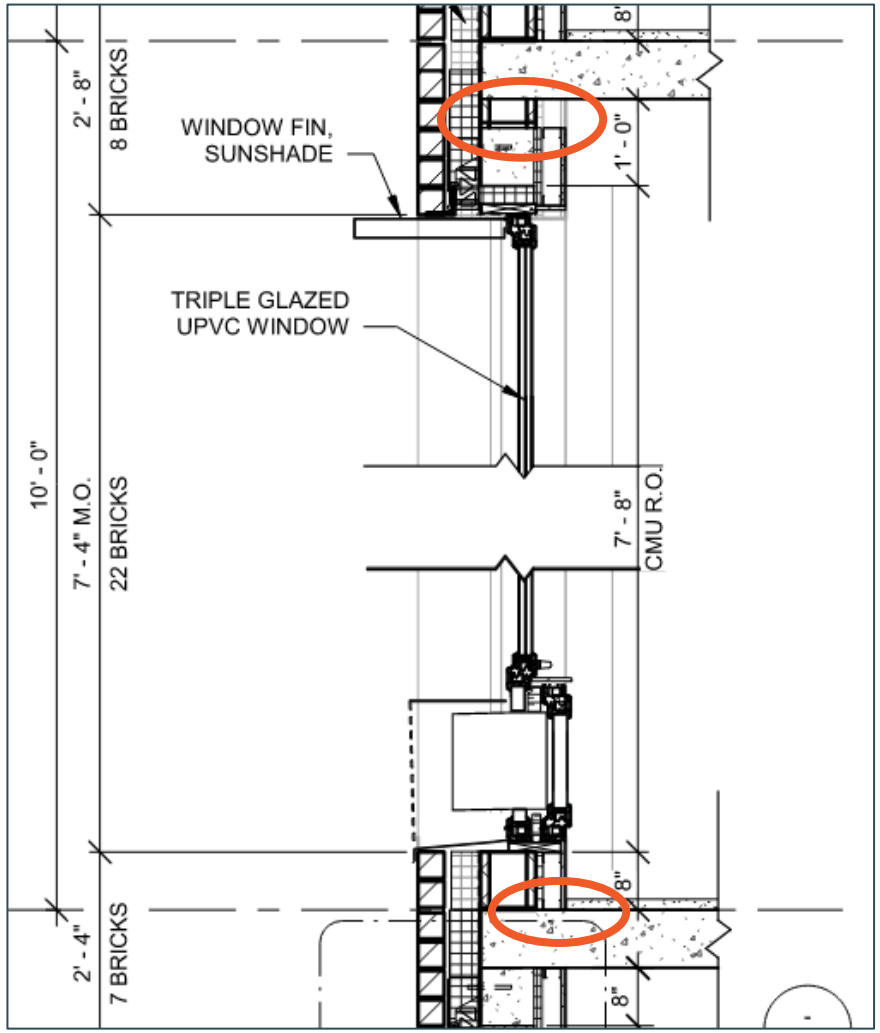


Red = sealed air barrier layer.
Blue = finished sheetrock that does not maintain an air barrier.

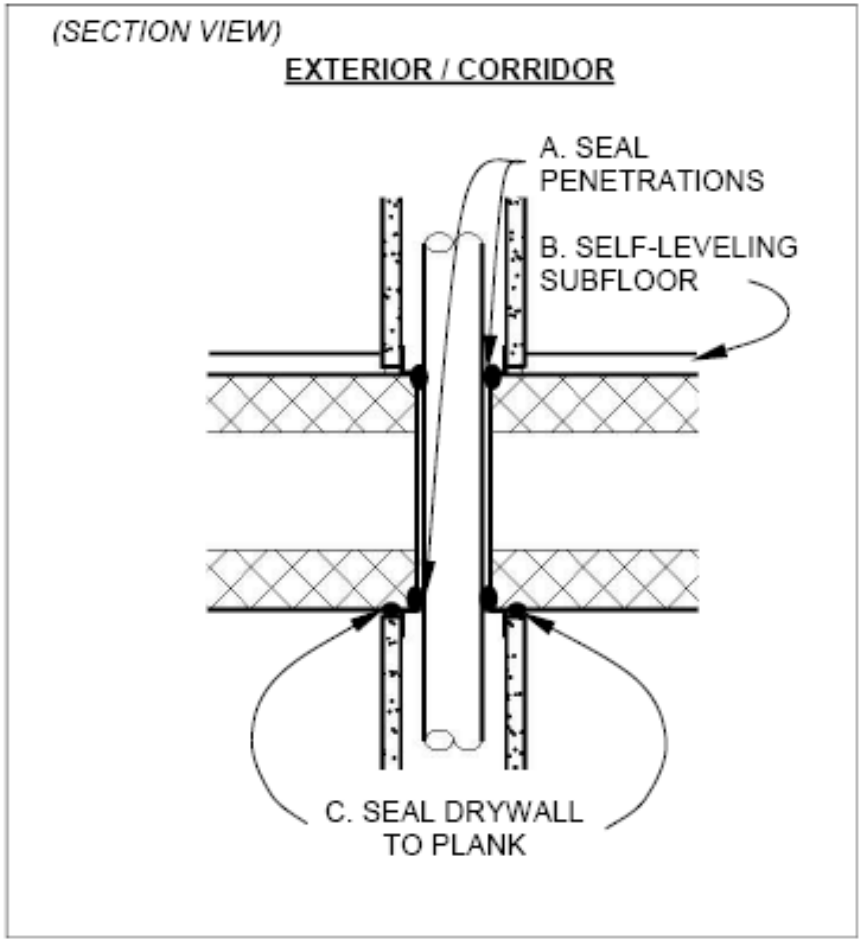
- Units typically aren't simple rectangles
- Trace out perimeter drywall for continuity during design phase and review sequencing with drywall installer

Think in 3D

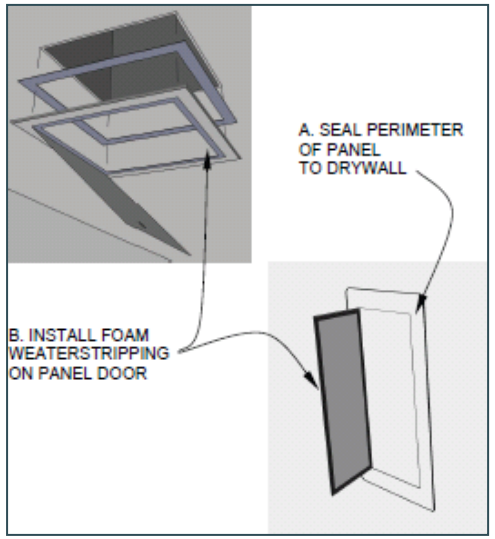

CORRIDOR
UNIT H
CORRIDOR
UNIT H
9TH FL
12
8TH FL
11
7TH FL
10
9' - 8"
9' - 8"

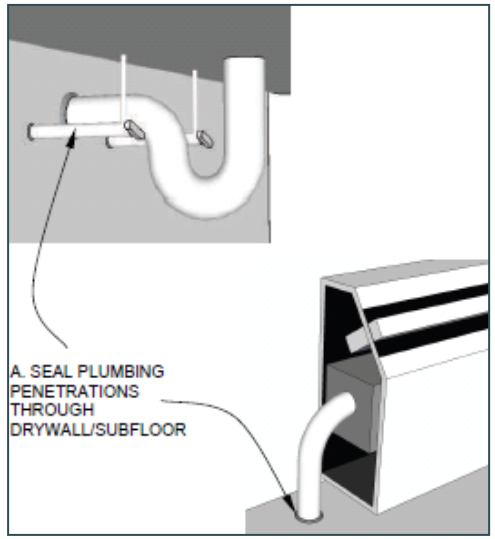

WINDOW FIN,
SUNSHADE
TRIPLE GLAZED
UPVC WINDOW
2' - 8"
8 BRICKS
1' - 0"
8"
10' - 0"
7' - 4" M.O.
22 BRICKS
7' - 8"
CMU R.O.
2' - 4"
7 BRICKS
8"
8"

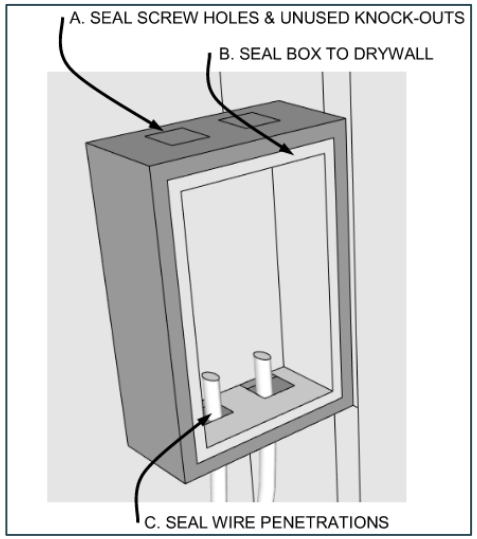
Ceiling – Top of Apartment Unit

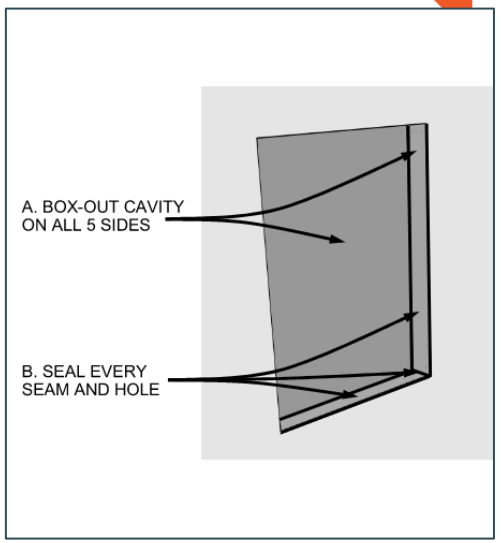


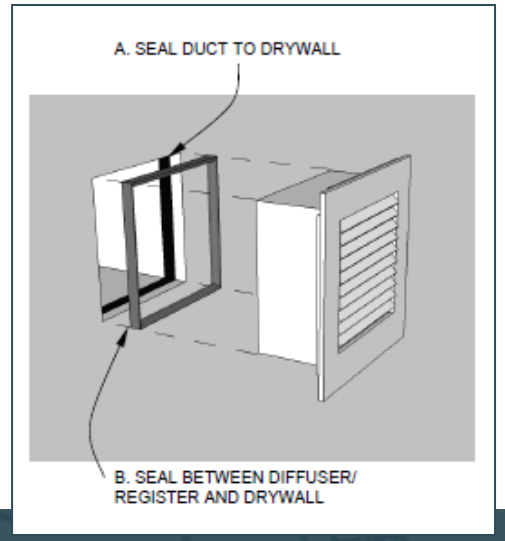
Seal Penetrations

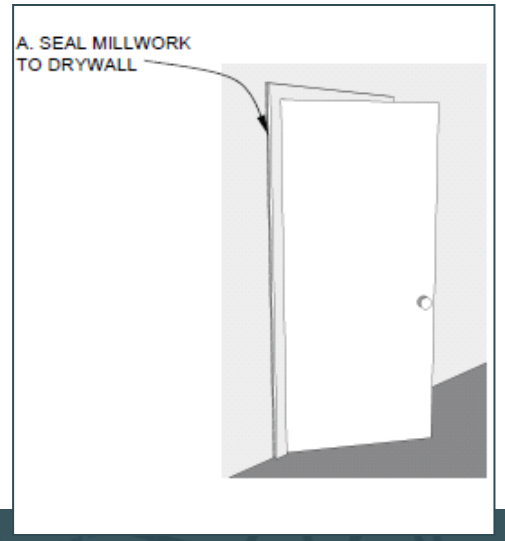


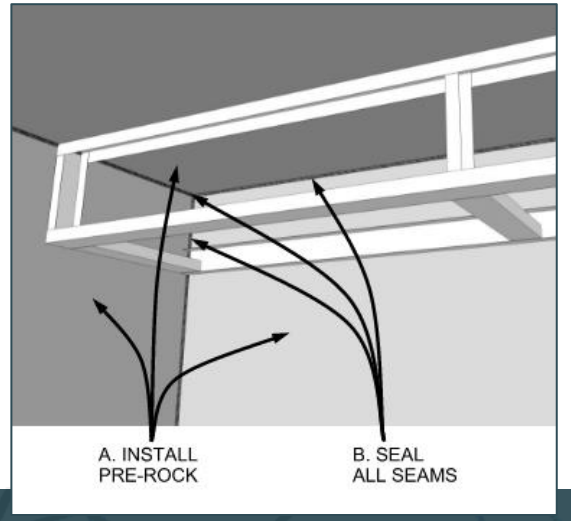


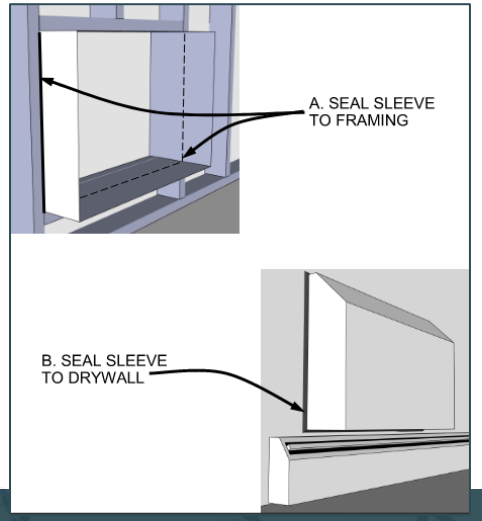






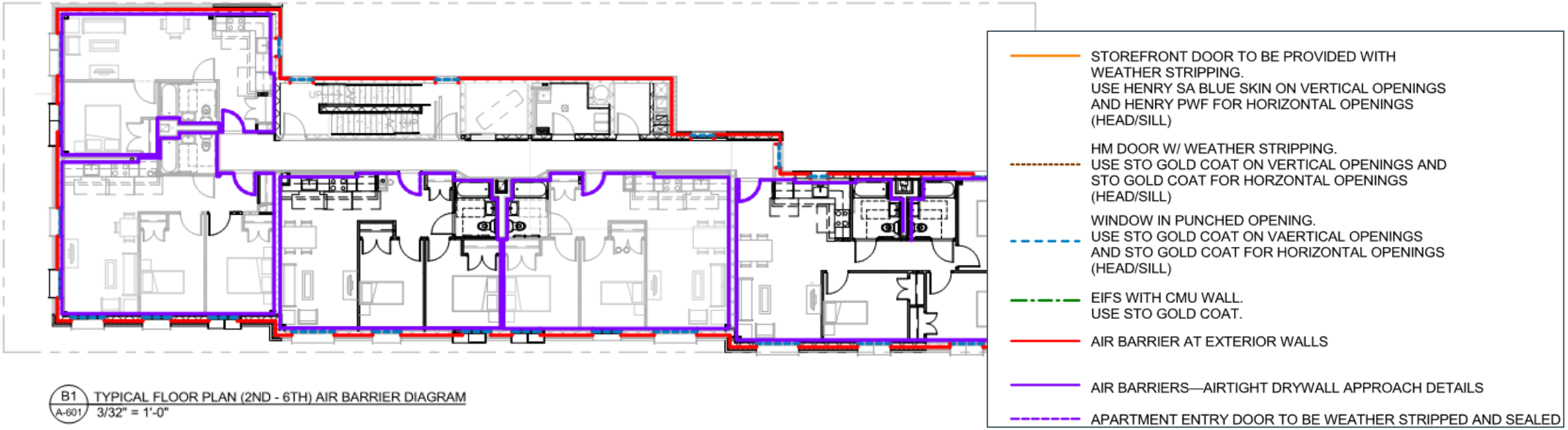






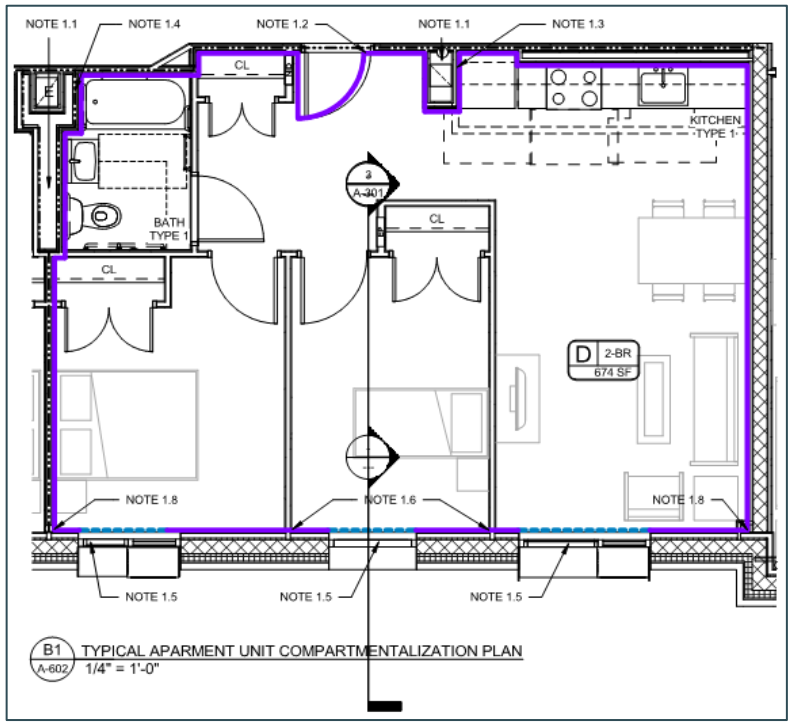
Air Sealing Details in Drawings Set

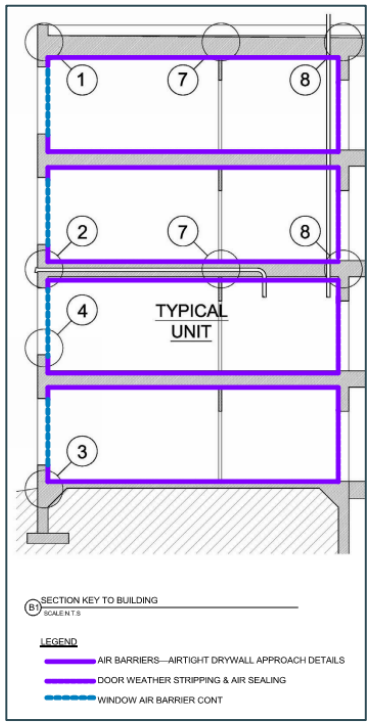
- Air Barrier Continuity Diagrams & Associated Details
  - Both in Plan and Section
  - Clearly address complicated air barrier application areas

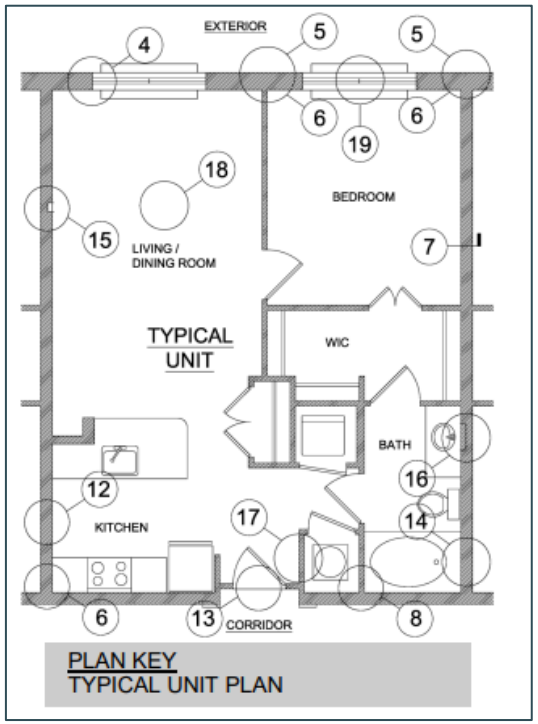


Air Sealing Details in Drawings Set

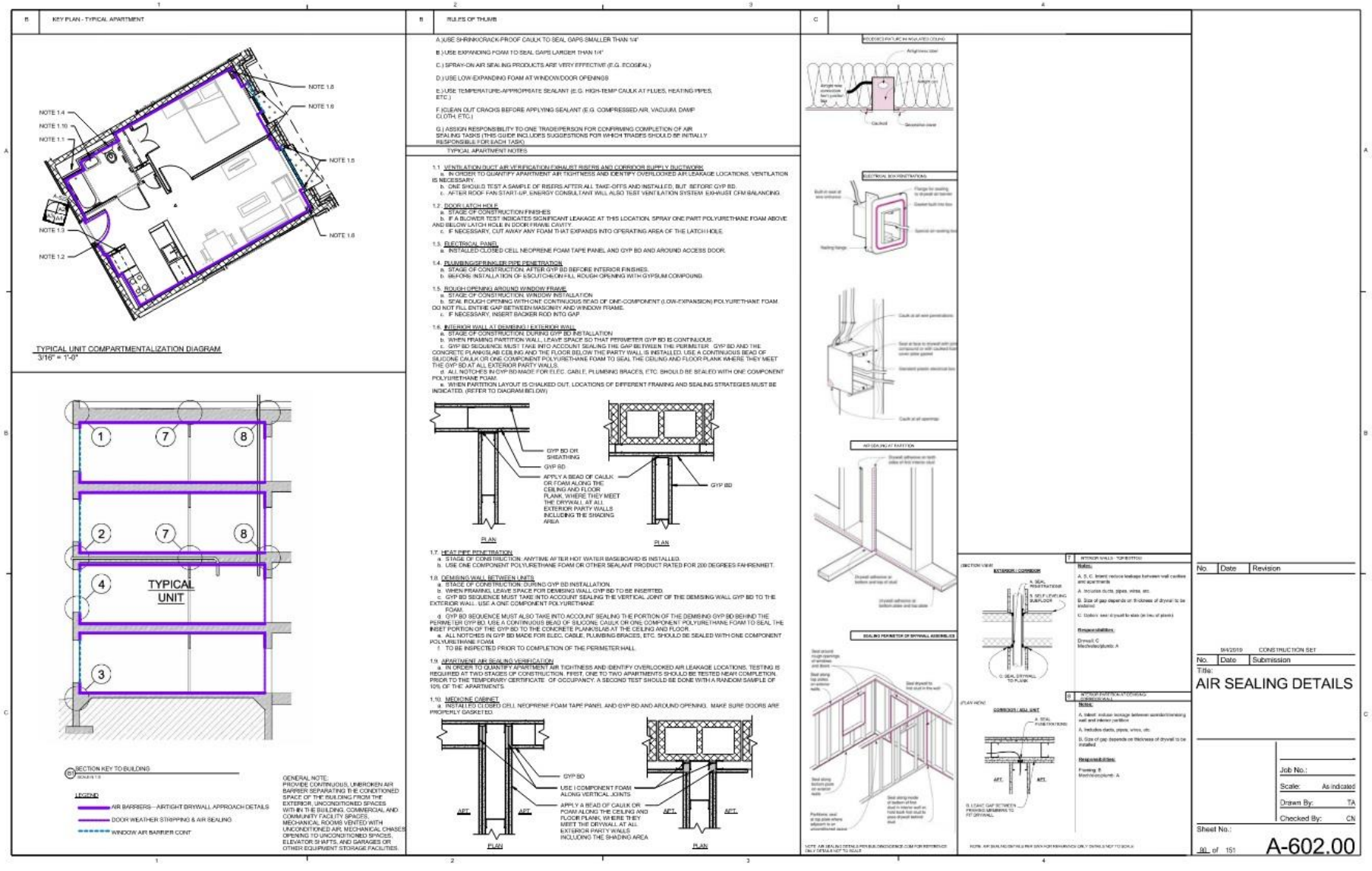
- Air Sealing Details
  - For whole building as well as compartmentalization
  - SWA Air Sealing Guide – focused on compartmentalization
    - https://www.swinter.com/about-us/news/news-item/air-sealing-guides/







Air Sealing Details in Drawings Set

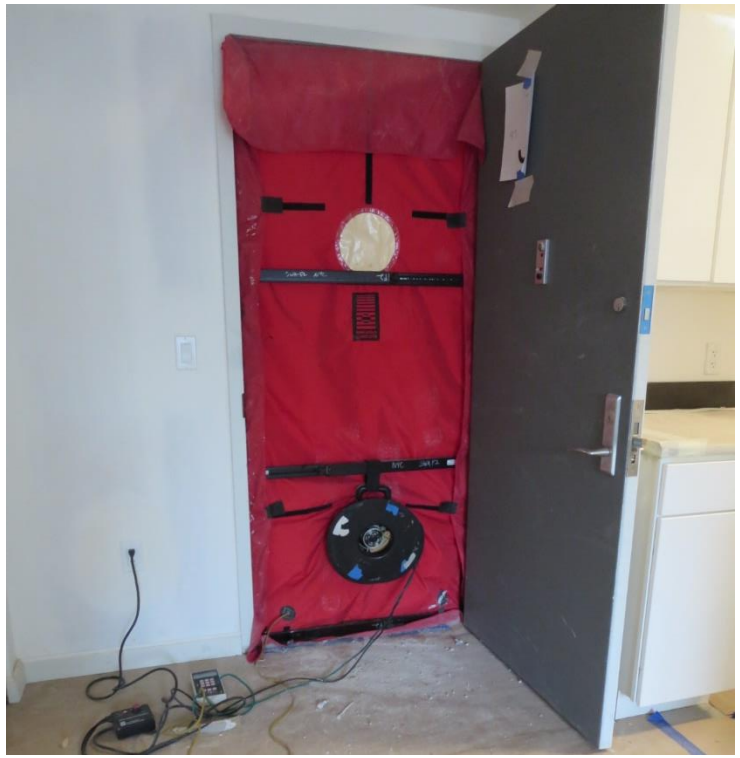


Evaluate Air Sealing During Construction

Field Evaluation of Air Sealing

1. Pre-drywall
   - Visual inspection (diagnostic tools if necessary, but not typ)

2. Final
   - Blower door & visual inspection



Pre-Drywall Visual Inspection

Use Checklists

Project Name: | Date Updated:

LEED for Homes Multi-Family Mid-Rise Thermal Enclosure Inspection Checklist

Complete the Below Thermal Enclosure System Rater Checklist
This document is based off of the ENERGY STAR Qualified Homes, Version 3 (Rev. 02) Thermal Enclosure Rater Checklist. Project teams may elect to use that document, and complete sections 2.2, 3, and 5.

	Inspection Guidelines	Must Correct	Builder Verified	Rater Verified	N/A
2.	**Quality-Installed Insulation**				
2.2	All ceiling, wall, floor, and slab insulation shall achieve RESNET-defined Grade I installation or, alternatively, Grade II for surfaces with insulated sheathing	☐	☐	☐	☐
3.	**Fully-Aligned Air Barriers**				
	At each insulated location noted below, a complete air barrier shall be provided that is fully aligned with the insulation as follows:				
3.1	Walls				
3.1.1	Walls behind showers and tubs	☐	☐	☐	☐
3.1.2	Walls behind fireplaces	☐	☐	☐	☐
3.1.3	Attic knee walls / Sloped attics	☐	☐	☐	☐
3.1.4	Skylight shaft walls	☐	☐	☐	☐
3.1.5	Wall adjoining porch roof	☐	☐	☐	☐
3.1.6	Staircase walls	☐	☐	☐	☐
3.1.7	Double walls	☐	☐	☐	☐
3.1.8	Garage rim / band joist adjoining conditioned space	☐	☐	☐	☐
3.1.9	All other exterior walls	☐	☐	☐	☐
3.2	Floors				
3.2.1	Floor above garage	☐	☐	☐	☐
3.2.2	Cantilevered floor	☐	☐	☐	☐
3.2.3	Floor above unconditioned basement or vented crawlspace	☐	☐	☐	☐
3.3	Ceilings				
3.3.1	Dropped ceiling/soffit below unconditioned attic	☐	☐	☐	☐
3.3.2	Sloped ceilings	☐	☐	☐	☐
3.3.3	All other ceilings	☐	☐	☐	☐
5.	**Air Sealing**				
5.1	Penetrations to unconditioned space or that penetrate the residential unit envelope fully sealed with solid blocking or flashing as needed and gaps sealed with caulk or foam	☐	☐	☐	☐
5.1.1	Duct / flue shaft	☐	☐	☐	☐
5.1.2	Plumbing / piping	☐	☐	☐	☐
5.1.3	Electrical wiring	☐	☐	☐	☐
5.1.4	Bathroom and kitchen exhaust fans	☐	☐	☐	☐
5.1.5	Recessed lighting fixtures adjacent to unconditioned space ICAT labeled and fully gasketed. Also, if in insulated ceiling without attic above, exterior surface of fixture insulated to > R-10 in CZ 4 and higher to minimize condensation potential.	☐	☐	☐	☐
5.1.6	Light tubes adjacent to unconditioned space include lens separating unconditioned and conditioned space and are fully gasketed	☐	☐	☐	☐

TABLE R402.4.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	
General requirements	A continuous air barrier shall be installed in the building envelope. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a seali
Ceiling/attic	The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be al
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls sl less than R-3 per inch. Exterior thermal envelope ins
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.	
Rim joists	Rim joists shall include an exterior air barrier.[b] The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation ma
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to m shall be in contact with the top side of sheathing, or c all perimeter floor framing members.
Basement crawl space and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.10 . Penetrations through concrete foundation walls and slabs shall be air sealed. Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the *International Residential Code*.	Crawl space insulation, where provided instead of flo Conditioned basement foundation wall insulation sha Slab-on-grade floor insulation shall be installed in ac
Shafts, penetrations	Duct and flue shafts and other similar penetrations to exterior or unconditioned space shall be sealed to allow for expansion, contraction and mechanical vibration. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	Insulation shall be fitted tightly around utilities
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated por
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed in accordance with Section R402.4.5 .	Recessed light fixtures installed in
Plumbing, wiring or other obstructions	All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	Insulation shall be installed to fill t insulation and air barrier systems
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.	Exterior walls adjacent to showers
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.	
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

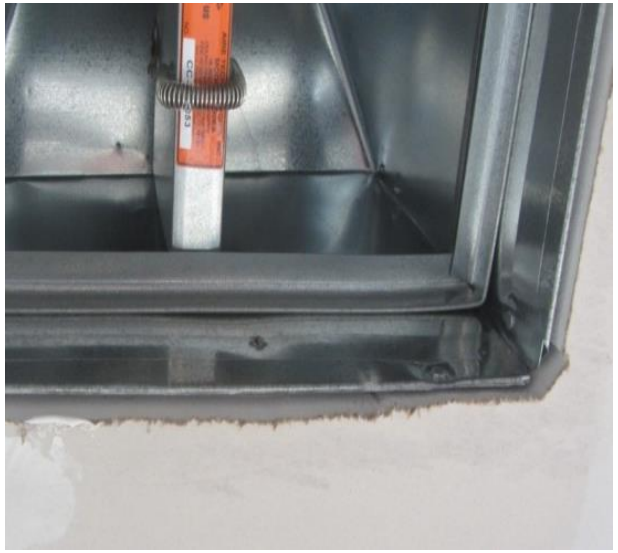
Prelim / Mock-up Blower Door Test

- Basic Components
  - Gauge (manometer)
  - Shroud
  - Frame
  - Fan

Finding Air Leaks During Testing

- Intuition (eyes, brain)
- Sound (ears)
- Your hands
- Theatrical fog / hand foggers
- IR (if conditions allow and have basic IR training)

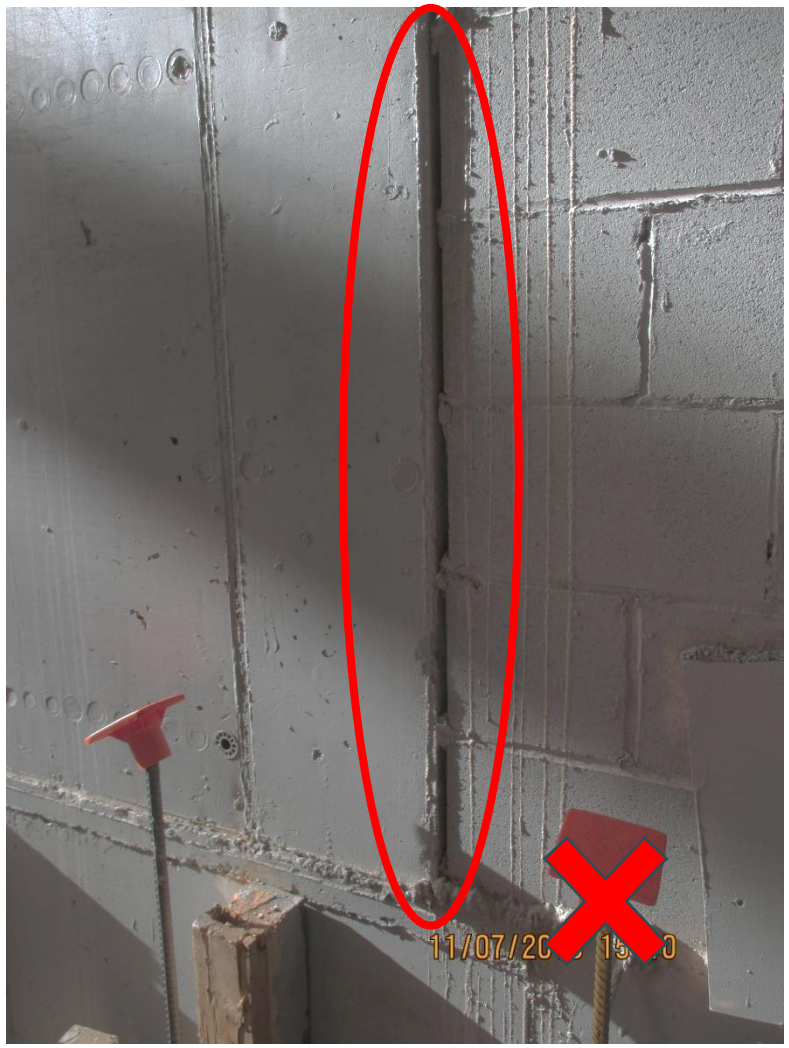
Corrective Measures



Examples

Air Sealing – Good and Bad

Air Sealing – Good and Bad

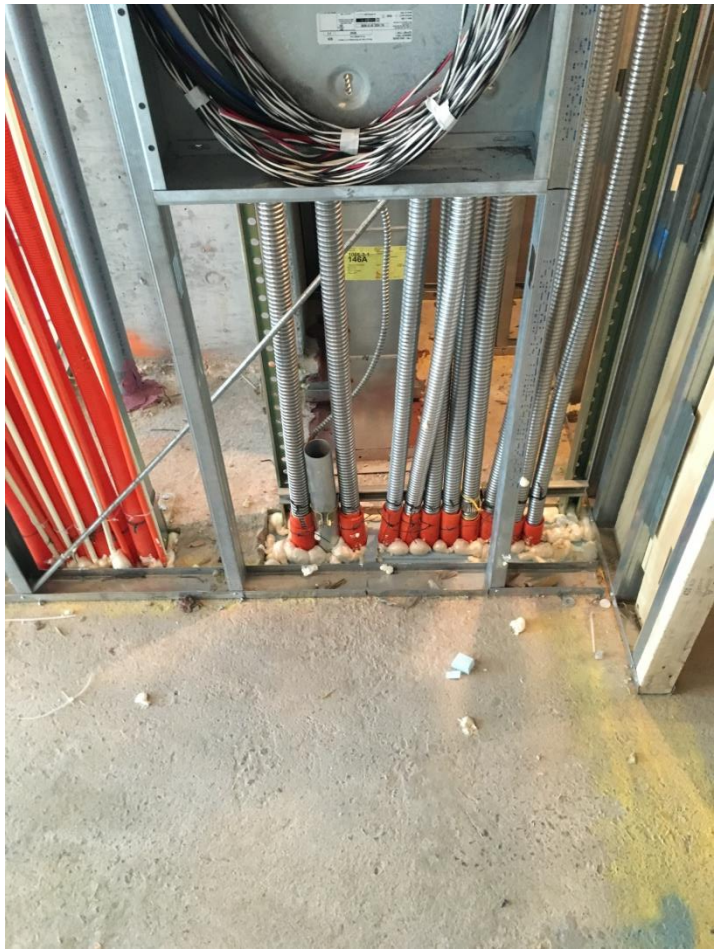


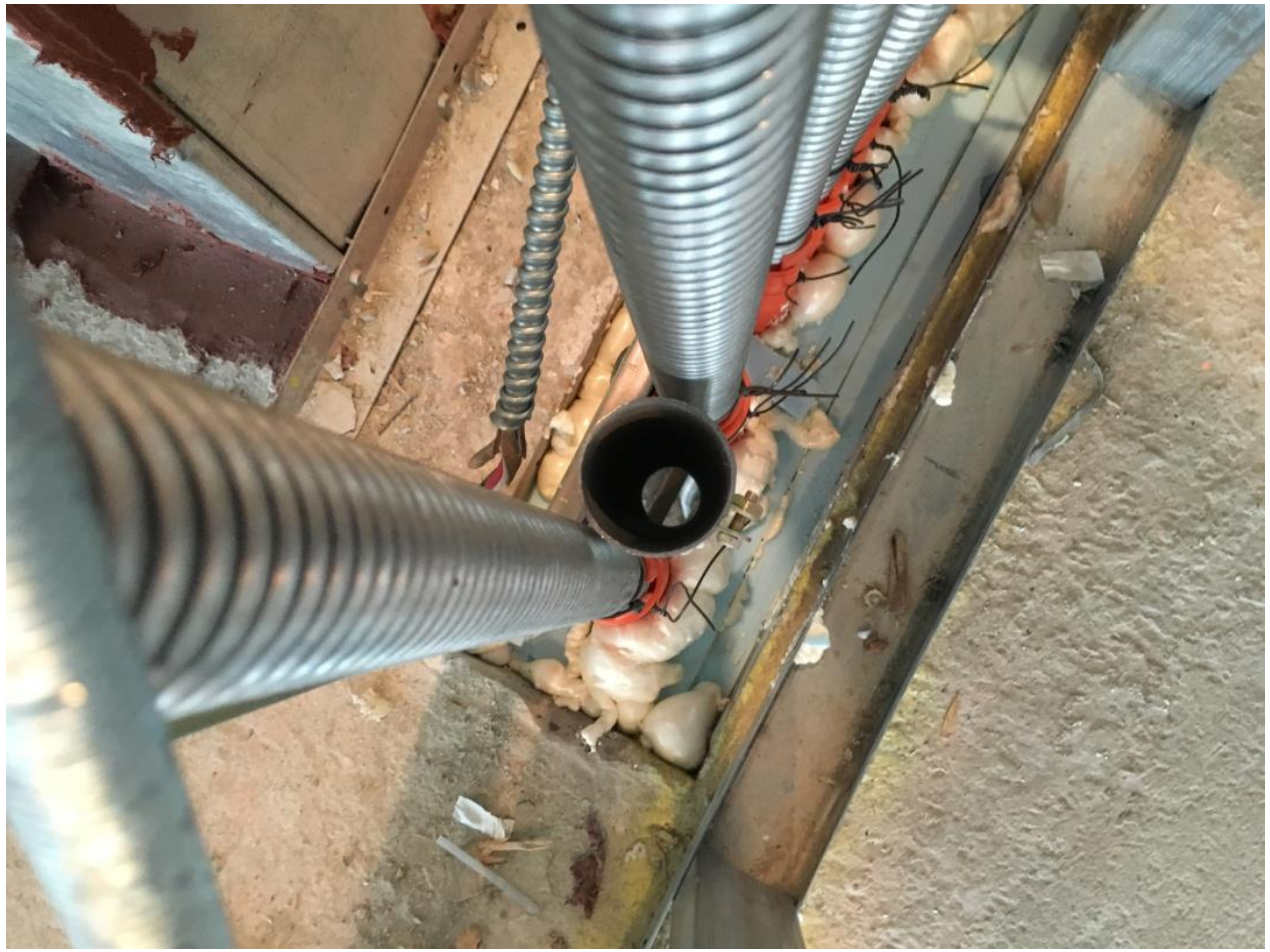
Air Sealing – Good and Bad

Air Sealing – Good and Bad

- Seal these abandoned penetrations before framing is installed over them

Air Sealing – Good and Bad





Air Sealing – Good and Bad

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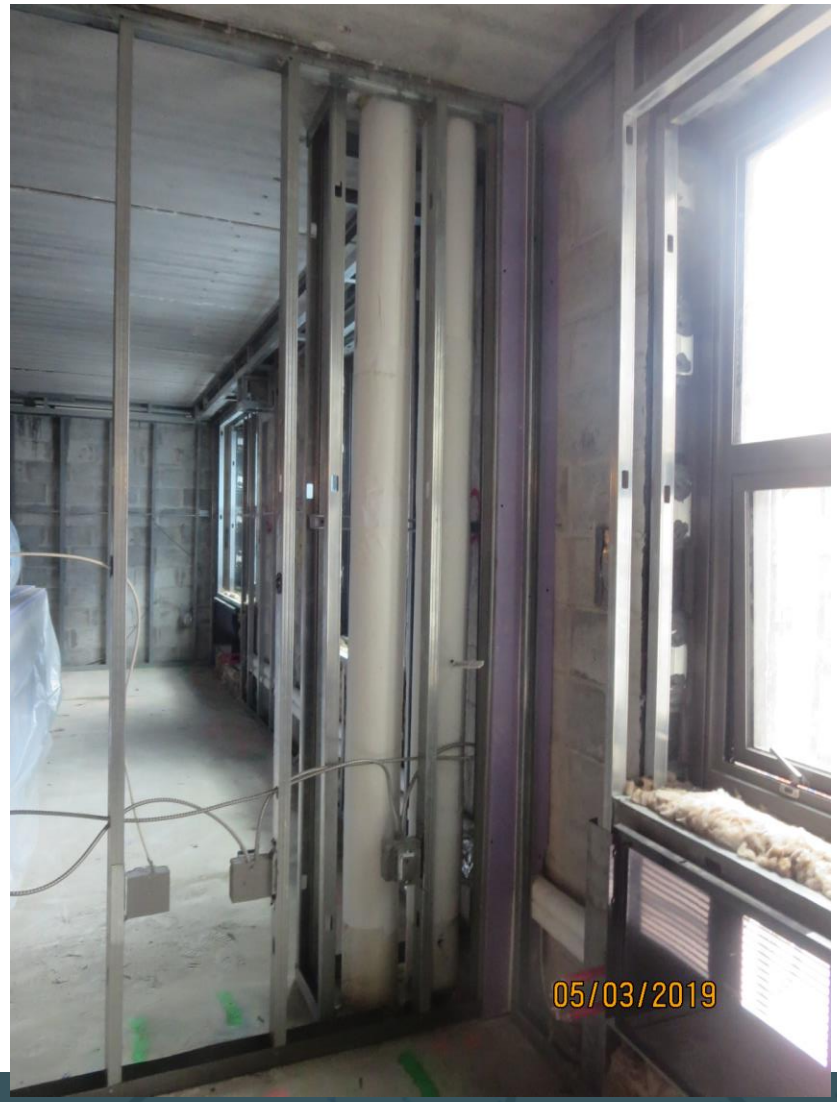
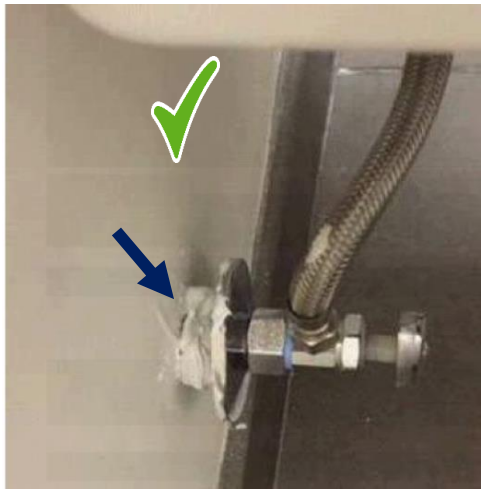
Air Sealing – Good and Bad



Air Sealing – Good and Bad

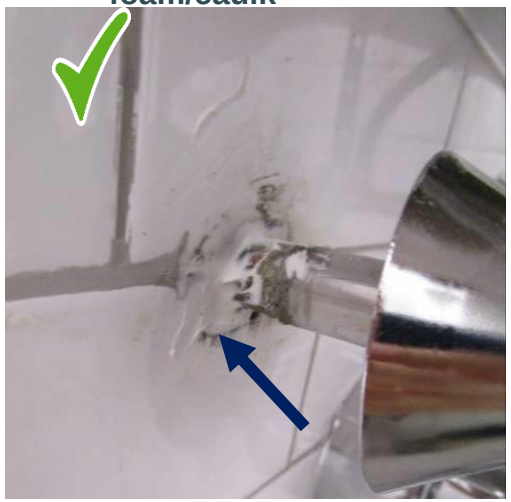
Air Sealing – Good and Bad

Unsealed Toilet penetration



Sealed Toilet penetration with spray foam/caulk

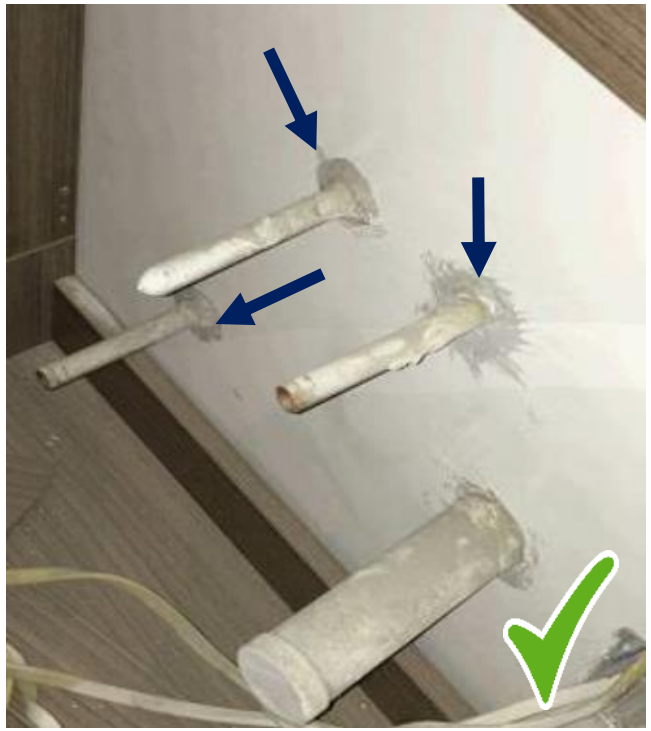
Unsealed Shower penetration



Sealed Shower penetration with caulk

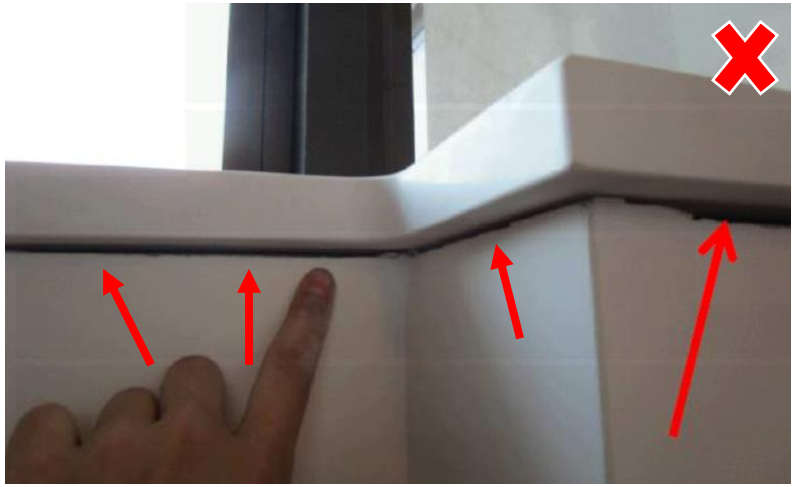
Air Sealing – Good and Bad

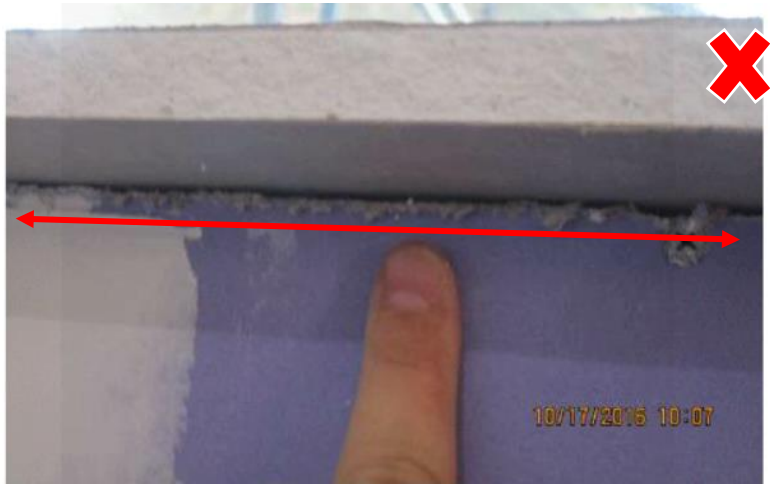
Sealed Kitchen sink penetration with spray foam/caulk



Air Sealing – Good and Bad

Air Sealing – Good and Bad

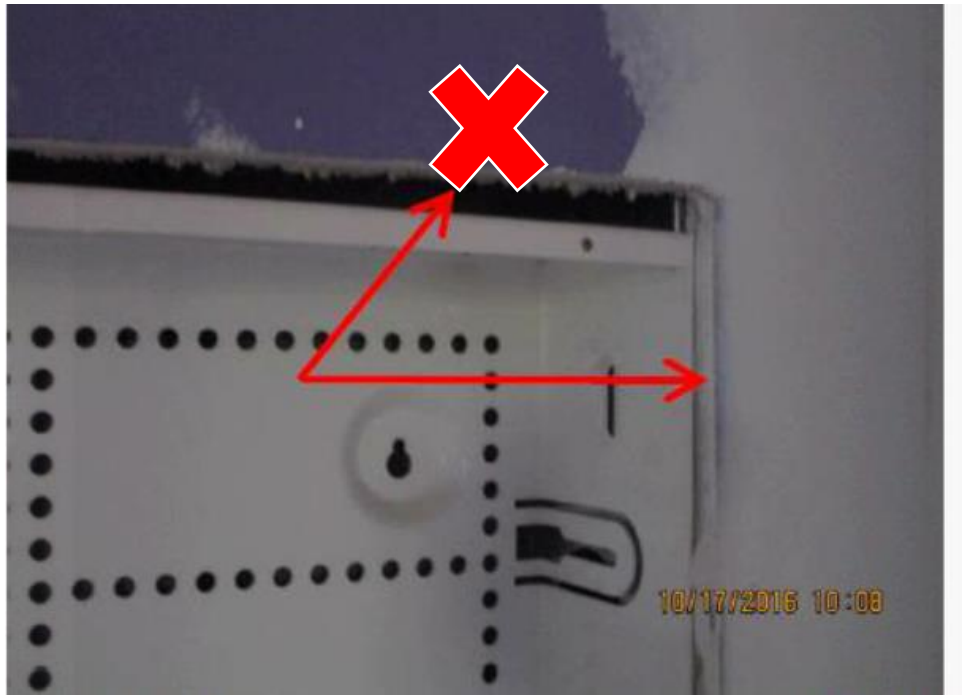




Unsealed gap between bottom of sill & drywall

Gap between frame of window & drywall

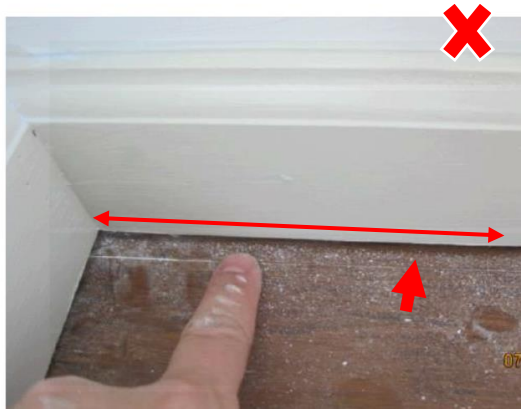
Air Sealing – Good and Bad



Large gap between telecom box & drywall

Large gap at access panel (use gasketing)

Air Sealing – Good and Bad



Unsealed gaps between floor and dry wall/base molding

Unsealed gaps between floor and dry wall/base molding

Sealed thoroughly with caulking/sealant/ spray foam

Air Sealing – Good and Bad

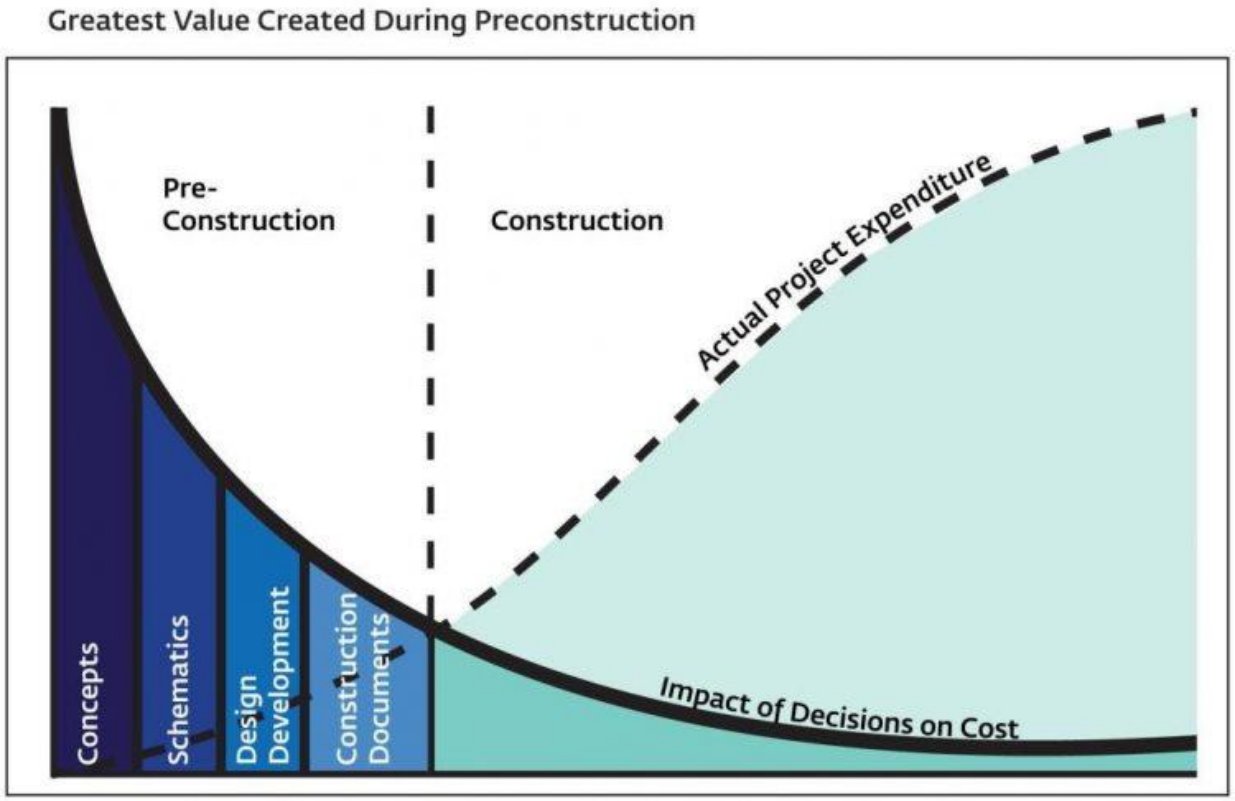
Missing bottom sweep

Missing perimeter weather striping

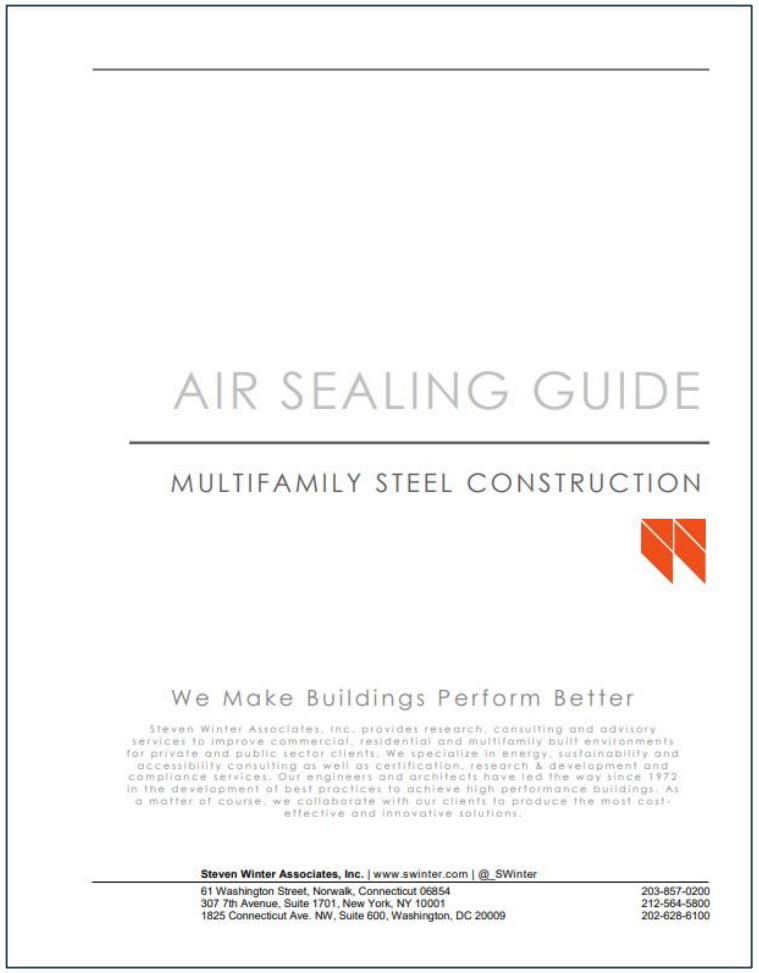
Recap

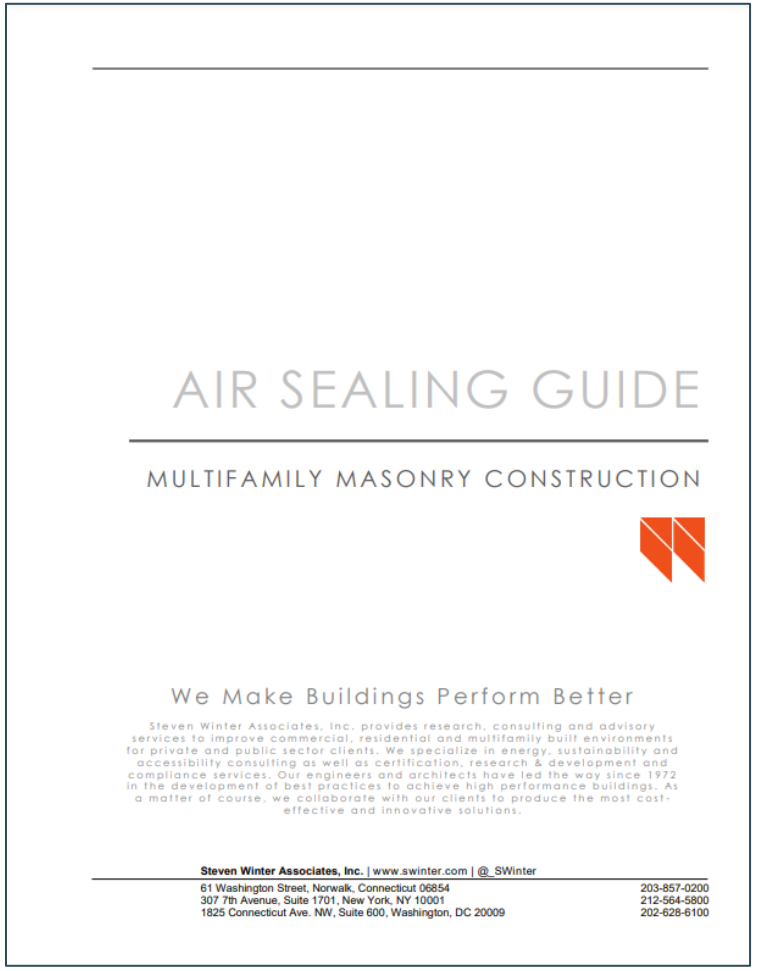
Summary

- Understand why / how / where
- Know your target limit
- Detail and specify
- Inspect and test
- Communicate
- Succeed!



Resources





https://www.swinter.com/about-us/news/news-item/air-sealing-guides/

Discussion

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