

BROUGHT TO YOU BY

EVERSOURCE



PROUD SPONSORS OF



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.



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

BROUGHT TO YOU BY

EVERSOURCE



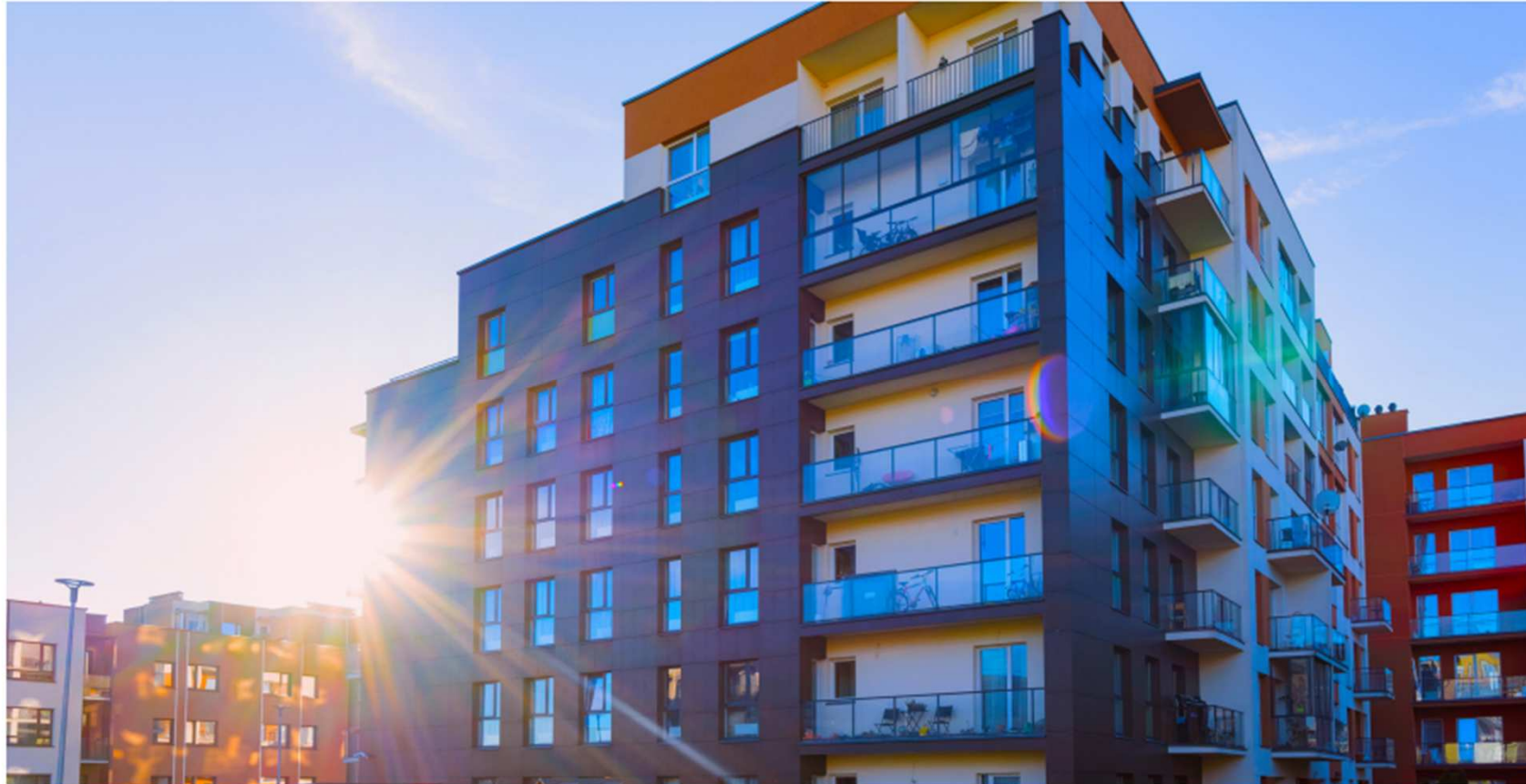
Part of the AVANGRID Family

PROUD SPONSORS OF



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](https://energizeCT.com) or call 1-877-WISE USE for more details.

BROUGHT TO YOU BY

EVERSOURCE



PROUD SPONSORS OF



BROUGHT TO YOU BY

EVERSOURCE



Part of the AVANGRID Family

PROUD SPONSORS OF

energize **CT**
CONNECTICUT



The future of high-performance,
all-electric homes starts here.



	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 > 850ft ² : ACH50 ≤ 4.0 CFA < 850ft ² : ACH50 ≤ 5.0	ACH50 ≤ 2.0	CFA > 850ft ² : ACH50 ≤ 3.0 CFA < 850ft ² : 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

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

Go to [EnergizeCT.com](https://energizeCT.com) or call 1-877-WISE USE for more details.

BROUGHT TO YOU BY

EVERSOURCE



PROUD SPONSORS OF



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



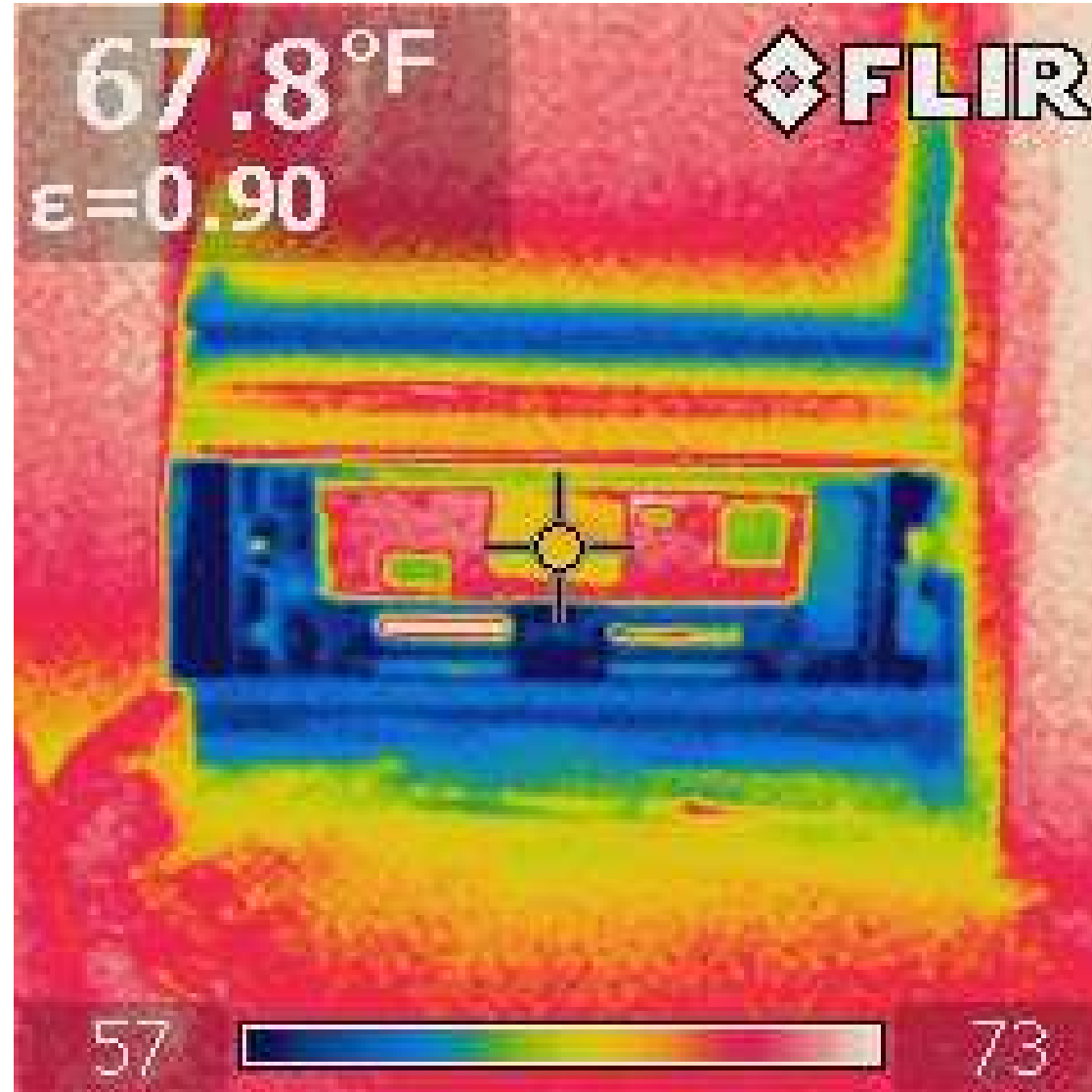
We Make
Buildings

Perform Better

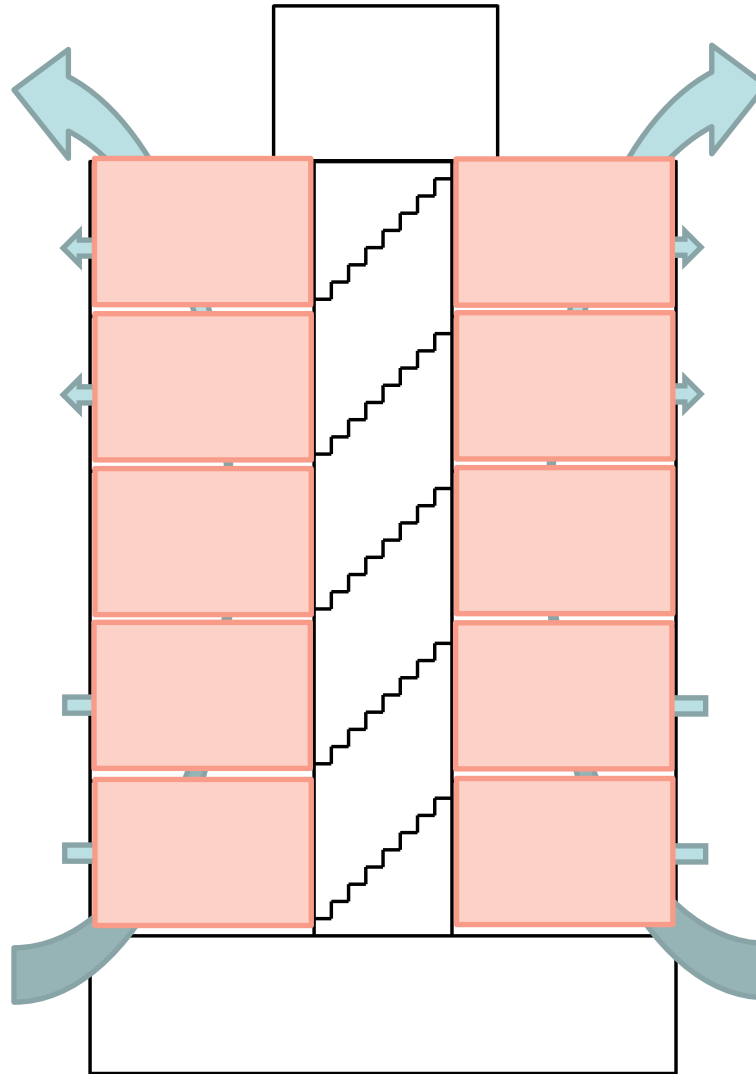
By providing a whole-building
approach to design, construction,
and
operation

Why air seal?

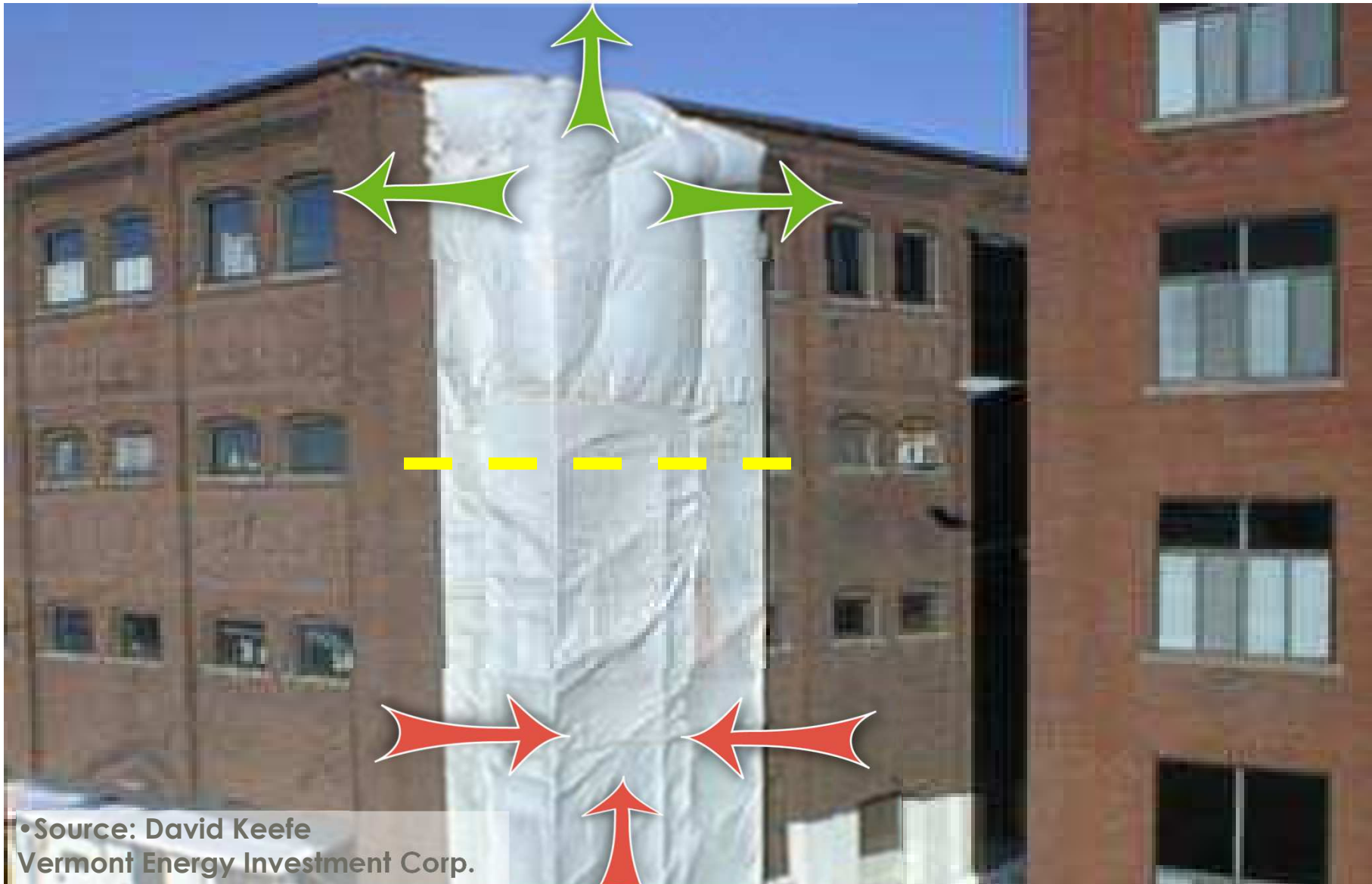
Air Seal to... Save Energy



Air Seal to... Overcome Stack Effect

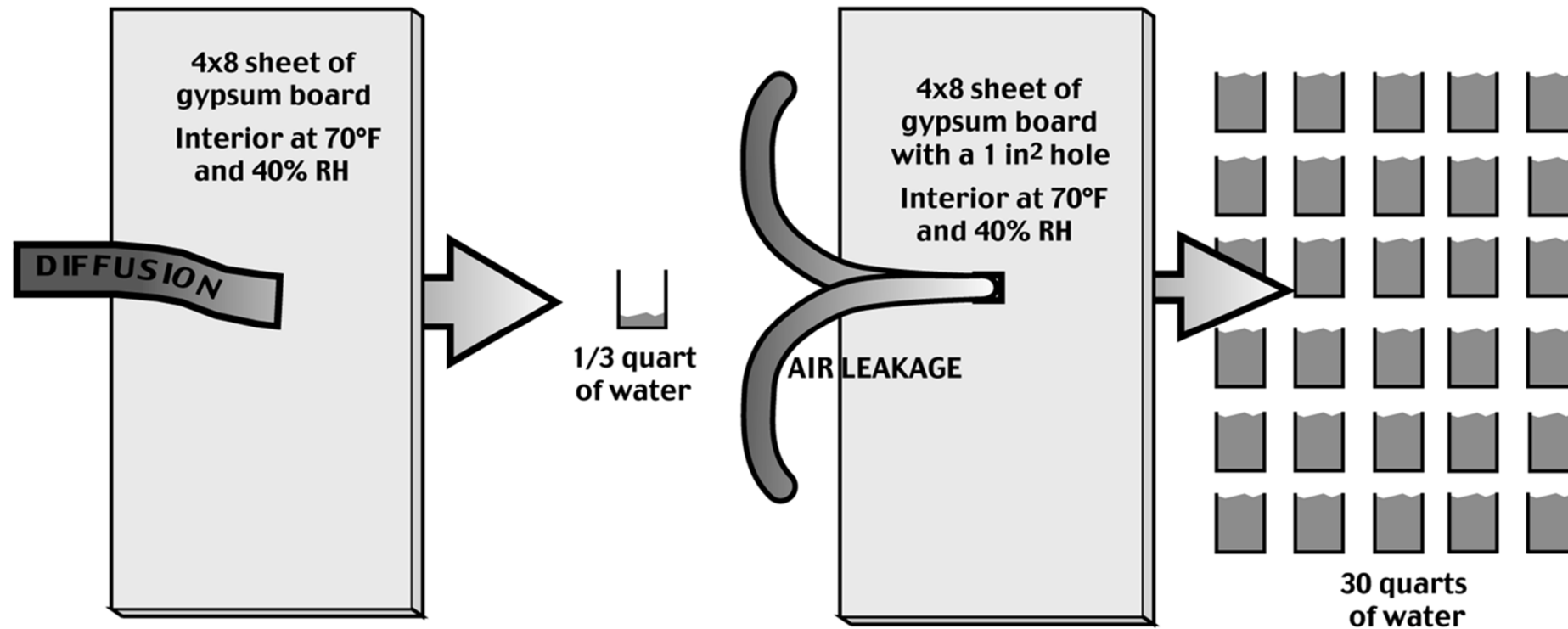


Air Seal to... Overcome Stack Effect



• Source: David Keefe
Vermont Energy Investment Corp.

Air Seal to ... Reduce Moisture Drive

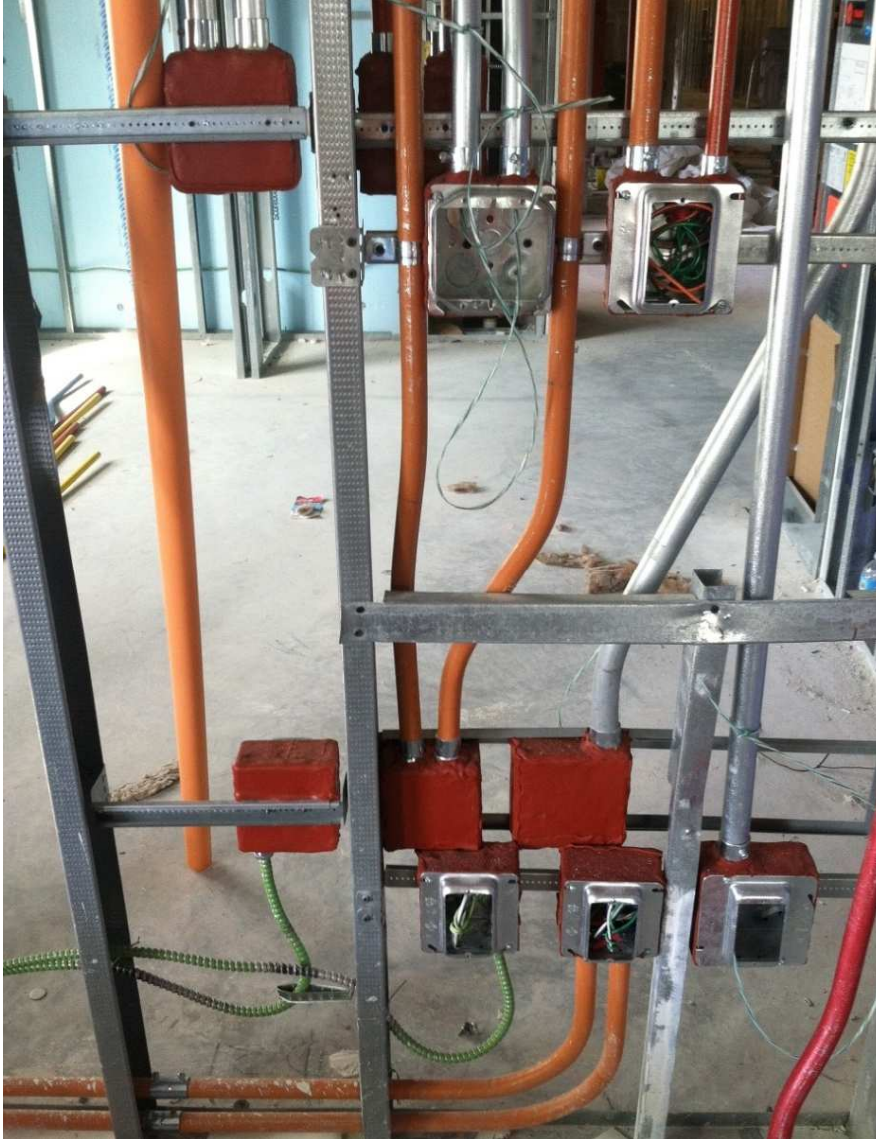


Source: Southface

Air Seal to... Control Sound/Smell Transfer



Air Seal to ... Stop Flame/Smoke Spread



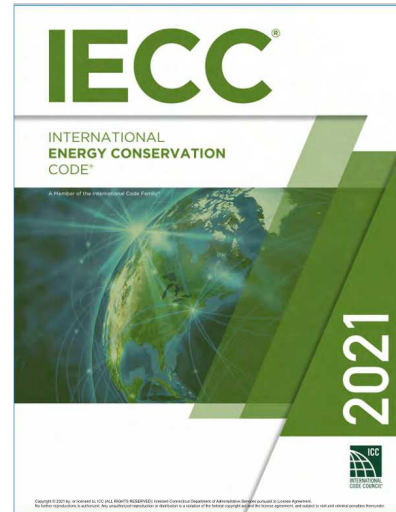
Air Seal to... Improve Occupant Comfort



Air Seal to... Stop Pest Migration



Air Seal to... Satisfy Code / Certifications



How and where
does air leakage
occur?

How does air leakage occur?

Air leakage requires 2 things:

1. An opening

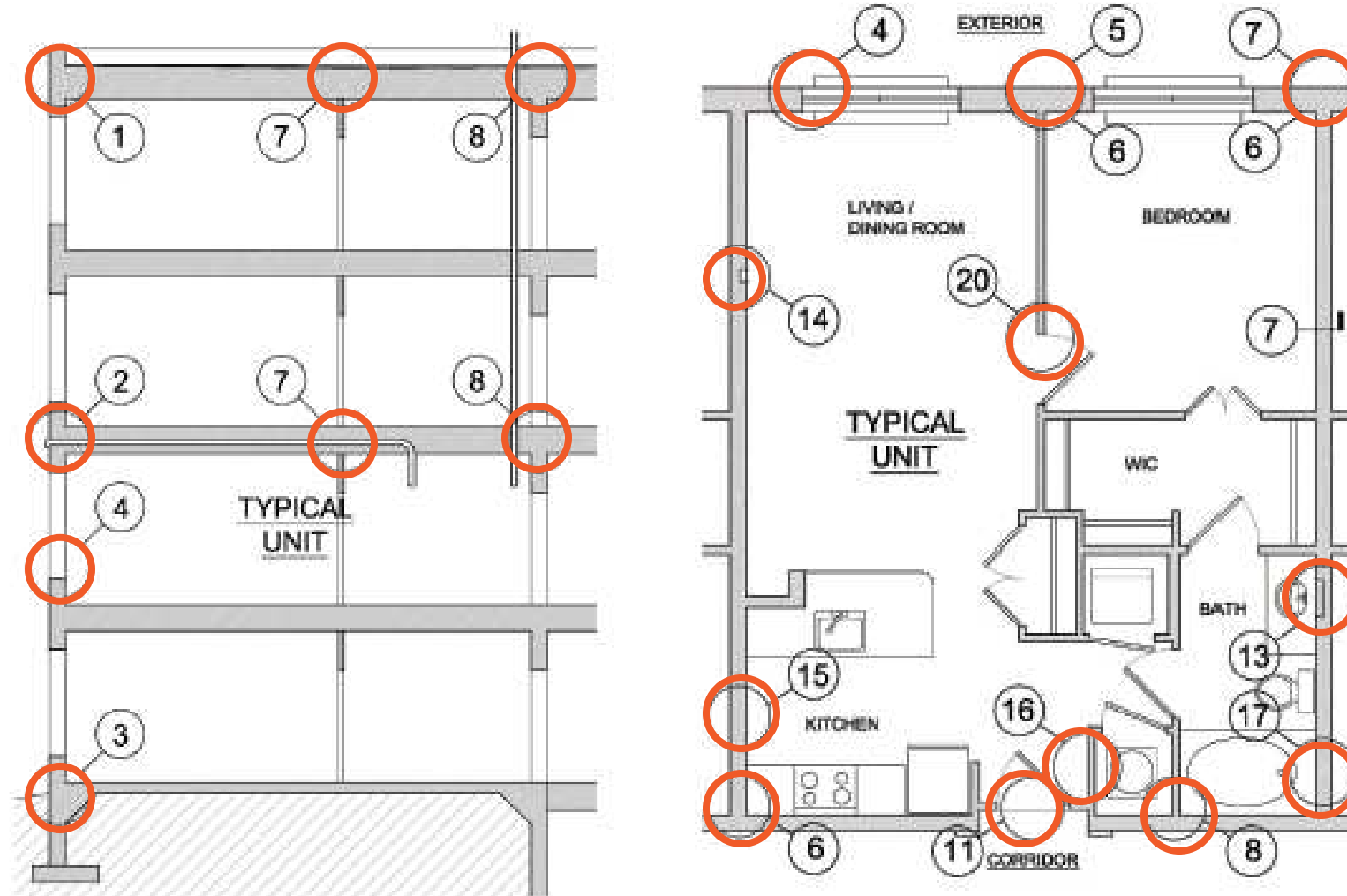
- Cracks
- Small holes
- Large holes
- Permeable material

2. A driving force

- Wind
- Stack effect
- Mechanicals

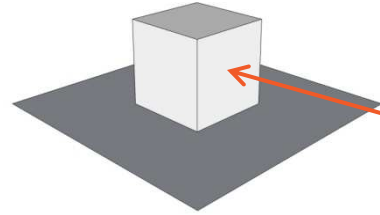


Where does air leakage occur?

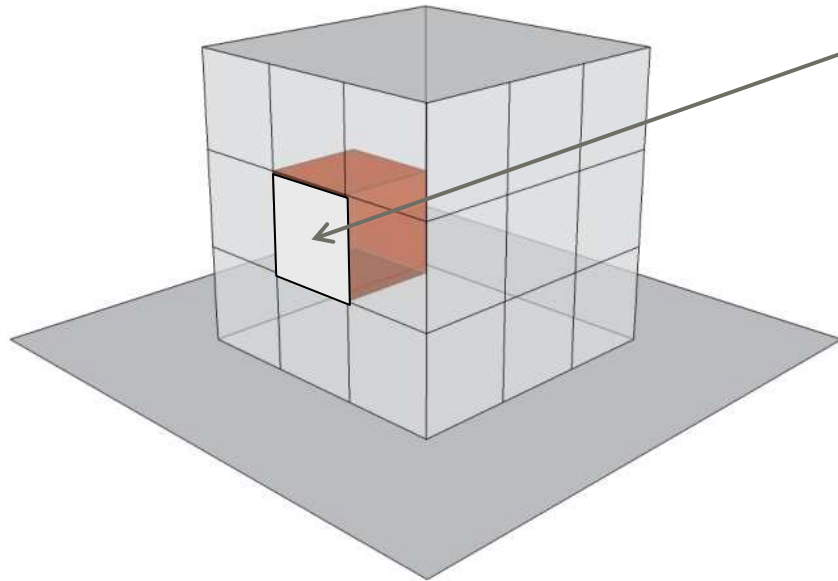


How can we control
leakage and
provide sufficient air
sealing?

Where Leakage Occurs... Ambient vs. Adiabatic



Detached: ~100% ambient exposure



Attached: 16% ambient exposure

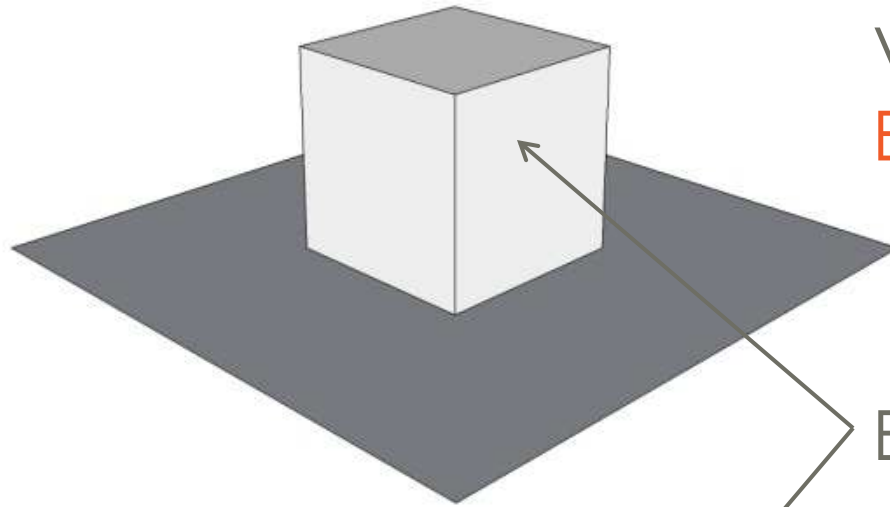
All air leakage matters!

How to control leakage... Minimize enclosure area

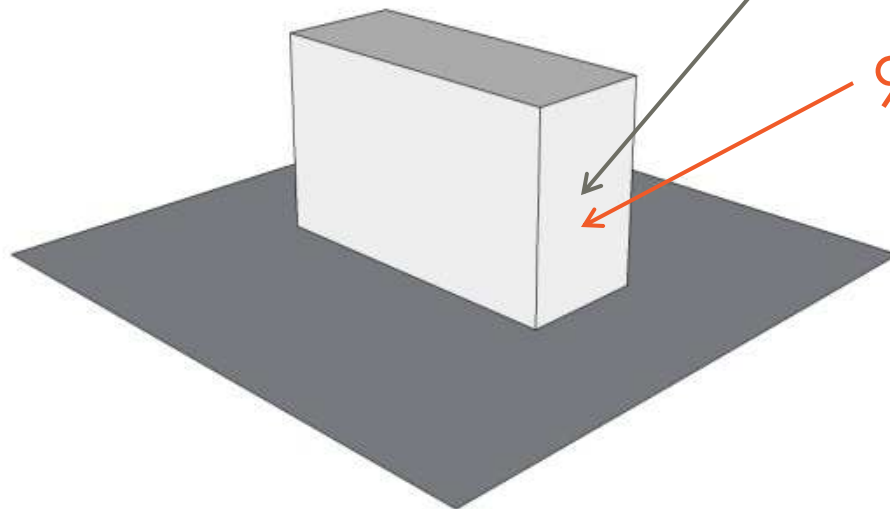
Testing metric:

Volume (ACH50) vs.

Enclosure area (CFM50/SF)

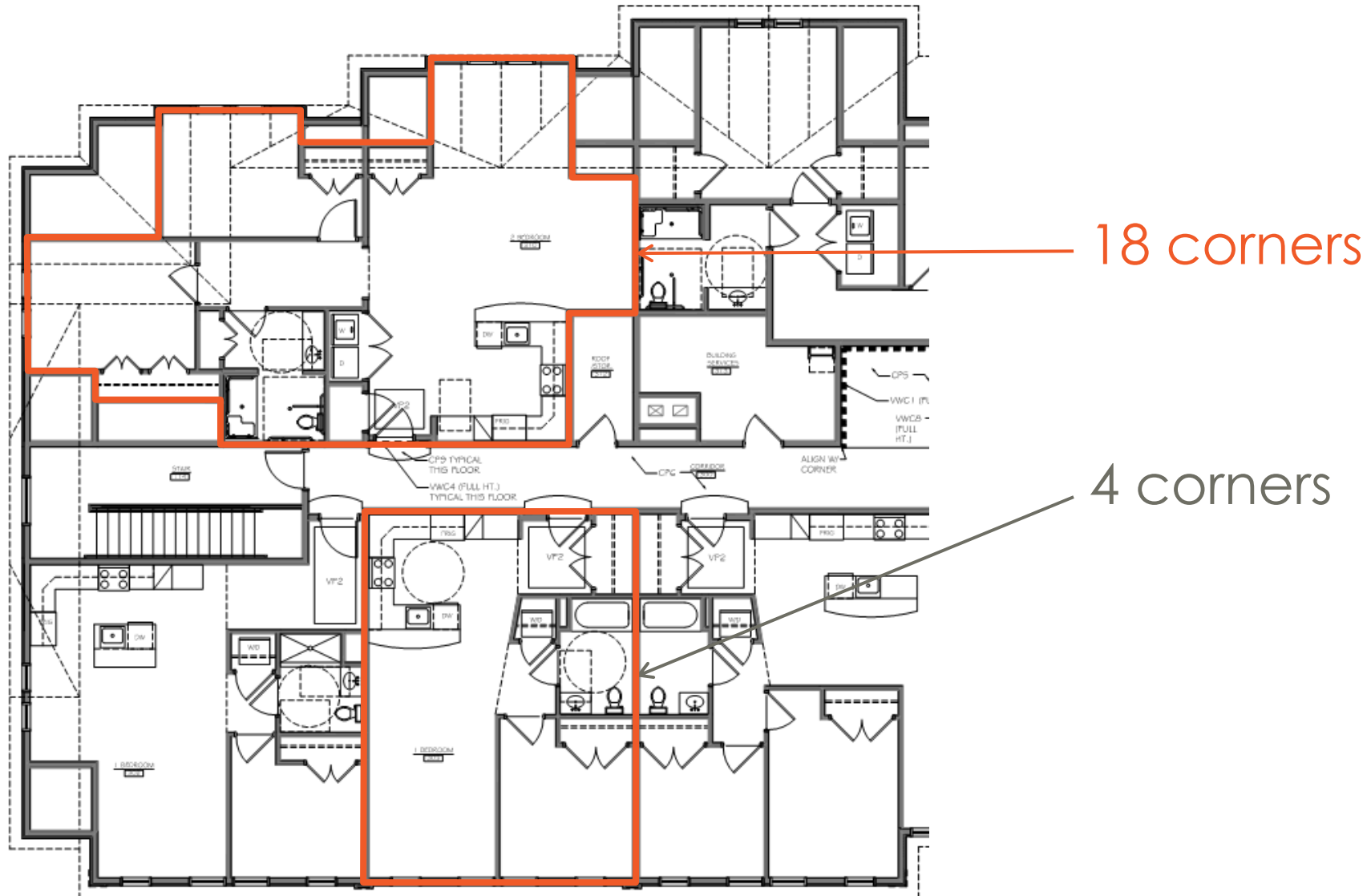


Equal volume & floor area

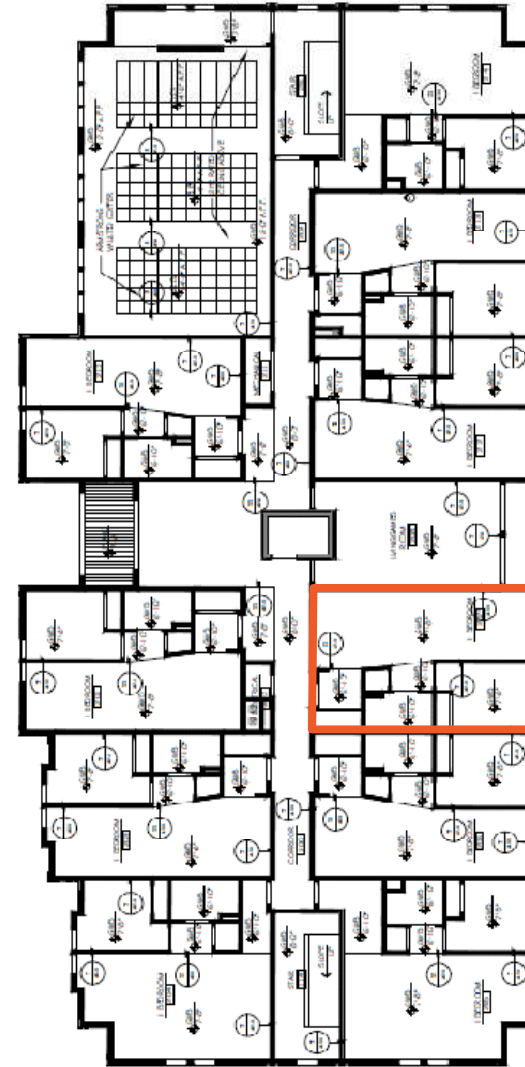
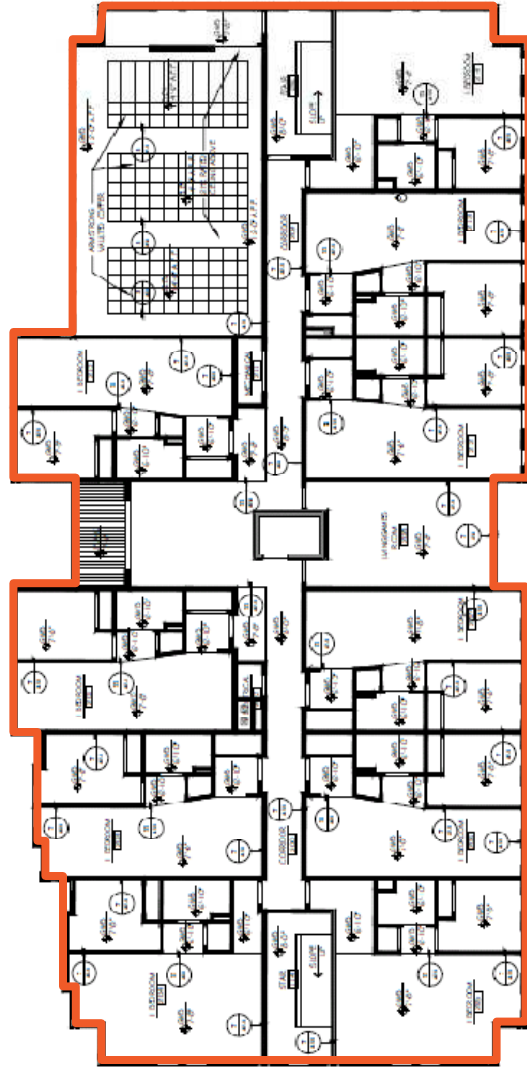


9% more enclosure area

How to control leakage... Simplify enclosure area



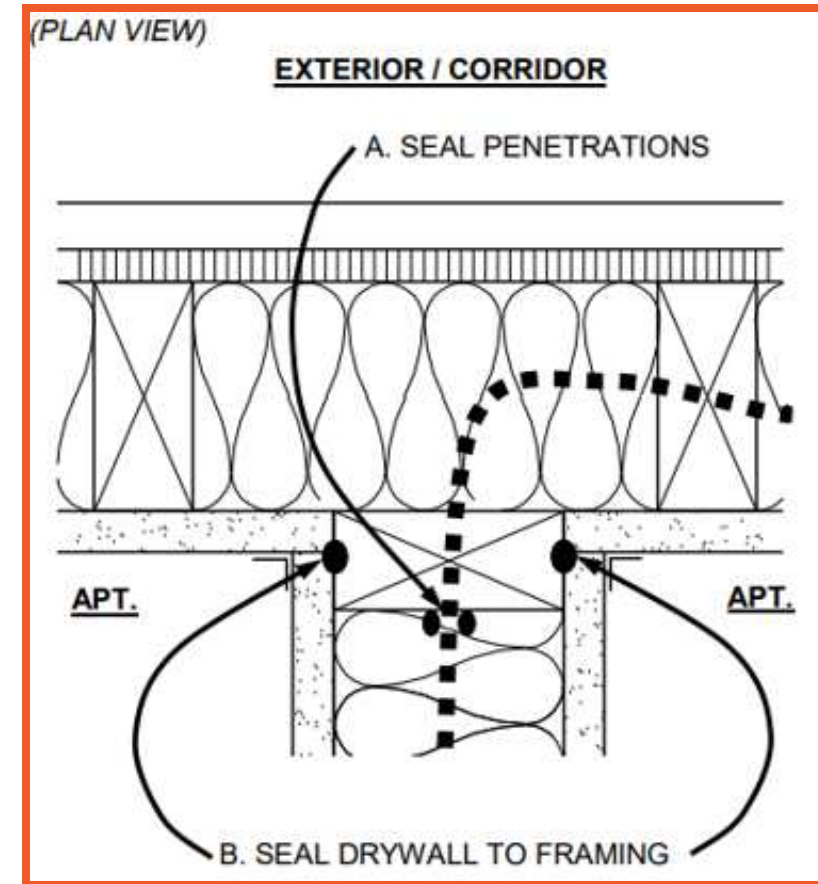
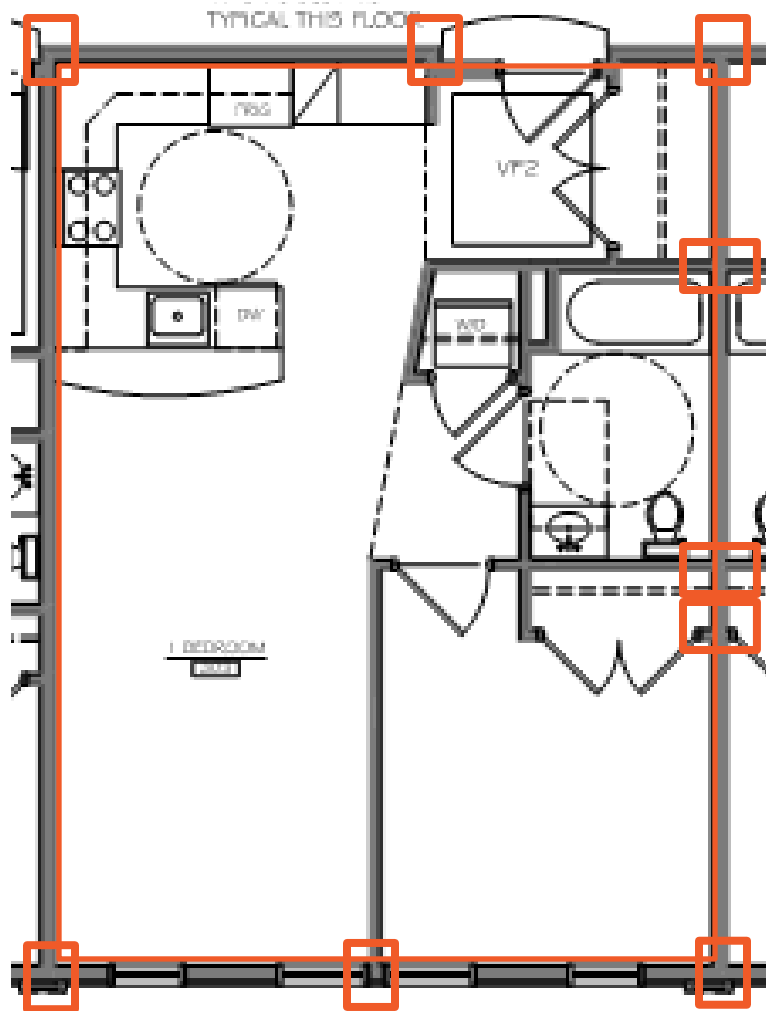
How to control leakage... Know your priorities



How to control leakage... Know your approach



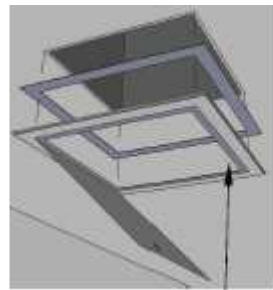
How to control leakage... Seal perimeter of unit



How to control leakage... Think like water

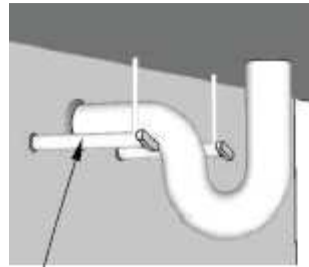
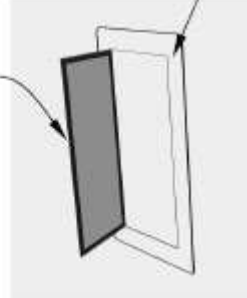


How to control leakage... Seal drywall enclosure

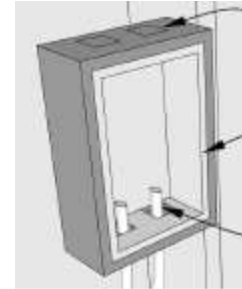


A. SEAL PERIMETER OF PANEL TO DRYWALL

B. INSTALL FOAM WEATERSTRIPPING ON PANEL DOOR



A. SEAL PLUMBING PENETRATIONS THROUGH DRYWALL/SUBFLOOR



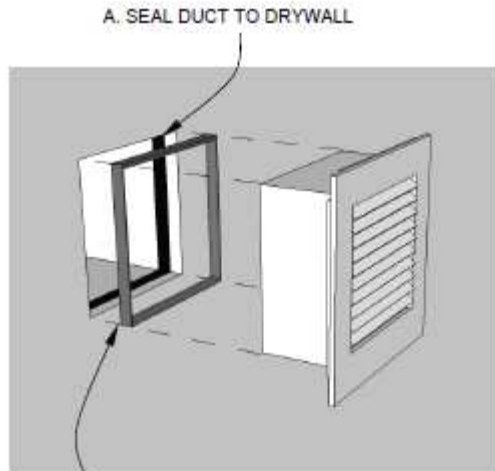
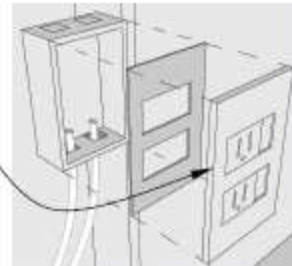
A. SEAL SCREW HOLES & UNUSED KNOCK-OUTS

B. SEAL BOX TO DRYWALL

C. SEAL WIRE PENETRATIONS

OPTION:
(OUTLETS ONLY)

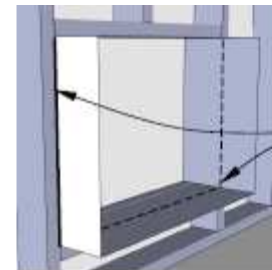
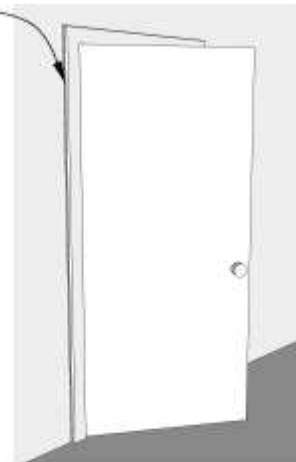
INSTALL "SAFE
PLATE COVERS"



A. SEAL DUCT TO DRYWALL

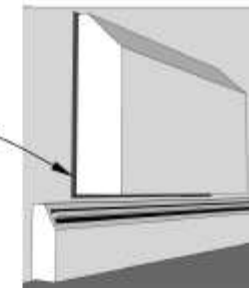
B. SEAL BETWEEN DIFFUSER/
REGISTER AND DRYWALL

A. SEAL MILLWORK
TO DRYWALL



A. SEAL SLEEVE
TO FRAMING

B. SEAL SLEEVE
TO DRYWALL



How to control leakage...Drawings/specifications

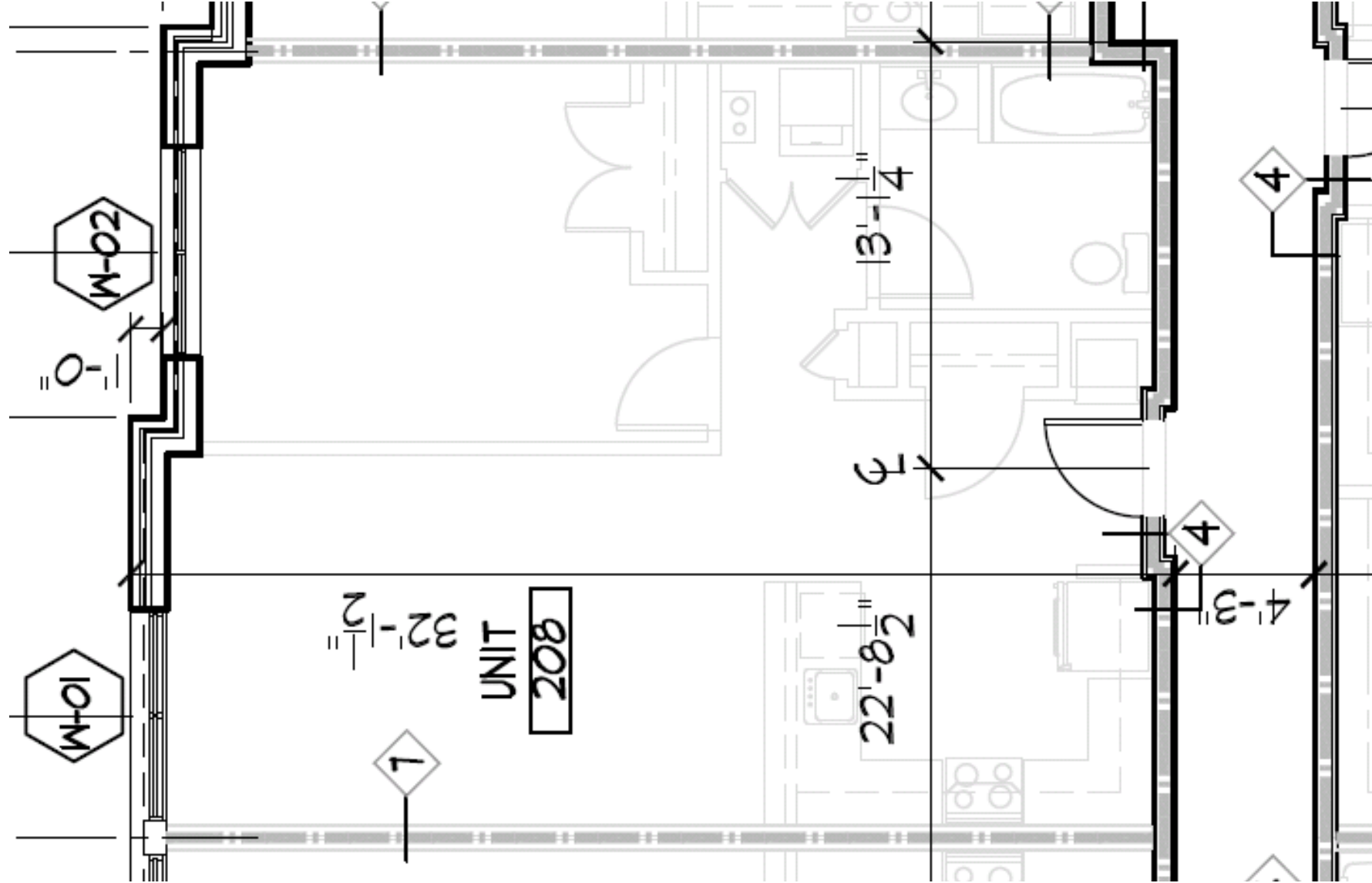
- Choose details/specs specific to each project
- Require unit-by-unit testing, not guarded or whole-building
- Max. 0.30 cfm/SF of enclosure - or as required by compliance path
- Be specific:
 - Gaps $< 1/4''$ - use caulk; gaps $> 1/4''$ use - foam
 - Use appropriate sealants (e.g. low-VOCs, high-temp, low-expanding, fire-rated, etc.)
 - Clean out cracks before applying sealant (e.g. compressed air, vacuum, damp cloth, etc.)
- Consider new products (elastomeric sealant, tape)

How to control leakage... Own it!



Design Exercise

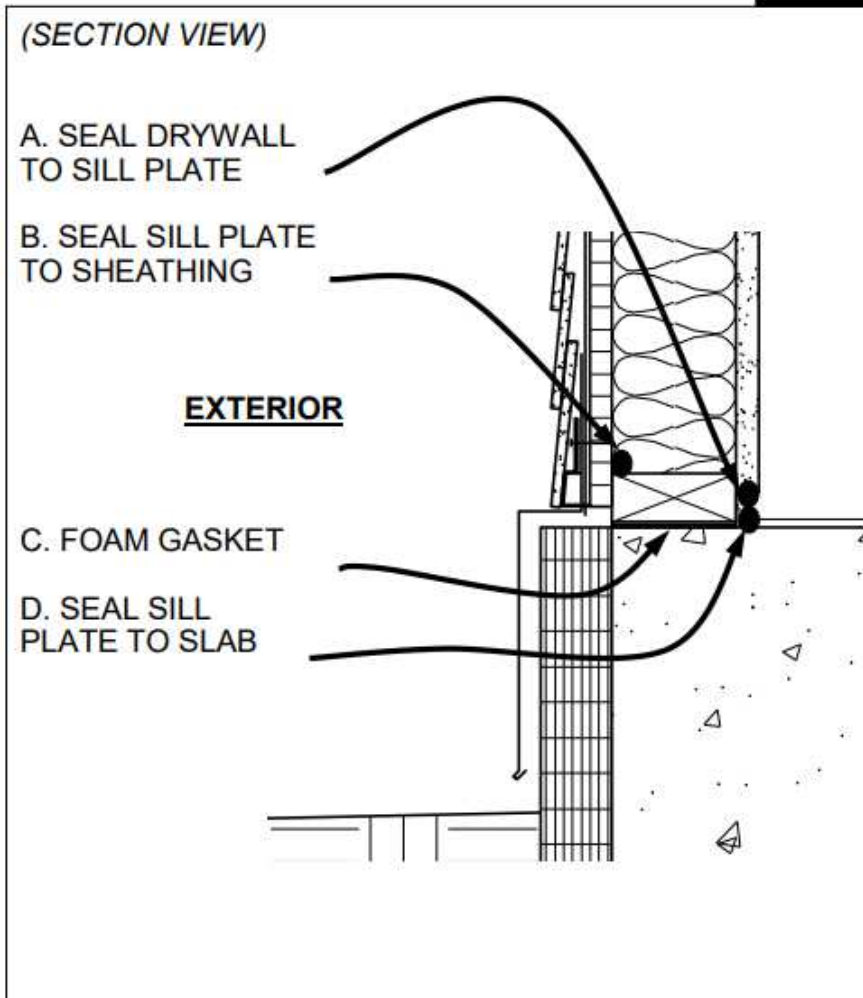
Define the enclosure



Seal bottom of wall

3

EXTERIOR WALL - BOTTOM (INTERIOR WALL SIMILAR)



Notes:

A. Intent: reduce leakage between wall cavity and apartment

B. Intent: reduce leakage between wall cavity and outdoors

A. Option: apply drywall adhesive to framing BEFORE installing drywall

A, B. Option: self-leveling subfloor (i.e. gypcrete)

C. To be installed in addition to sealant between the plate and slab

D. Same intent as item B

Responsibilities:

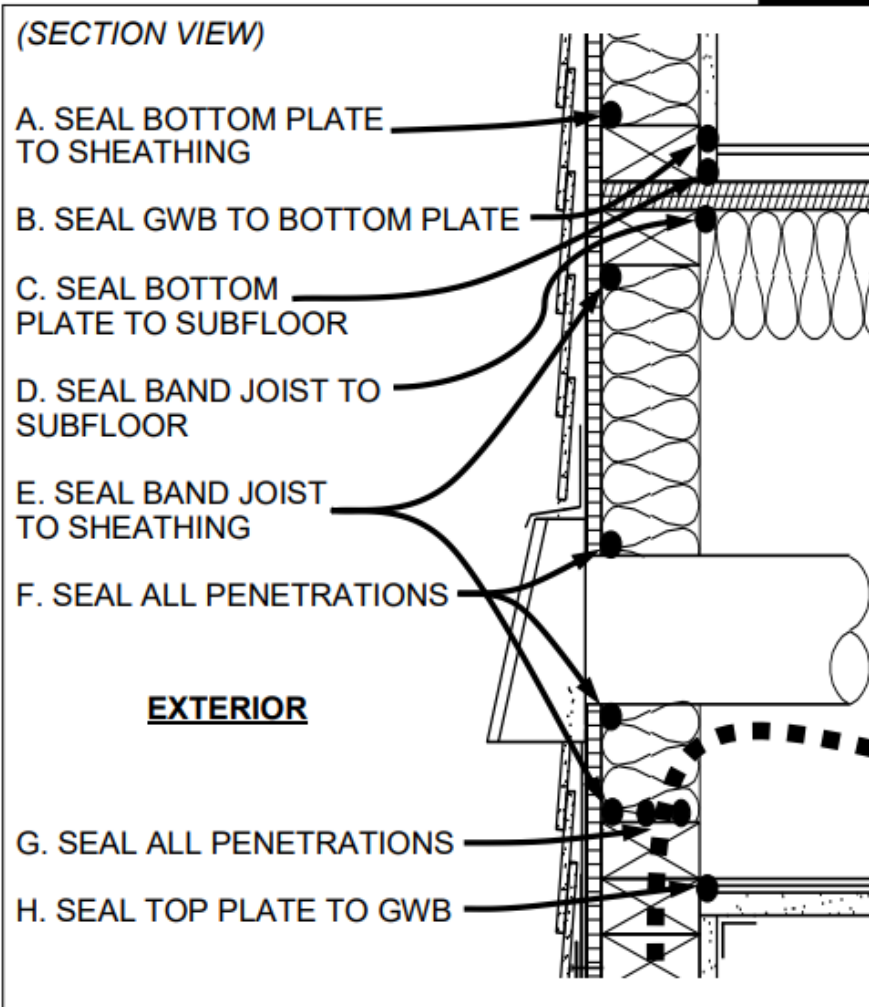
Framing: B, C, D

Drywall: A

Seal between levels + penetrations

2

EXTERIOR WALL - PENETRATIONS, BOTTOM AND TOP PLATE



Notes:

A, C. Intent: reduce leakage between floor and wall cavities

B. Intent: reduce leakage between wall cavity and apartment

B, C. Option: self-leveling subfloor (i.e. gypcrete)

E, H. Intent: reduce leakage between floor and wall cavities

E. Continuous seal of the rim/band joist to sheathing, if a TJI joist seal at top and bottom

F, G. Includes ducts, pipes, wires, etc.

H. Option: apply drywall adhesive to framing BEFORE installing drywall

Responsibilities:

Framing: A, C, D, E

Drywall: B, H

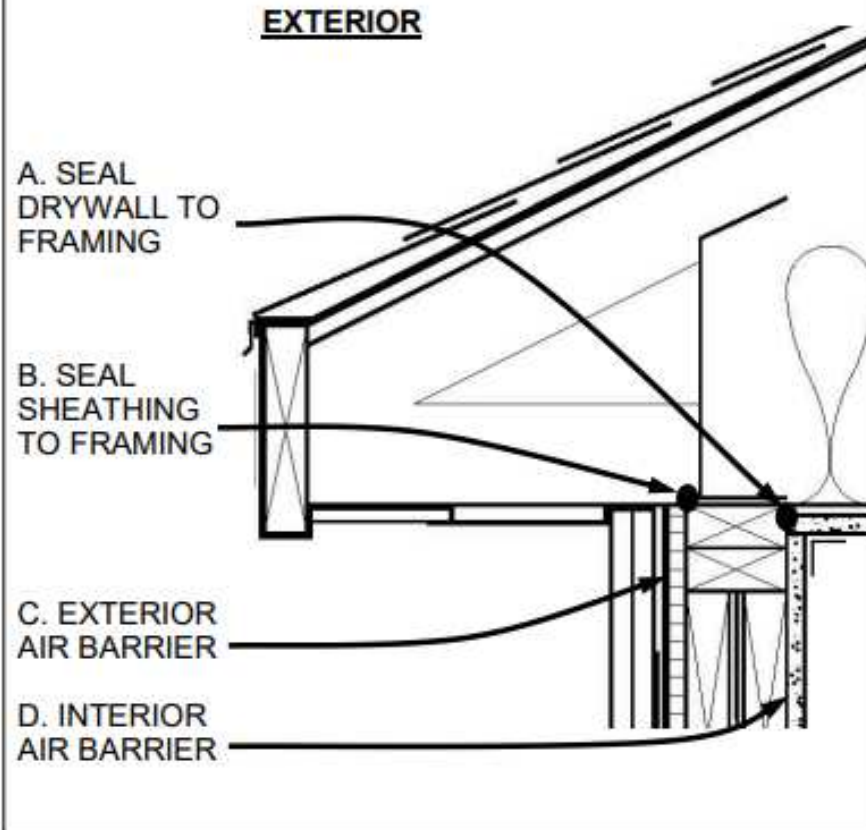
Mech/Elec/Plumb: F, G

Seal top of wall

1

EXTERIOR WALL - TOP

(SECTION VIEW)



Notes:

A, B. Intent: reduce leakage between unconditioned attic and wall cavities

A. Option: apply drywall adhesive to framing BEFORE installing drywall ("screw & glue")

C. Options:

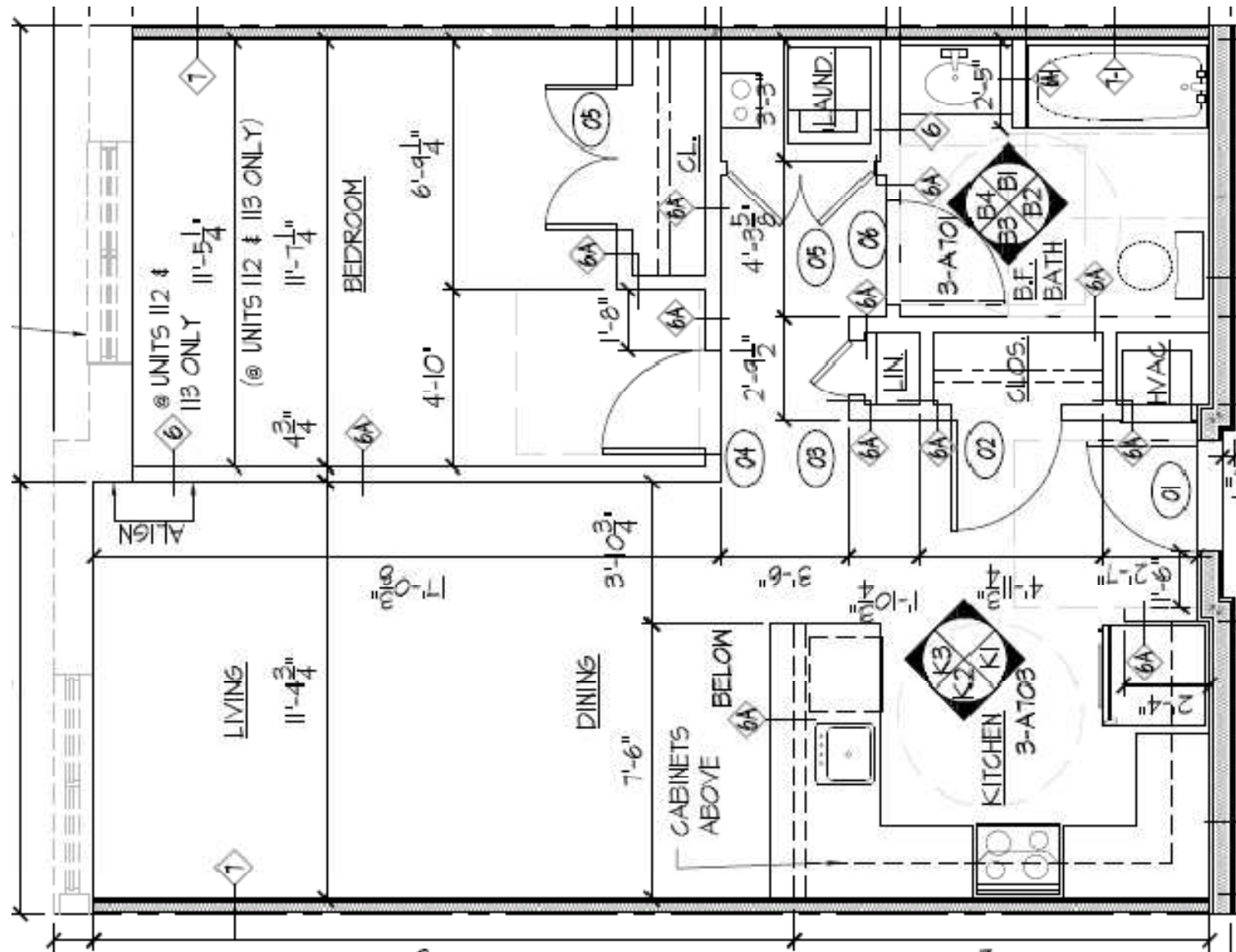
- Sheathing with seams sealed (i.e. ply wood or rigid foam board)
- Fluid-applied/adhesive membrane on sheathing (i.e. Grace / Henry products)

D. Typically drywall

Responsibilities:

Framing: B, C
Drywall: A, D

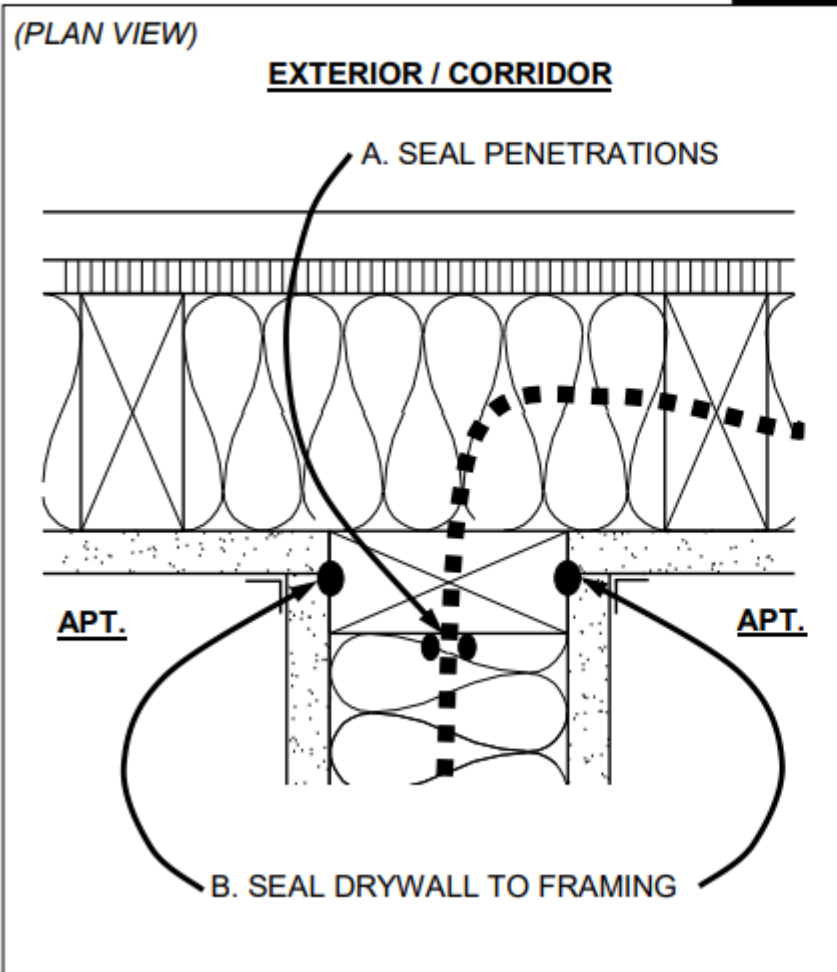
Isolate interior partitions



Isolate interior partitions

6

ALTERNATE - DEMISING / INTERIOR WALL AT EXTERIOR / CORRIDOR WALL



Notes:

A, B. Intent: reduce leakage between exterior / corridor wall and demising wall / interior partition

A. Includes ducts, pipes, wires, etc.

B. Option: apply drywall adhesive to framing BEFORE installing drywall

Responsibilities:

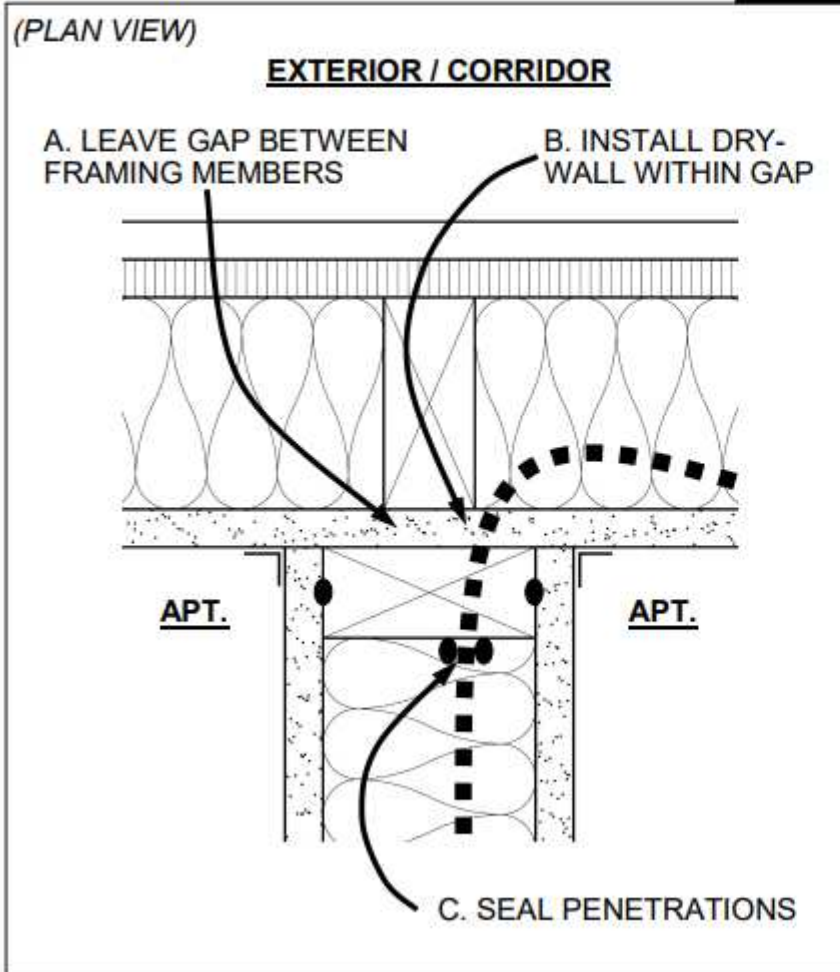
Drywall: B

Mech/Elec/Plumb: A

Isolate interior partitions

5

DEMISING / INTERIOR WALL AT EXTERIOR / CORRIDOR WALL



Notes:

A, B. Intent: reduce leakage between exterior / corridor wall and demising wall / interior partition

A. Size of gap depends on thickness of drywall to be installed

B. Option: sheathing (at shear walls)

A, B. Similar at double walls

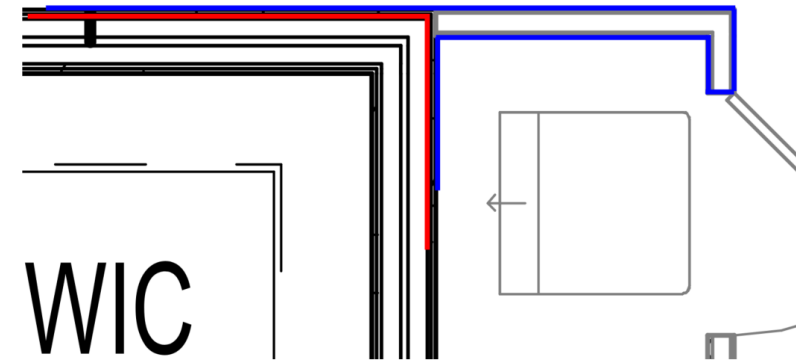
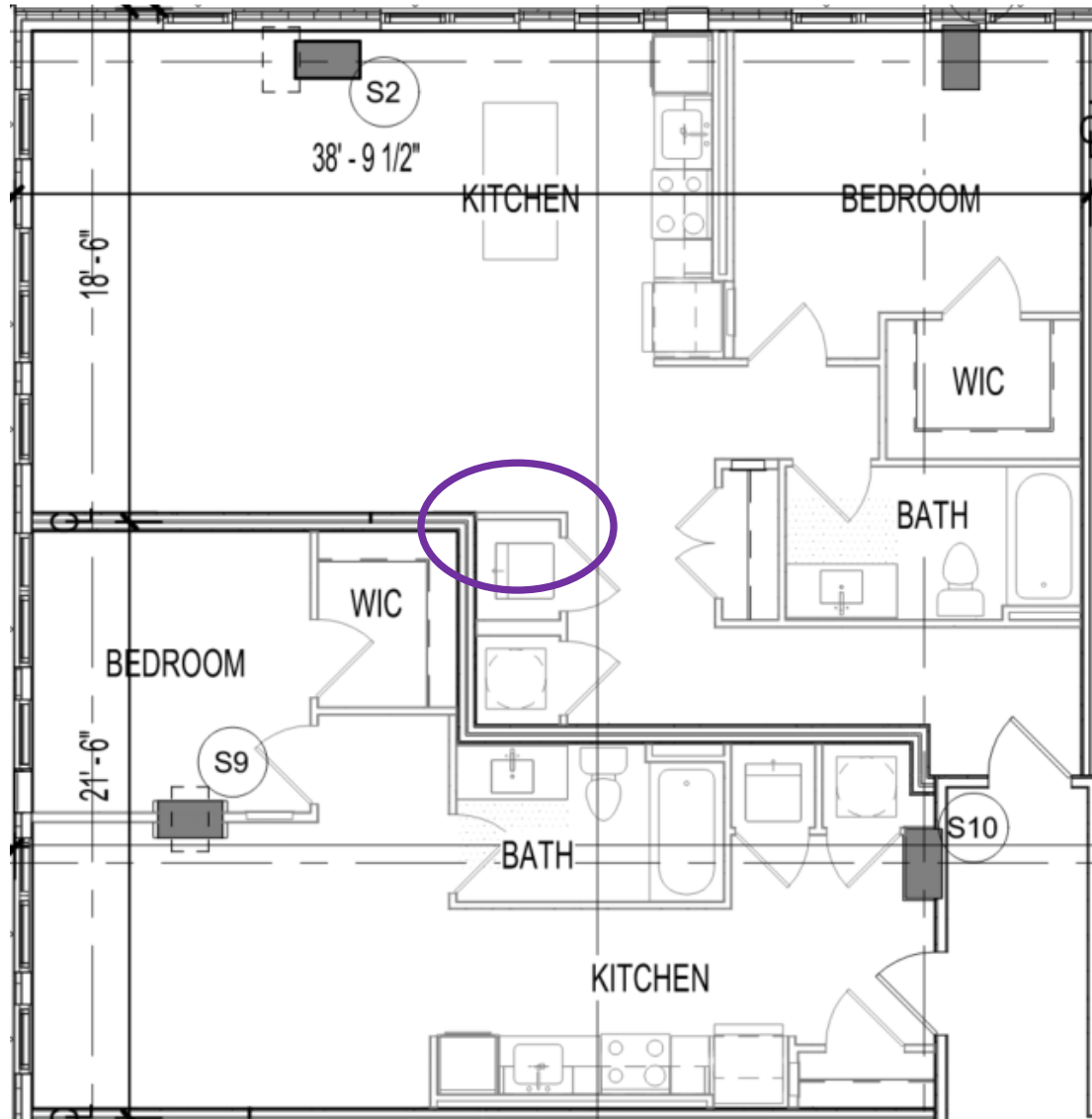
Responsibilities:

Framing: A

Drywall: B

Mech/Elec/Plumb: C

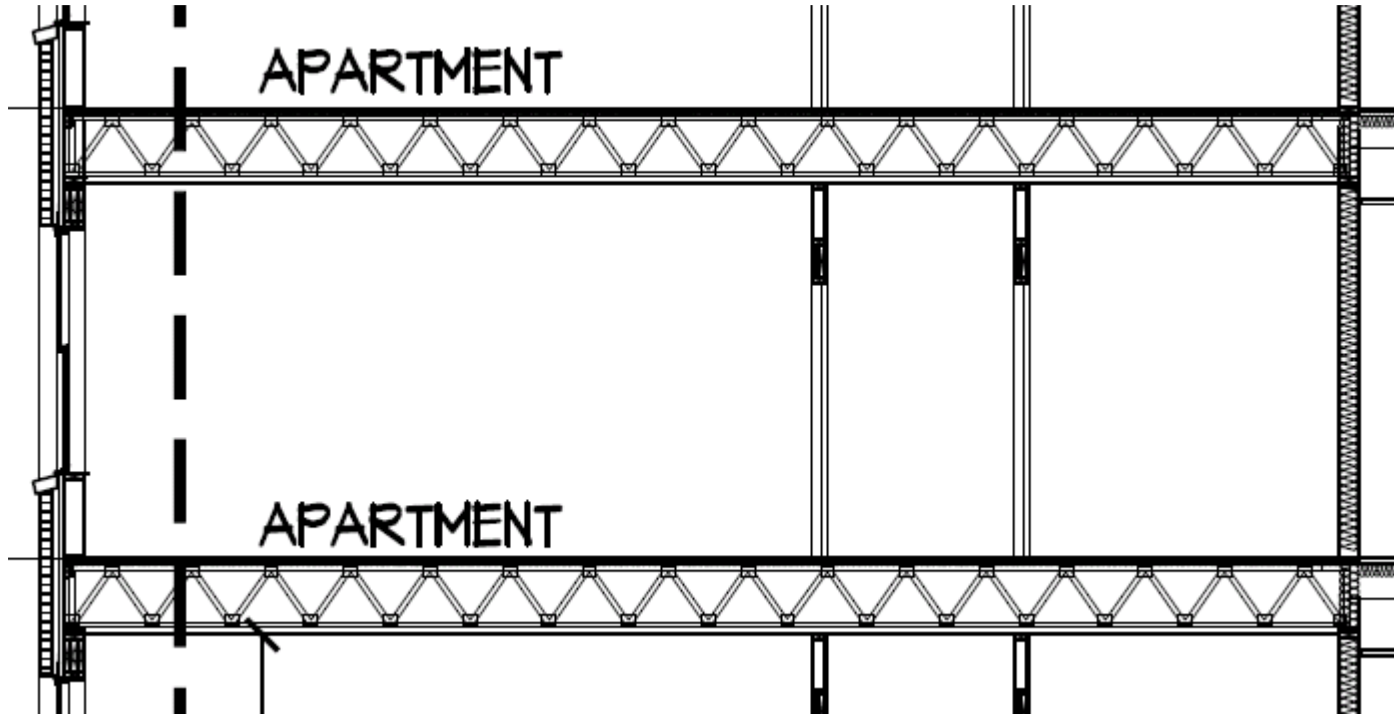
Isolate interior partitions



WIC

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

Think in 3D

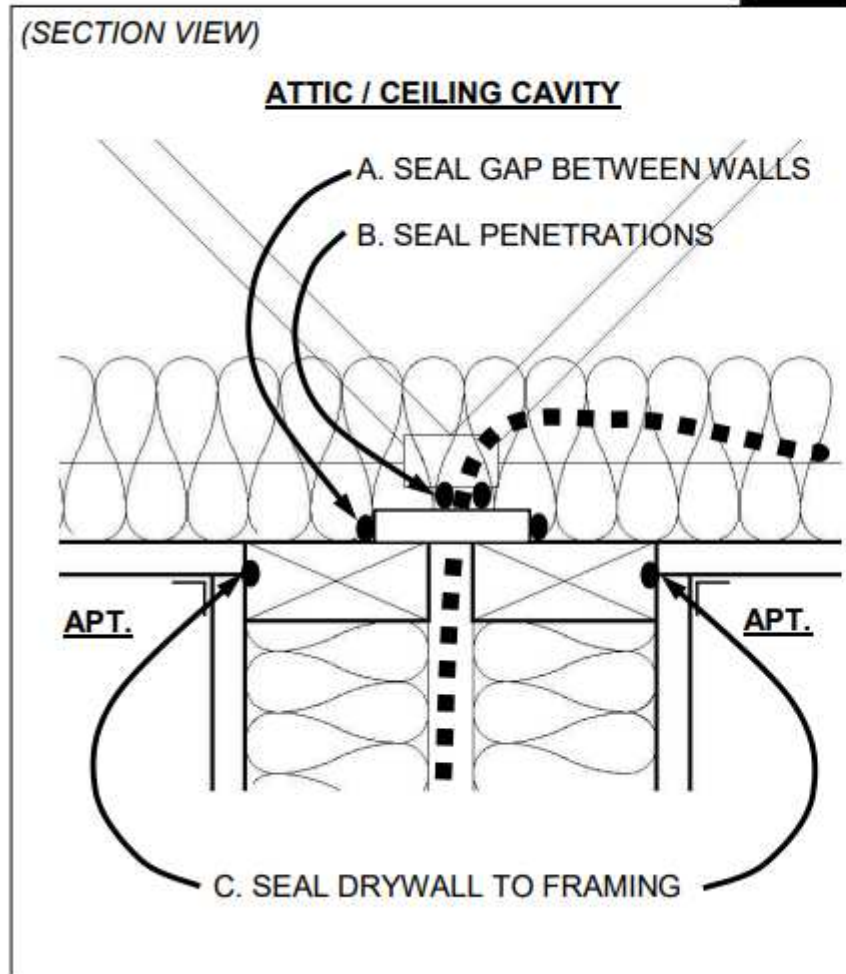


Source: Studio 5p Partnership

Seal between levels

8

DEMISING DOUBLE WALL - TOP (SHAFTS SIMILAR)



Notes:

A, B, C. Intent: reduce leakage between attic / ceiling cavity and demising wall / interior partition / shaft

A. Options:

- Expanding foam
- Plywood, drywall or rigid foam board will edges caulked

A. Mineral wool or fiberglass batts are NOT acceptable as an air barrier

C. Option: apply drywall adhesive to framing BEFORE installing drywall

Responsibilities:

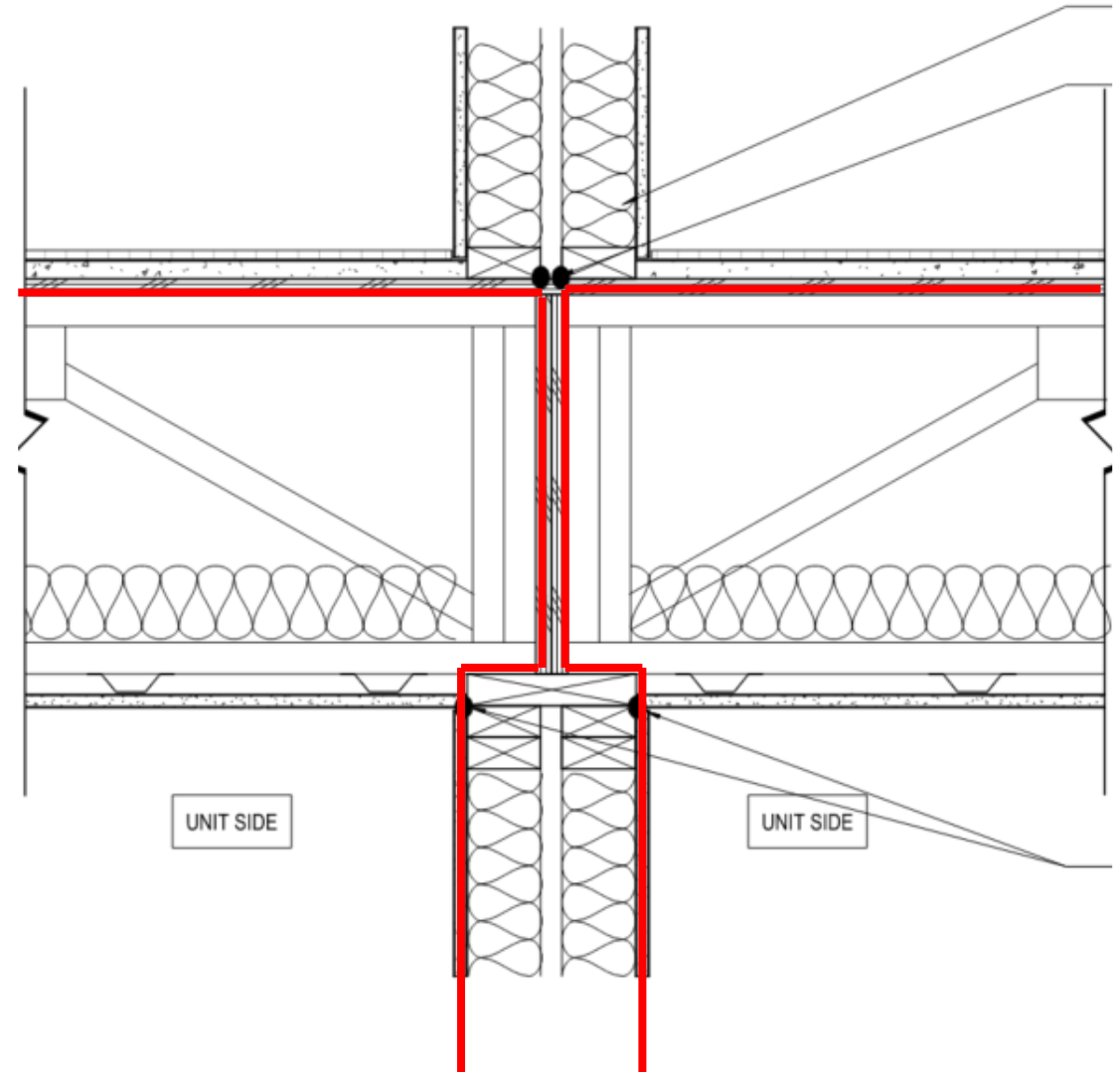
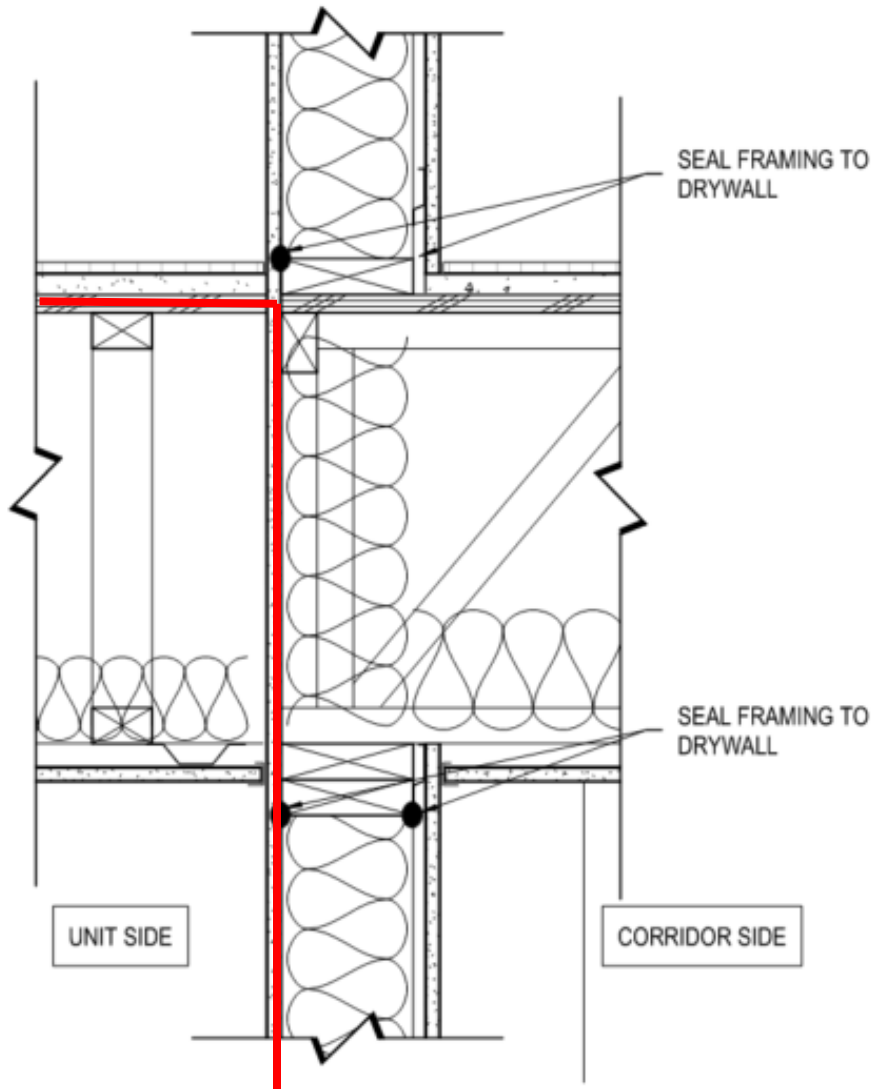
Drywall: C

Mech/Elec/Plumb: A, B

Ceiling = top of enclosure



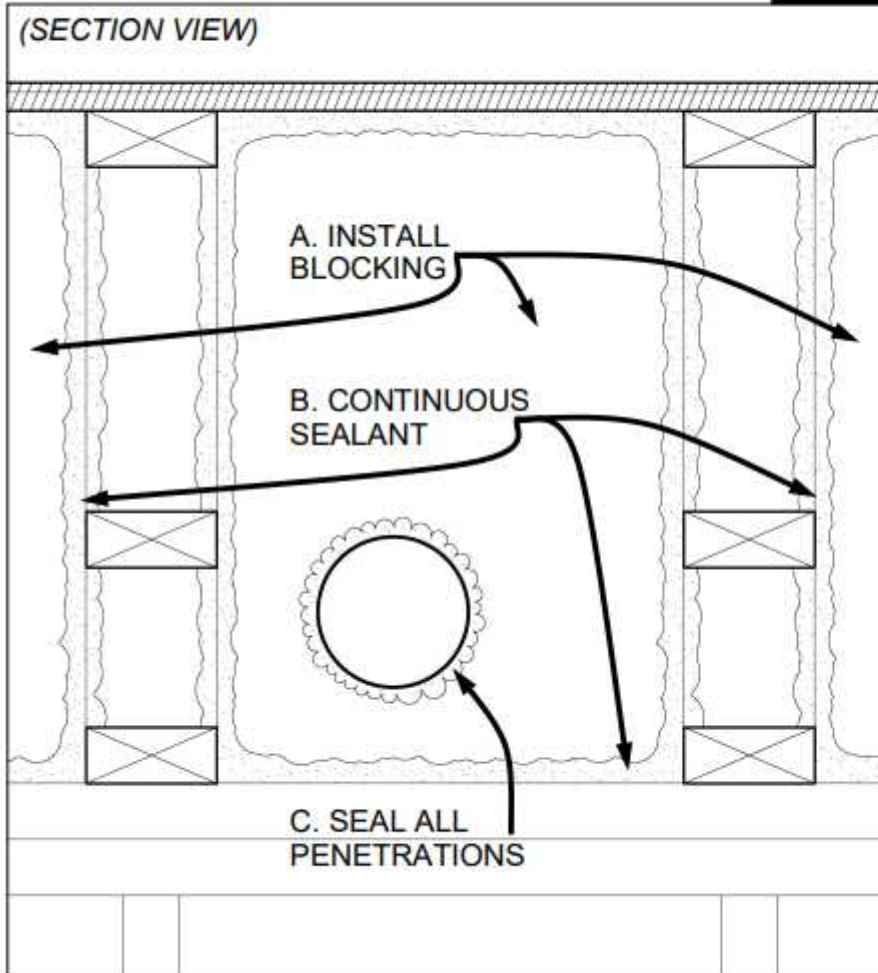
Seal draft-stopping



Seal draft-stopping

11

CEILING CAVITY BLOCKING & SEALING AT DEMISING / CORRIDOR WALL



Notes:

A, B, C. Intent: reduce leakage between the unit and adjacent spaces

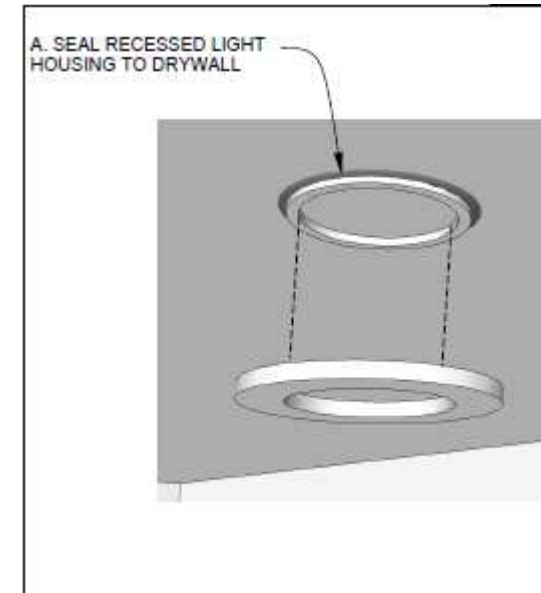
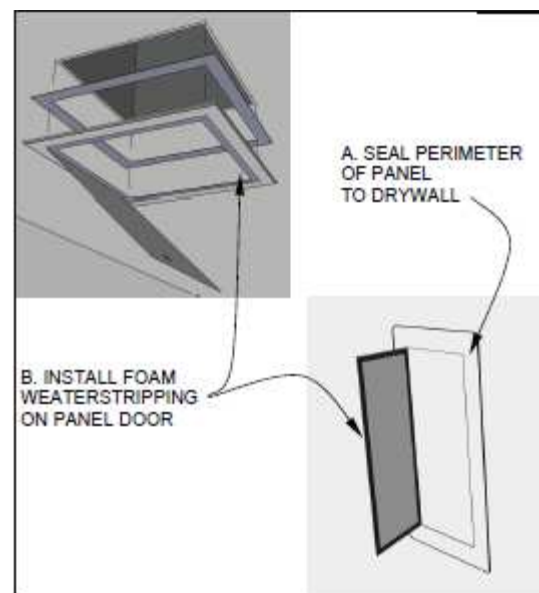
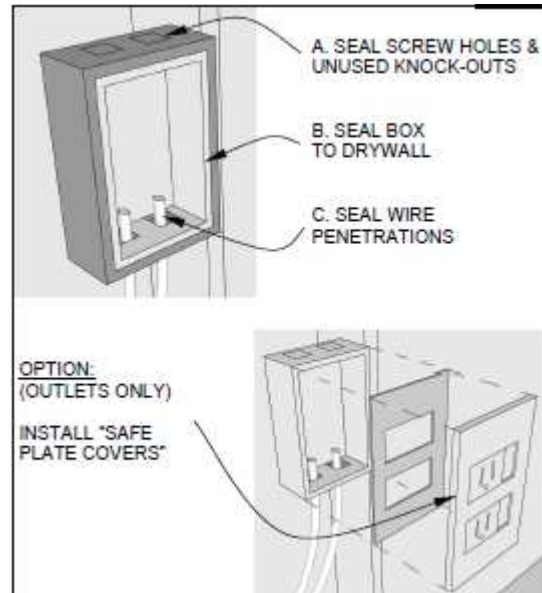
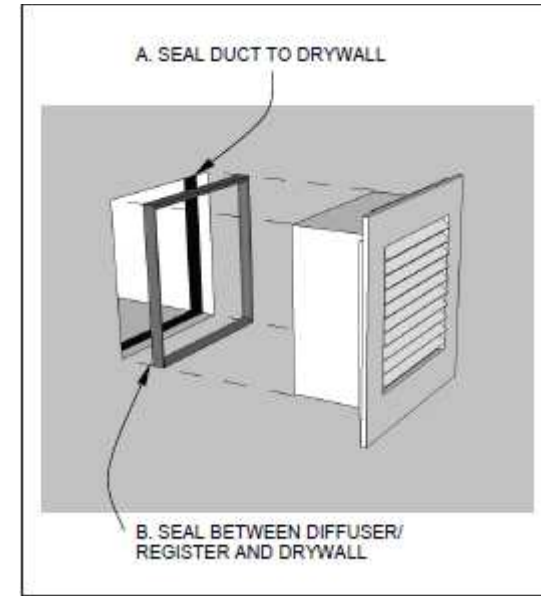
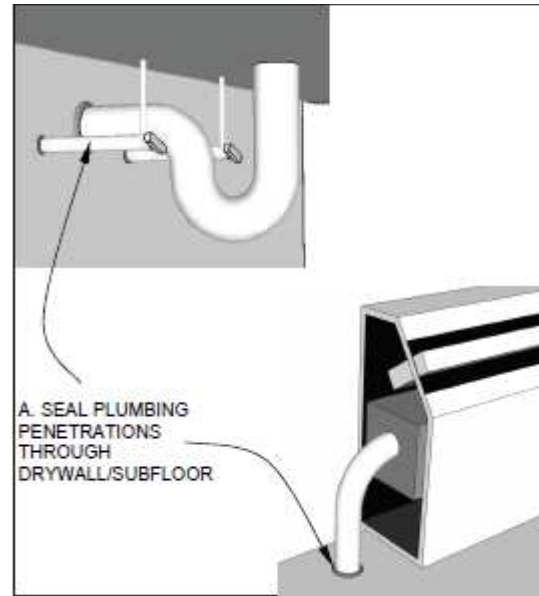
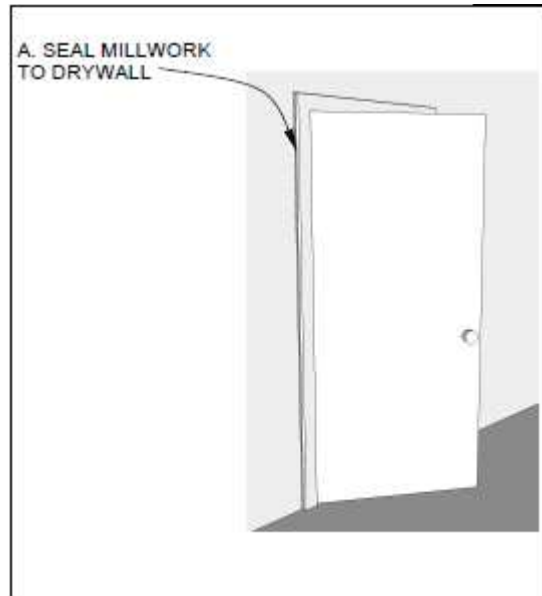
Responsibilities:

Framing: A, B
Mech/Elec/Plumb: C

Seal draft-stopping



Seal penetrations



Q&A

Townhouse party walls

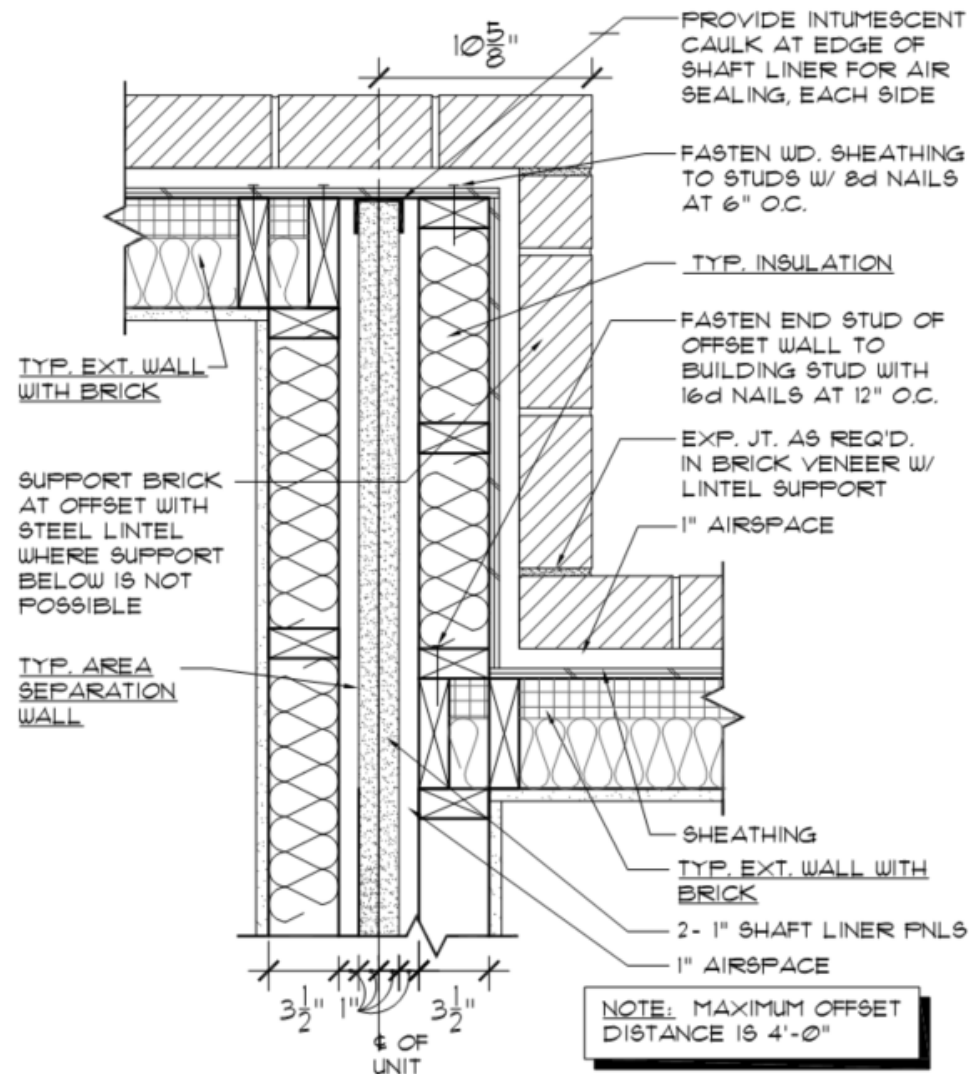


TYPICAL AREA SEPARATION WALL (2 HOUR RATED - UL #U336)
2-1" GYPSUM LINER PANELS SET BETWEEN STEEL C-H STUDS W/
ALUMINUM CLIPS @ FLOOR & CEILING, CONTINUE TO UNDERSIDE OF FRT
ROOF SHEATHING. SET 2x4 STUDS @ 16" O.C., 1" FROM LINER PANEL (EA.
SIDE) W/ 1/2" GYPSUM BOARD @ INTERIOR FACE, FASTENED TO STUDS,
SILLS, PLATES & BLOCKING W/ 6d COOLER NAILS SPACED AT 4" O.C.
PROVIDE 2x BLOCKING AT ALL WOOD PANEL EDGES & SEAL ALL
PENETRATIONS. PROVIDE INSULATION ONE SIDE ONLY. PROVIDE ALL
SUPPORTS PER MANUFACTURER RECOMMENDATIONS.

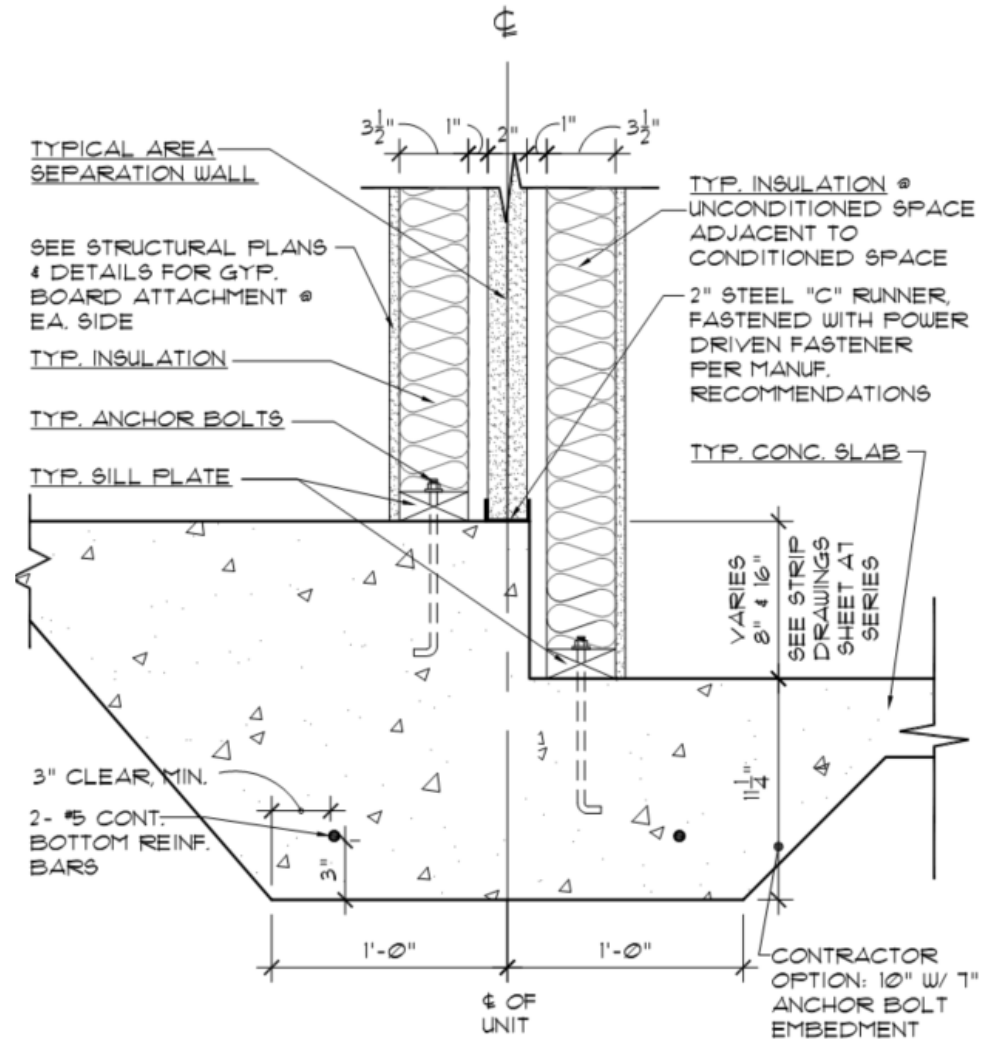
Townhouse party walls



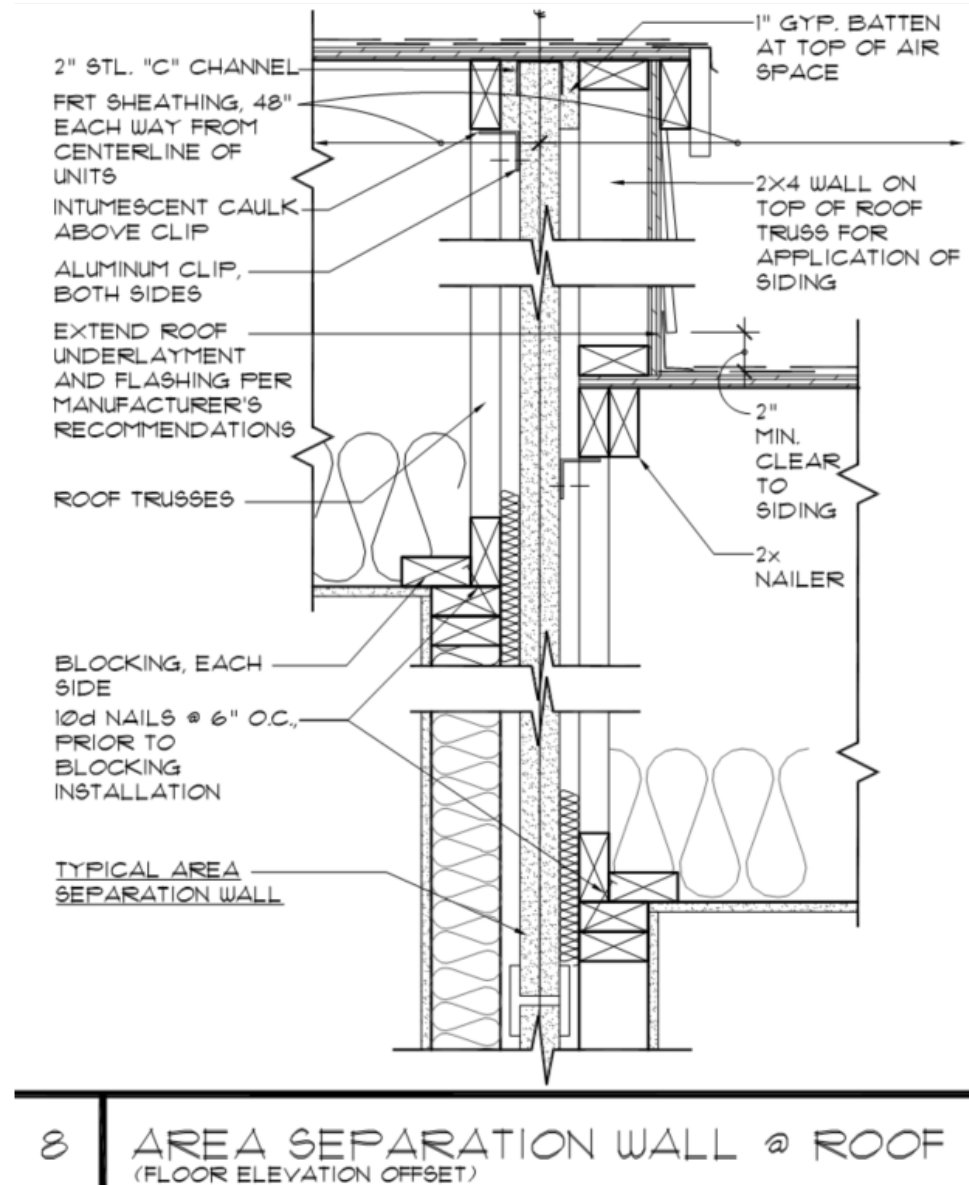
Townhouse party walls



Townhouse party walls



Townhouse party walls



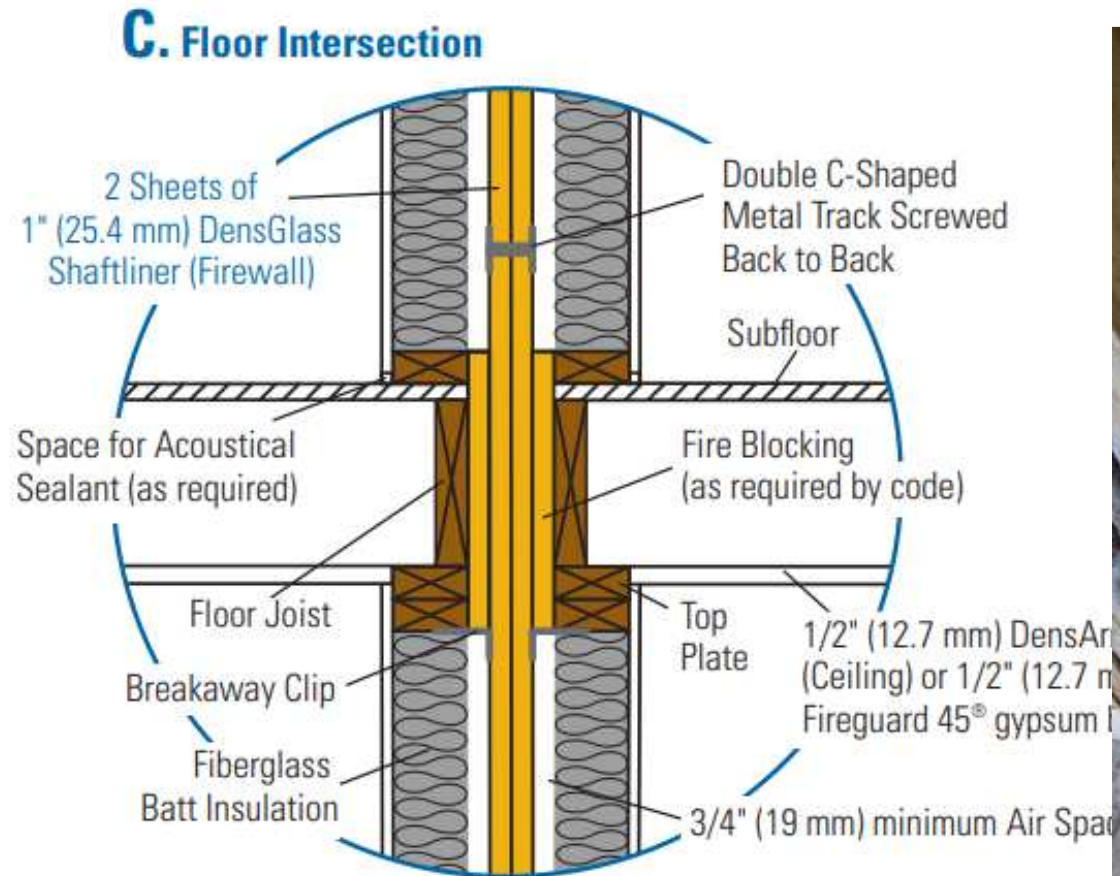
Townhouse party walls



Townhouse party walls

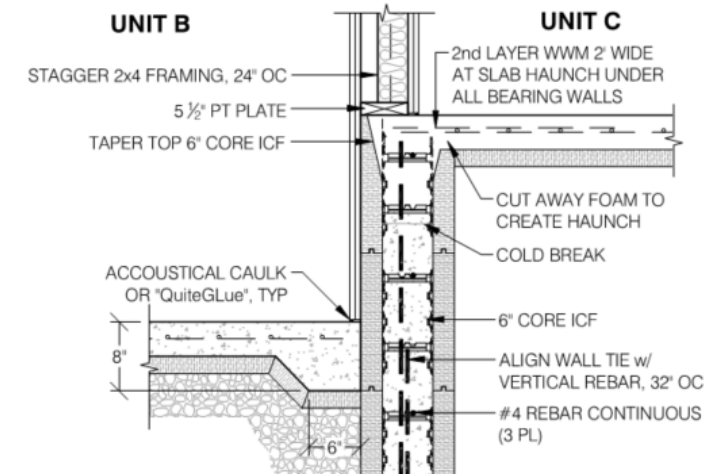
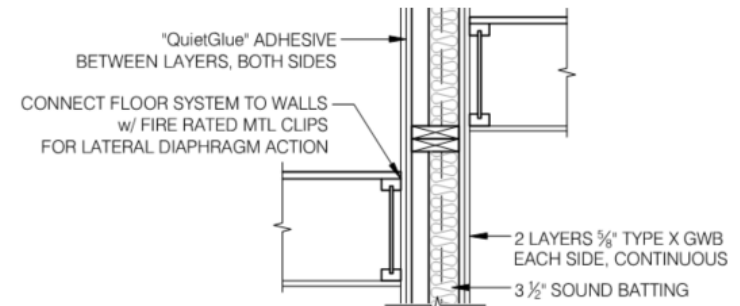
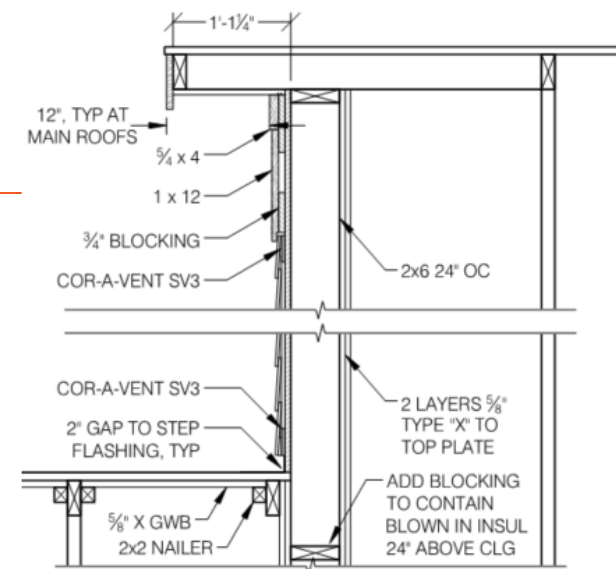


Townhouse party walls



<https://www.buildgp.com/wp-content/uploads/2018/11/DensGlass-Shaftliner-area-walls-technical-guide.pdf>

Townhouse party walls



Townhouse party walls



Townhouse party walls



Q&A

How do we evaluate
air sealing during
construction?

Field Evaluation of Air Sealing

1. Pre-drywall

- Visual inspection (diagnostic tools if necessary)



2. Final

- Blower door & visual inspection



Pre-drywall Field Evaluation... Visual Inspection



Pre-drywall Field Evaluation... 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	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.1.2	Walls behind fireplaces	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.1.3	Attic knee walls / Sloped attics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.1.4	Skylight shaft walls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.1.5	Wall adjoining porch roof	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.1.6	Staircase walls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.1.7	Double walls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.1.8	Garage rim / band joist adjoining conditioned space	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.1.9	All other exterior walls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.2	Floors				
3.2.1	Floor above garage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.2.2	Cantilevered floor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.2.3	Floor above unconditioned basement or vented crawlspace	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.3	Ceilings				
3.3.1	Dropped ceiling/soffit below unconditioned attic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.3.2	Sloped ceilings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.3.3	All other ceilings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.1.1	Duct / flue shaft	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.1.2	Plumbing / piping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.1.3	Electrical wiring	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.1.4	Bathroom and kitchen exhaust fans	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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 GZ 4 and higher to minimize condensation potential	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.1.6	Light tubes adjacent to unconditioned space include lens separating unconditioned and conditioned space and are fully gasketed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

TABLE 402.4.2
AIR BARRIER AND INSULATION INSPECTION COMPONENT CRITERIA

COMPONENT	CRITERIA
Air barrier and thermal barrier	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier. Breaks or joints in the air barrier are filled or repaired. Air-permeable insulation is not used as a sealing material. Air-permeable insulation is inside of an air barrier.
Ceiling/attic	Air barrier in any dropped ceiling/soffit is substantially aligned with insulation and any gaps are sealed. Attic access (except unvented attic), knee wall door, or drop down stair is sealed.
Walls	Corners and headers are insulated. Junction of foundation and sill plate is sealed.
Windows and doors	Space between window/door jambs and framing is sealed.
Rim joists	Rim joists are insulated and include an air barrier.
Floors (including above-garage and cantilevered floors)	Insulation is installed to maintain permanent contact with underside of subfloor decking. Air barrier is installed at any exposed edge of insulation.
Crawl space walls	Insulation is permanently attached to walls. Exposed earth in unvented crawl spaces is covered with Class I vapor retarder with overlapping joints taped.
Shafts, penetrations	Duct shafts, utility penetrations, knee walls and flue shafts opening to exterior or unconditioned space are sealed.
Narrow cavities	Batts in narrow cavities are cut to fit, or narrow cavities are filled by sprayed/blown insulation.
Garage separation	Air sealing is provided between the garage and conditioned spaces.
Recessed lighting	Recessed light fixtures are air tight, IC rated, and sealed to drywall. Exception: fixtures in conditioned space.
Plumbing and wiring	Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.
Shower/tub on exterior wall	Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.
Electrical/phone box on exterior walls	Air barrier extends behind boxes or air sealed-type boxes are installed.
Common wall	Air barrier is installed in common wall between dwelling units.
HVAC register boots	HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
Fireplace	Fireplace walls include an air barrier.

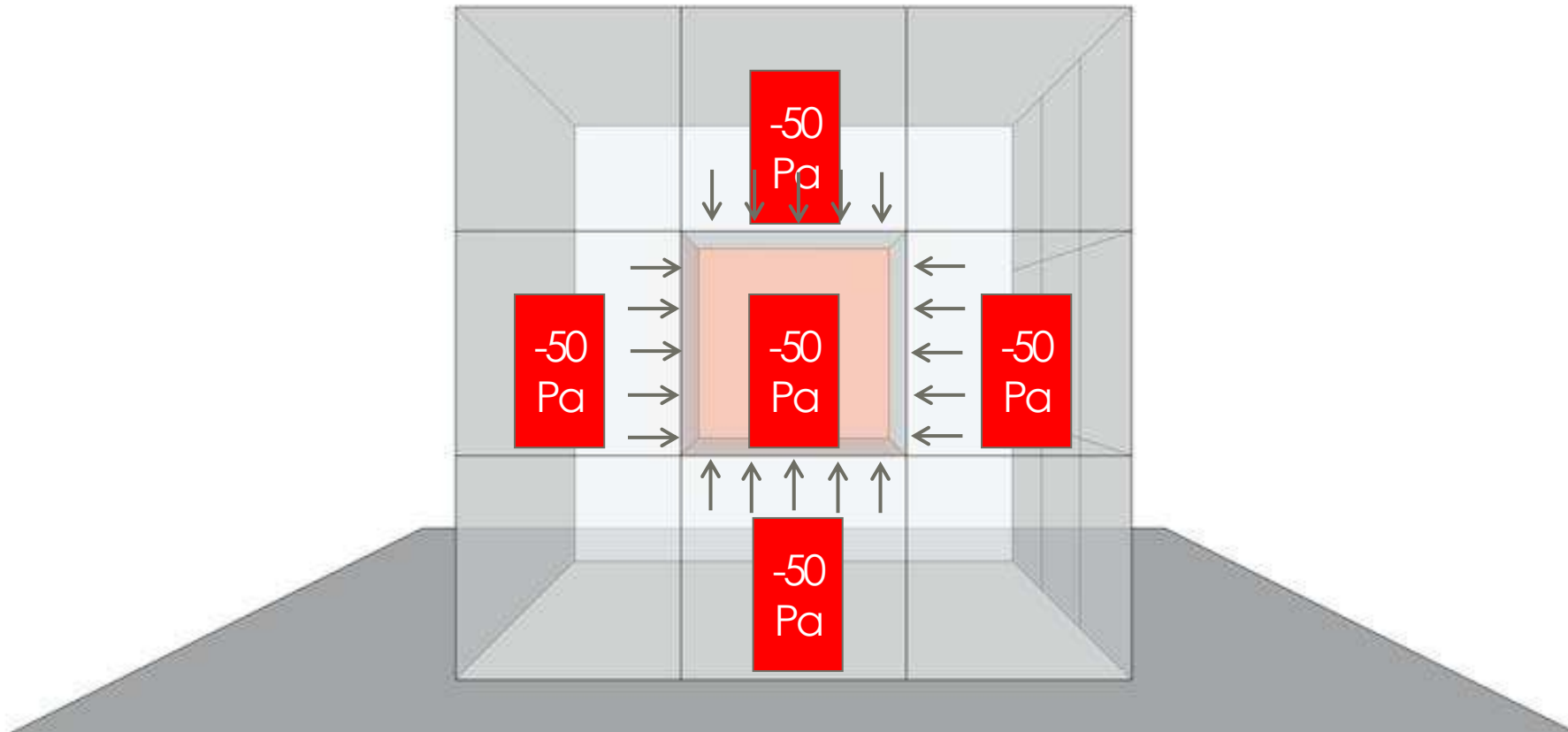
IECC 2009 Table 402.4.2

L-H MF Mid-Rise EA
alternative compliance

Final Field Evaluation... Blower Door



Final Field Evaluation... Guarded vs. Unguarded



Final Field Evaluation... Guarded vs. Unguarded

- Guarded:
 - Energy
- Unguarded:
 - Energy
 - Moisture
 - Fire/smoke
 - Comfort
 - Noise
 - Smells



Field Evaluation... Corrective Measures



Evaluation Exercise

Air Sealing – Greatest Hits FAILS!



Air Sealing – Greatest Hits FAILS!



Air Sealing – Greatest Hits FAILS!



Air Sealing – Greatest Hits FAILS!



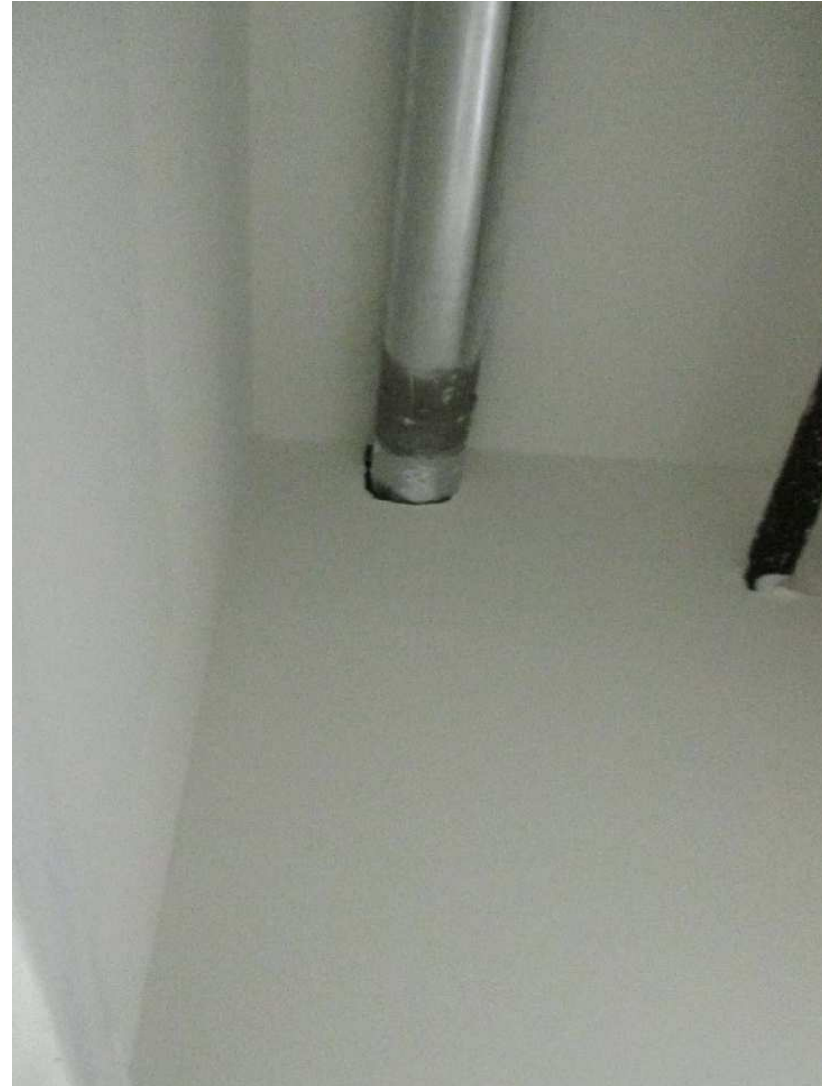
Air Sealing – Greatest Hits FAILS!



Air Sealing – Greatest Hits FAILS!



Air Sealing – Greatest Hits FAILS!



Air Sealing – Greatest Hits FAILS!



Air Sealing – Greatest Hits FAILS!



Air Sealing – Greatest Hits FAILS!



Air Sealing – Greatest Hits FAILS!

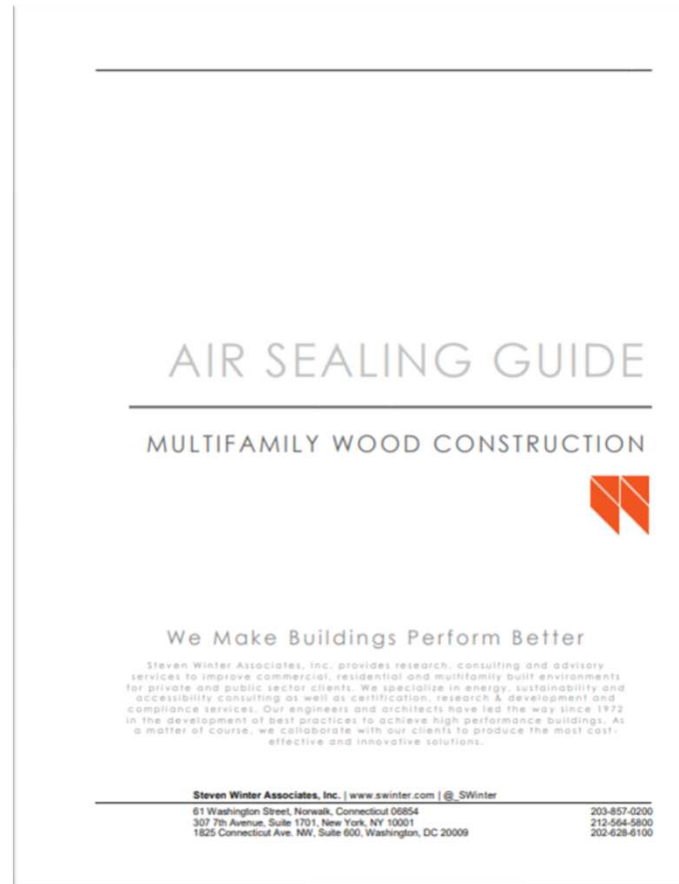


In summary...

Summary

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

Resources



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

Discussion

Contact Us

Steven Winter Associates, Inc.

55 North Water Street, Suite 1
Norwalk, CT 06854



Steve Klocke



sklocke@swinter.com



347.622.3118 (c)



www.swinter.com



BROUGHT TO YOU BY

EVERSOURCE



PROUD SPONSORS OF

energize 
CONNECTICUT

Thank You

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