City of Fort Collins

Lessons from the field: Multifamily Building Air Tightness

5/16/2017

Gary Schroeder, Kim DeVoe & Brad Smith

“Houses do NOT need to breathe. People do.” *Allison Bailes – Energy Vangaurd*

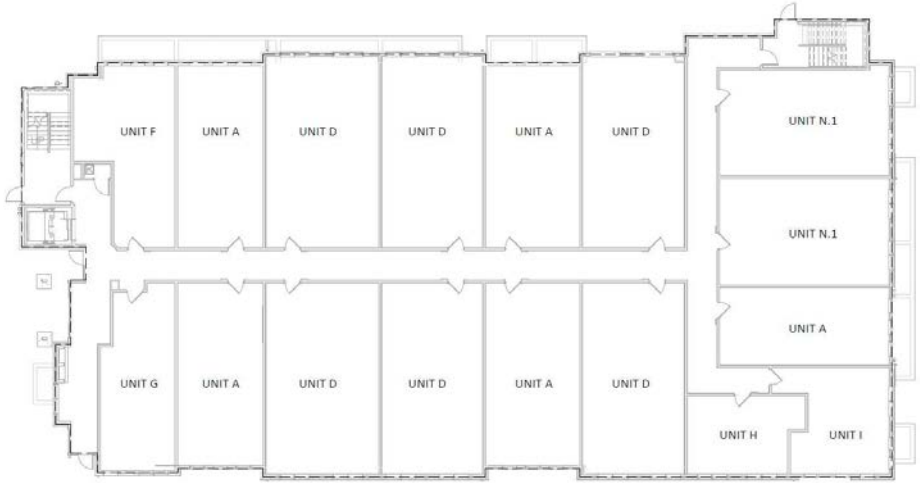
Many people still have the mistaken impression that air leakage is good for health. But when they say that "Yeah, sealing is good, but you don't want to make it too tight," what they are really saying is, “Don’t forget about air quality.” *Sean Maxwell – Contributer - Green Building Advisor*

Previous Multifamily Testing
2009 I-Codes

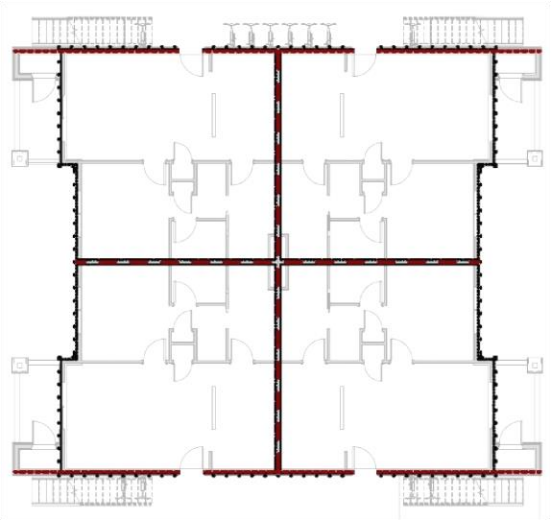
- **Commercial Multifamily - 4 stories and above**
  - Whole building was treated as a single zone
  - 0.25 CFM75/Sq Ft of exterior envelope area

- **Residential Multifamily - buildings less than 4 stories**
  - Non-electric heat: 4.0 ACH50
  - Electric heat: 3.0 ACH50

How did we get to this new test metric



vs



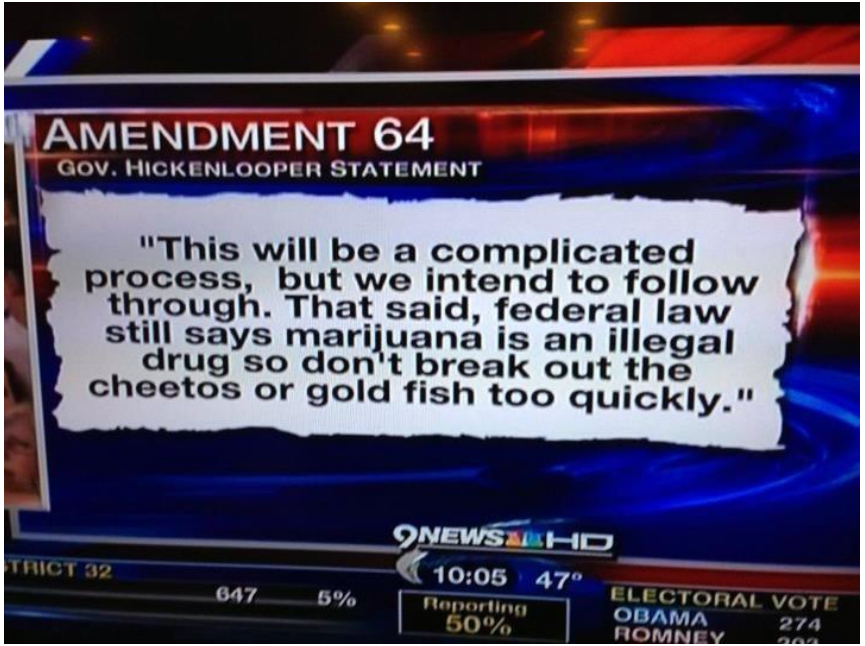
Previously testing whole building envelope.

- How to test the building envelope with adjoining units that have entry doors on exterior.

Colorado Amendment 64

Then Colorado votes…

and on November 6, 2012



City Council direction

City Council takes action to address pollutants.

Directs Chief Building Official to… minimize uncontrolled pathways for smoke and other indoor pollutants to transfer between units. Walls, ceilings and floors that separate each apartment from neighboring apartments, corridors, common spaces, trash chutes, utility chases, floors above and below, stairwells and elevator shafts must be air sealed by sealing all penetrations in walls, ceilings, floors and chases. Weather-strip all doors that lead to common hallways.

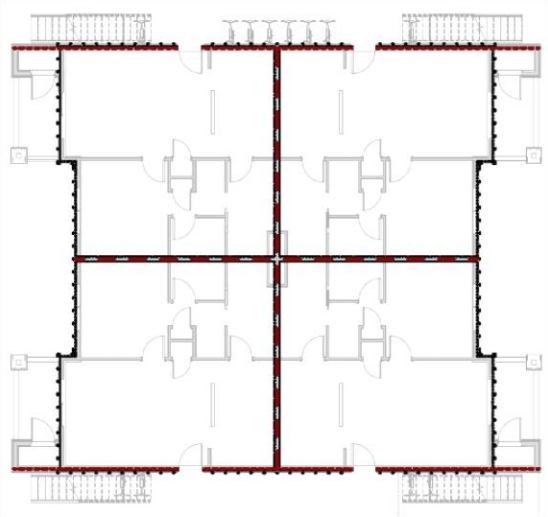
Why this all matters

Dirty insulation is an indication of air leakage. In this case the insulation is acting like an air filter.

The primary goal of air sealing party walls is not so much energy reduction as much as it is improving indoor air quality by limiting the transfer of smoke or pollutants from one unit to another.

MF testing issues

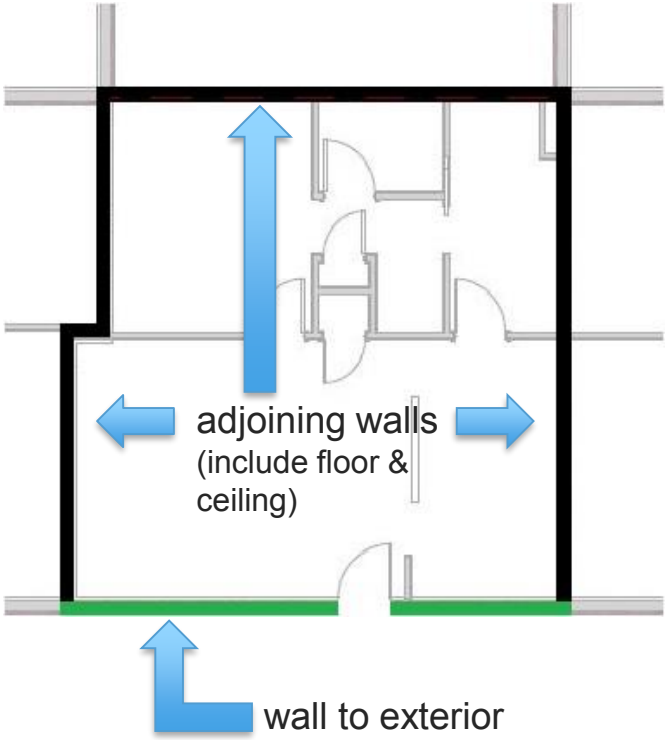
- Compartmentalization is the best way to limit transfer of smoke or pollutants.
- Test by unit instead of the entire building
- Amendment to code to define air barrier around each unit on plans.
- New air leakage metric created for MF stacked units:



.30 CFM50/ sq ft surface area adopted

Why choose a different metric for stacked MF

- Senior Plan Reviewers, Testers and Builders mention difficulty hitting 3 ACH50.
- Typical Stacked MF units have less area thus much less volume than attached MF.
- Volume based tightness metrics can be hard to meet in small units.
- Stacked metric uses unit enclosure surface area including wall to exterior.



Sampling protocol

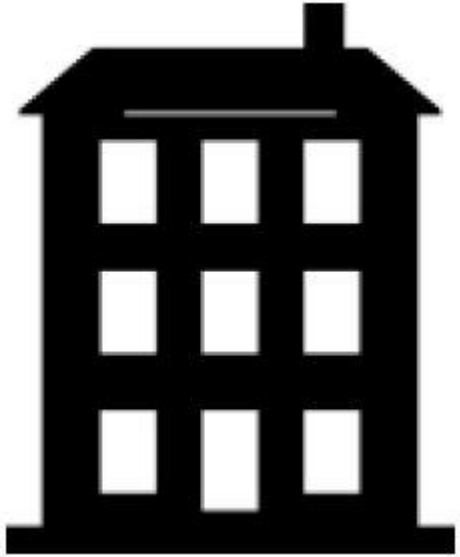
- **LEED sampling considered**
- **Not used due to complexity, number of units to be tested & cost**

We developed our own

Unit Sampling

- Min 20% of units in each building to test, including at least one of each type & approximately an equal number on each floor level.
- Each must pass without failure. If failure occurs, diagnose, correct & re-test until passing. Test two additional units of this type to passing.

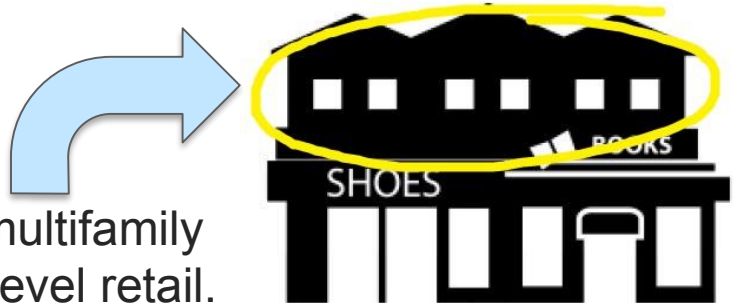
Define MF Stacked



Multifamily - Stacked units (low-rise and high-rise)

Stacked apartments or condos (to include high-rise projects built under the International Building Code – IBC R2 & R3).

Also included are multifamily units above street level retail.



Defining building types

Airtightness Testing Required for Different Building Types: City of Fort Collins Building Code

New Construction Building Types	Single Family Detached	Single Family Attached	Multi-family – stacked units (low-rise and high-rise)	Small Commercial (≤5,000 sf)	Large Commercial (>5,000 sf)	Commercial / Residential Mixed Use
						
Examples	Houses that are free of any shared walls and stand alone	Duplex, triplex, town-homes, row-houses. Each unit has its own foundation and roof (including IBC R2, R3)	Stacked apartments or condos (to include high-rise projects built under the IBC)	Small office buildings, offices adjacent to unconditioned space	Large multi-story office buildings, large multi-use buildings	Retail on street level, MF stacked units above
Test Required	Residential Air Tightness Test	Residential Air Tightness Test	Multifamily Unit Air Tightness Test	Small Commercial Building Air Barrier Test	Large Commercial Building Air Leakage Test	Large or Small Commercial Building Air Leakage Test & MF Unit Air Tightness Test
Compliance Metric (Leakage not to exceed)	3 ACH50	3 ACH50	0.30 CFM50/SF unit enclosure surface area (SA)	0.25 CFM50/SF unit enclosure surface area (SA)	0.25 CFM75/SF building envelope surface area (SA)	0.25 CFM50/SF SA for small commercial. 0.25 CFM75/SF for large commercial. 0.30 CFM50/sf for MF units above

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Air barrier assemblies

5/16/2017

Control Layers

Water (liquid & vapor), Air, Thermal

- Liquid water: *drainage plane*, *water-resistive barrier (WRB)*
- Vapor: *vapor barrier*, *vapor retarder*
- Air: *air barrier*
- Thermal: *insulation*

Air Barriers

Materials

- ≤ 0.004 cfm/ft^2 at 75 Pa

Assemblies

- ≤ 0.04 cfm/ft^2 at 75 Pa

What kind of layer is it?

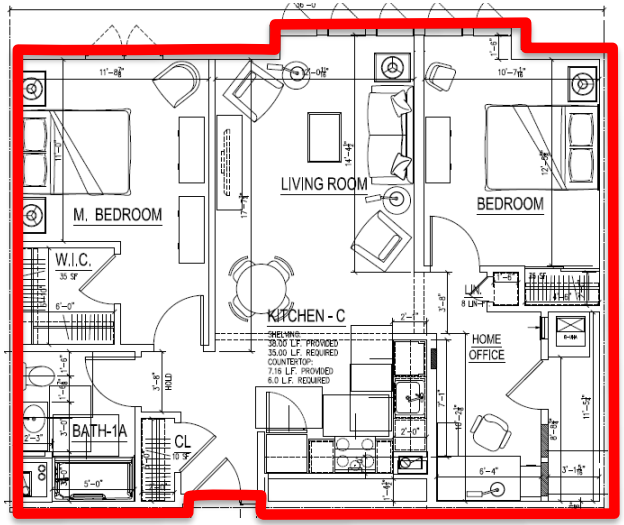
Material	WRB	Vapor Barrier	Air Barrier	Insulation
Building Wrap	✓	×	✓	×
Building Paper	✓	×	×	×
Drywall (painted)	×	×	✓	×
OSB	×	×	✓	×
Polyethylene Sheet	?	✓	?	×
Fluid Applied Membrane	✓	?	✓	×
Fiberglass Ins., Mineral Wool	×	×	×	✓
Open Cell Foam	×	×	?	✓
Closed Cell Foam	✓	✓	✓	✓

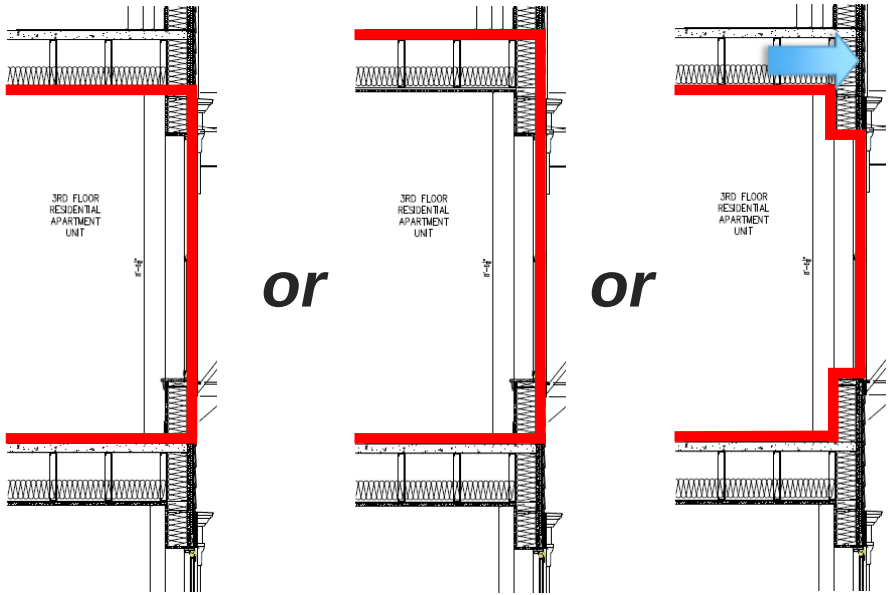
Key questions

- **What is the intended AB?**
  - **Material(s)**
  - **Identify plane of air tightness**
  - **Connection of materials**
- **How is AB detailed on plans?**
  - **Third party review recommended**
- **How/where does AB fit into construction sequence?**
- **Who is responsible for the primary AB? Scope of work.**

Continuity of air barrier

- **Clear understanding of plane of air tightness.**





Images courtesy Brian Christensen - NORESCO

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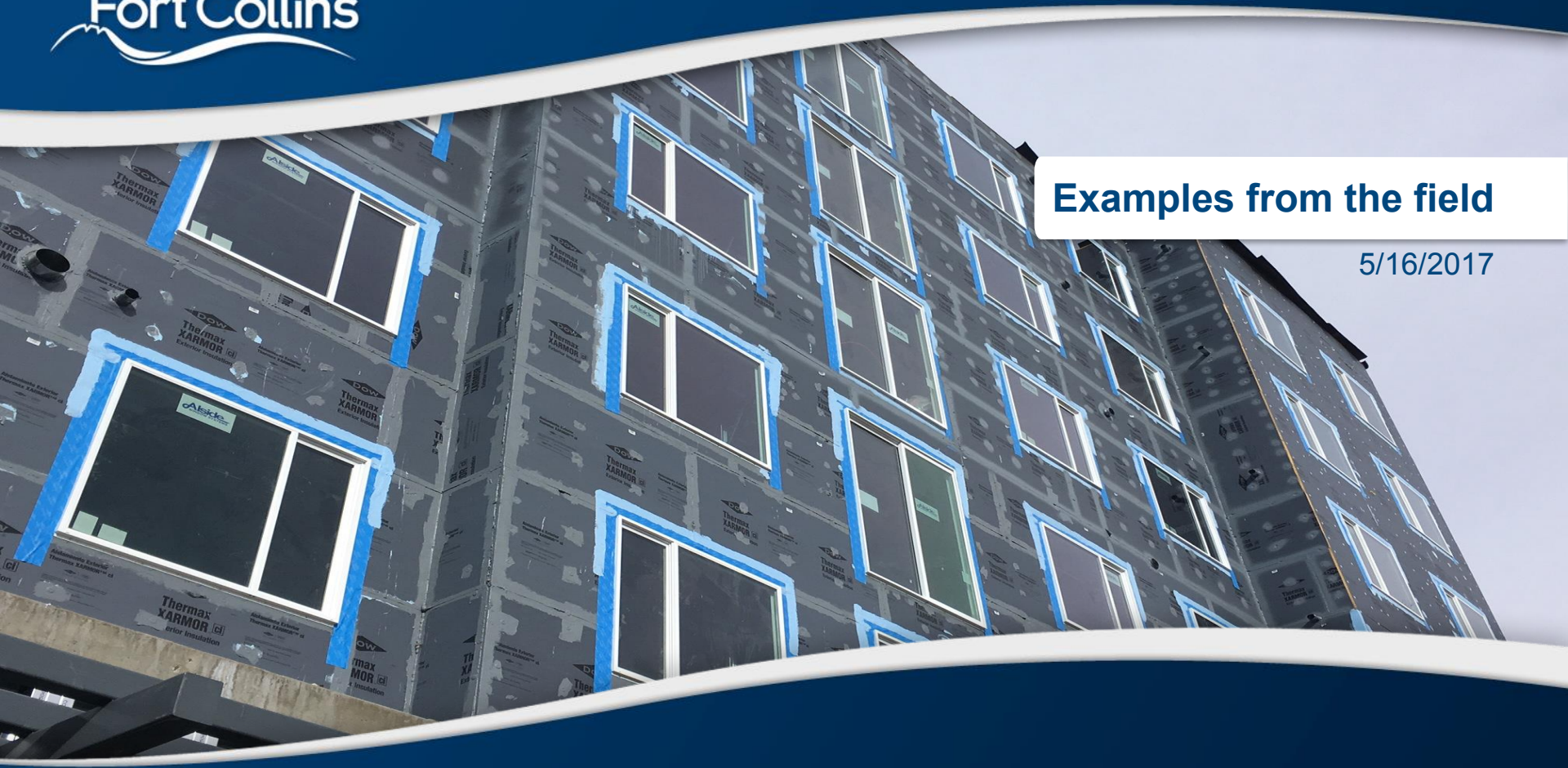


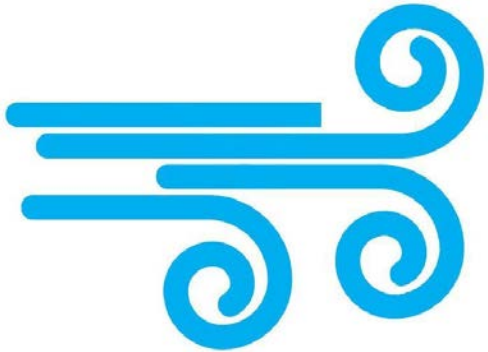
Examples from the field

5/16/2017

Walls pulling triple duty

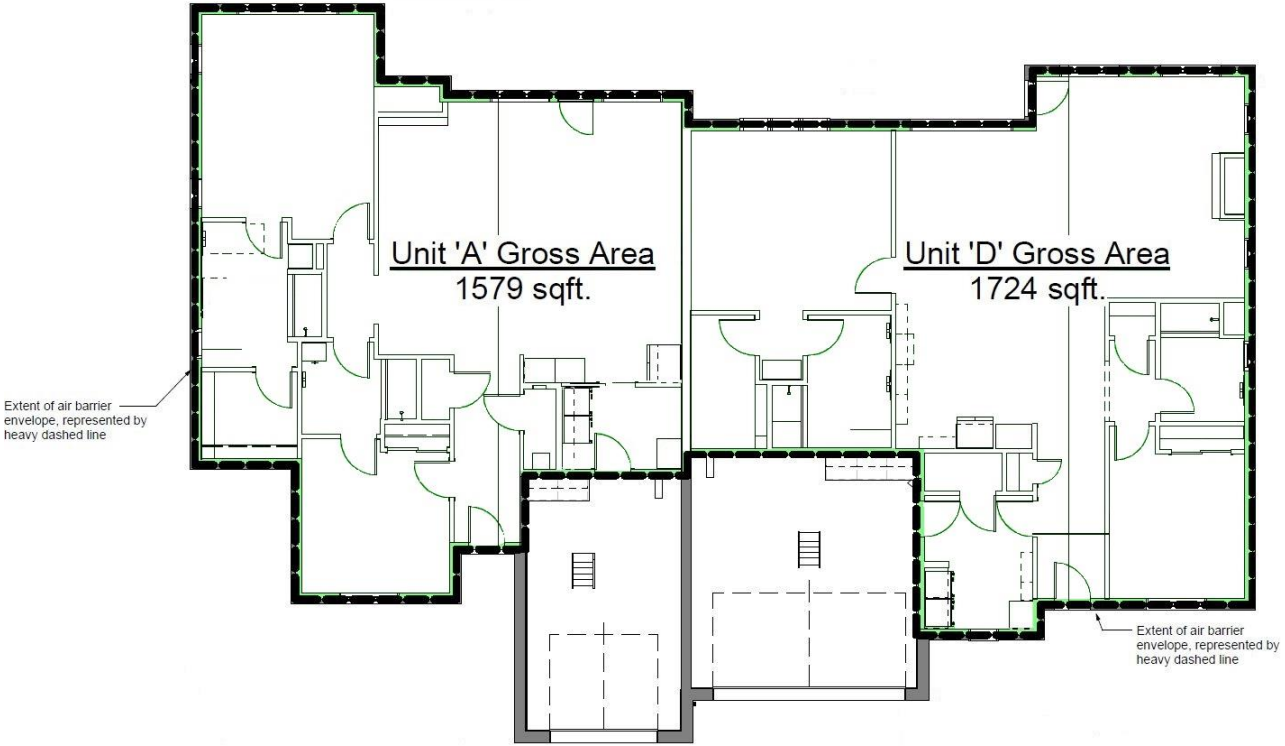
UL Fire resistance rating

STC sound transmission class rating



Air tightness

Define air barrier on plans



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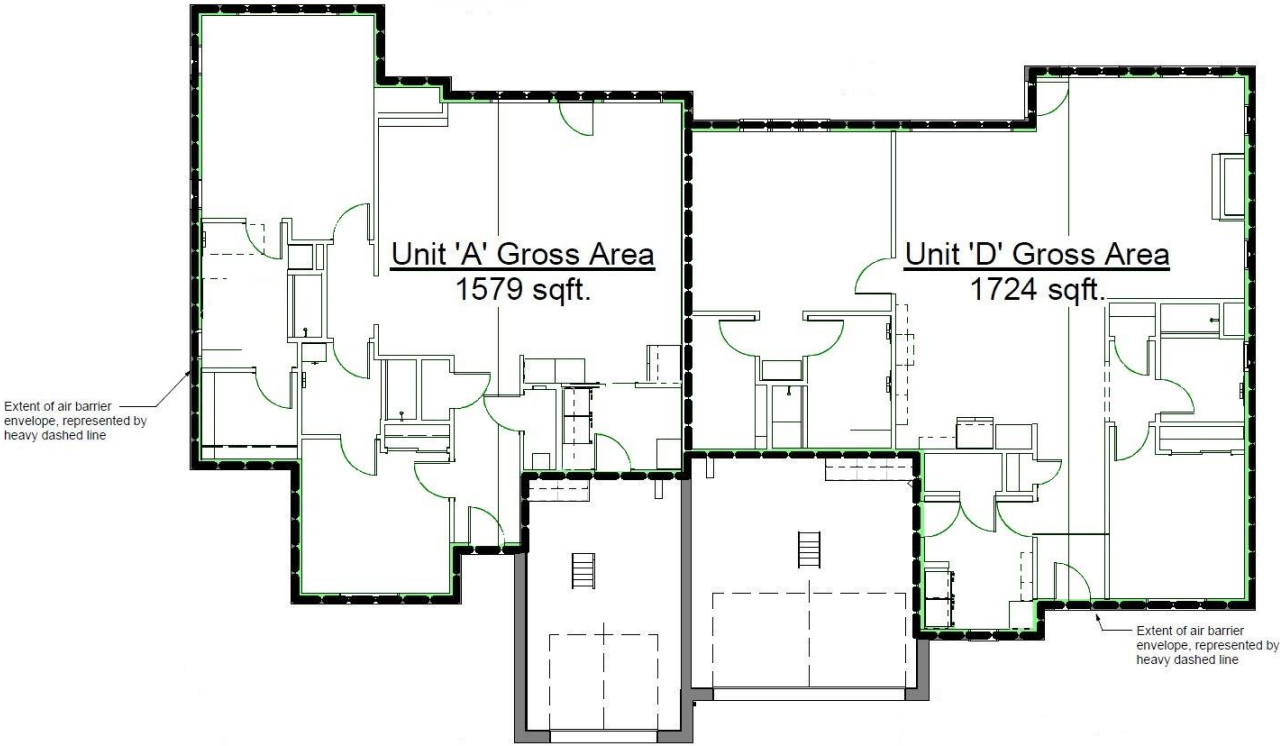
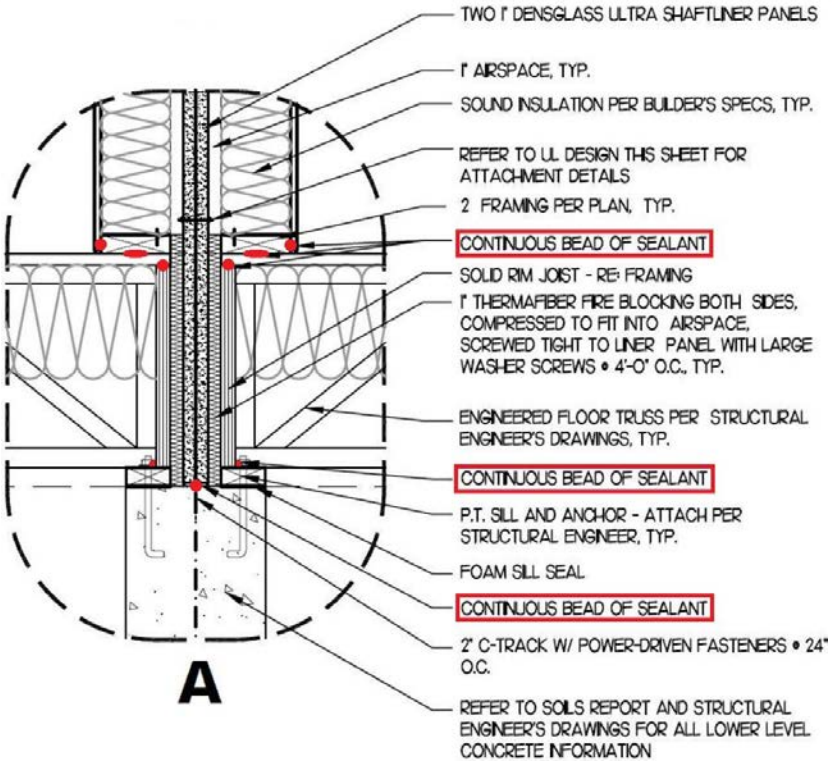
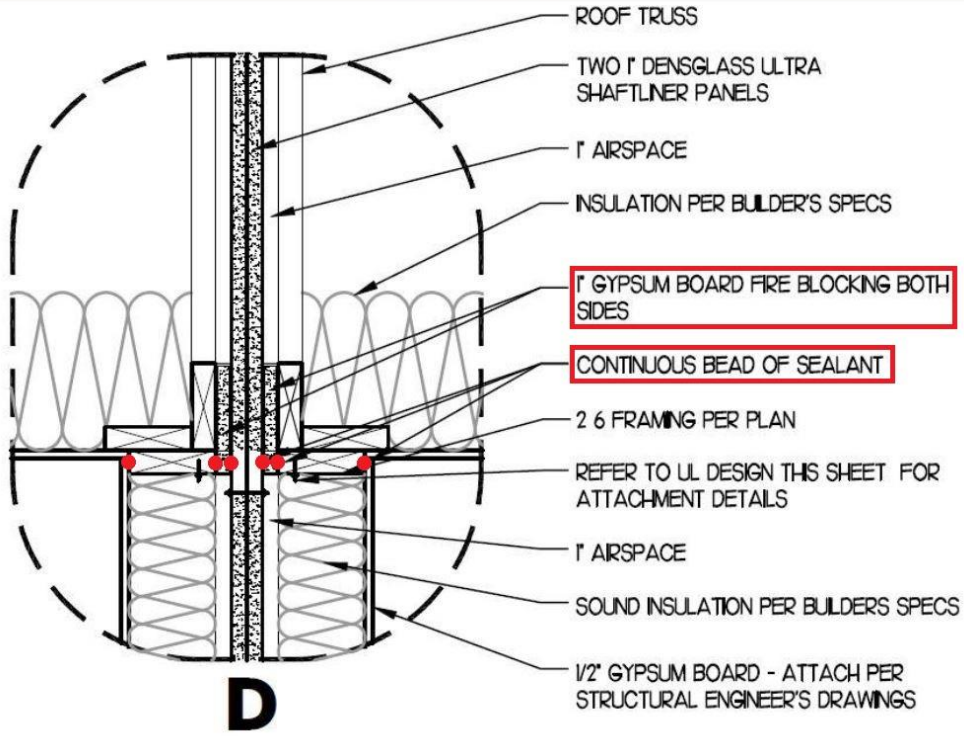
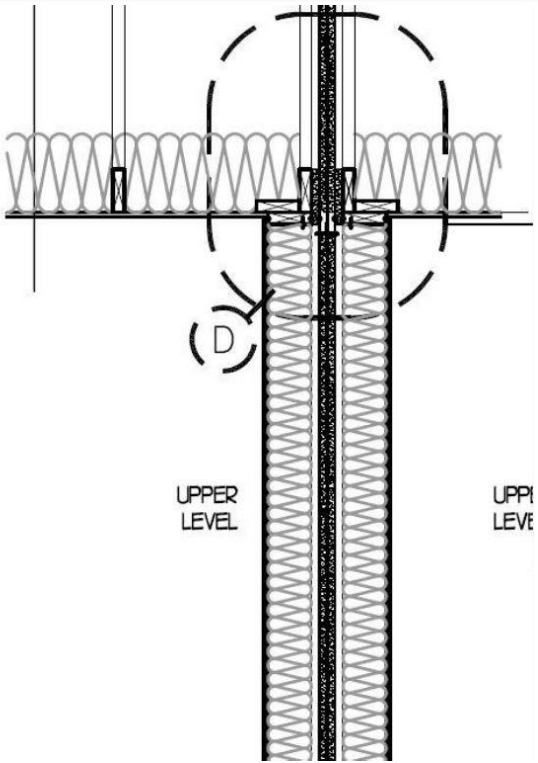


Well developed plans



Two hour wall assembly - Shaftliner

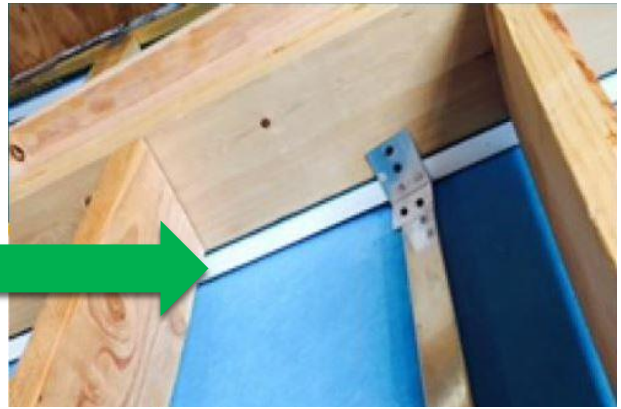




Two hour wall assembly

Large gap is left to air seal.

Ripper installed in gap.
Smaller gap to seal.



Examples from the field

Looking up at top plate

Top plate from above – 6” ripper filling the gap is visible

Mind the transitions

Interior looking out to front porch.

Exterior front porch looking at porch roof.

Gap between sheathing & shaft-liner allowing air behind rim.

Mind the transitions

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Exterior front porch looking a porch roof.

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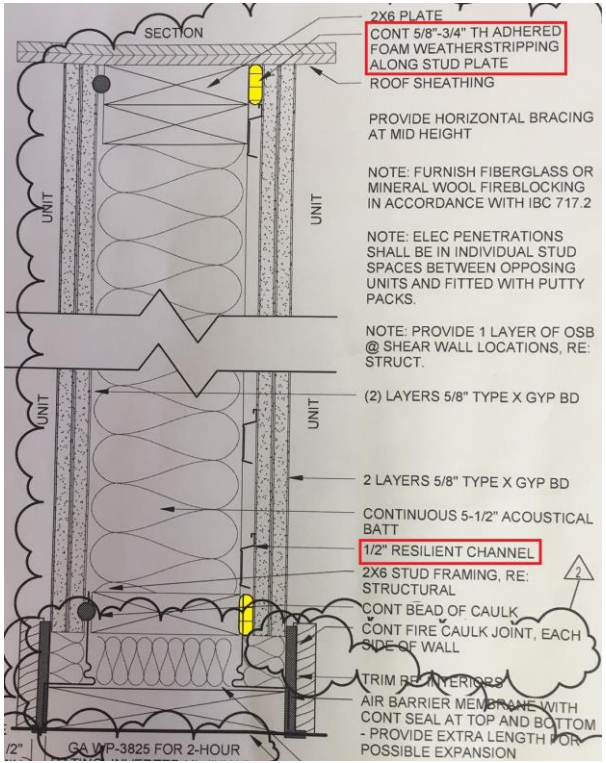
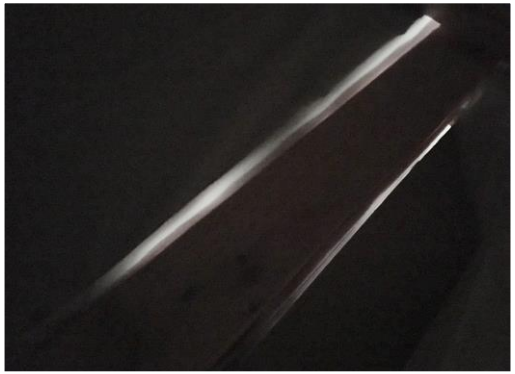
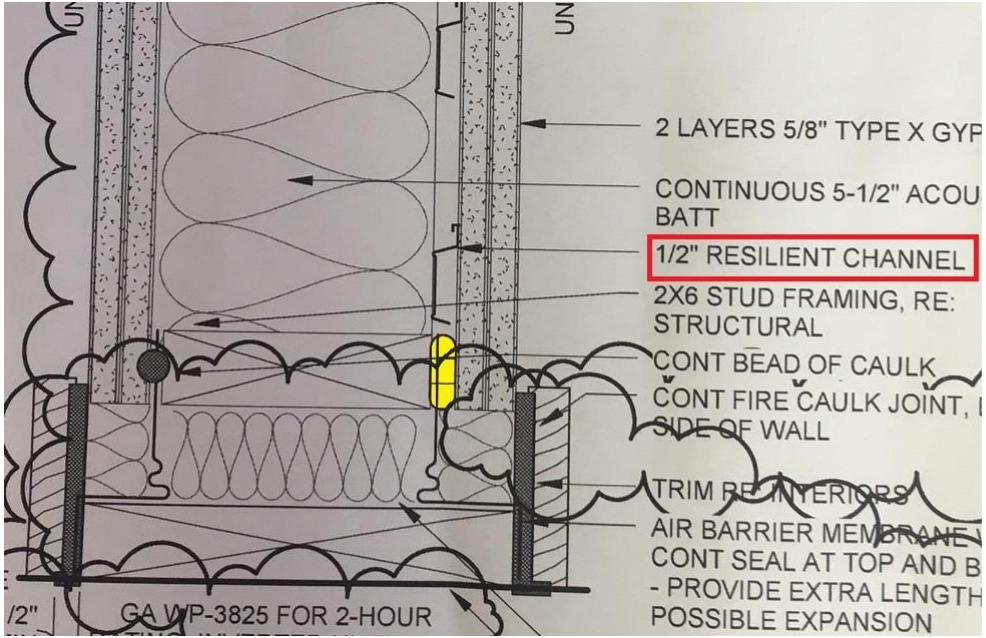
Are plan details being followed?

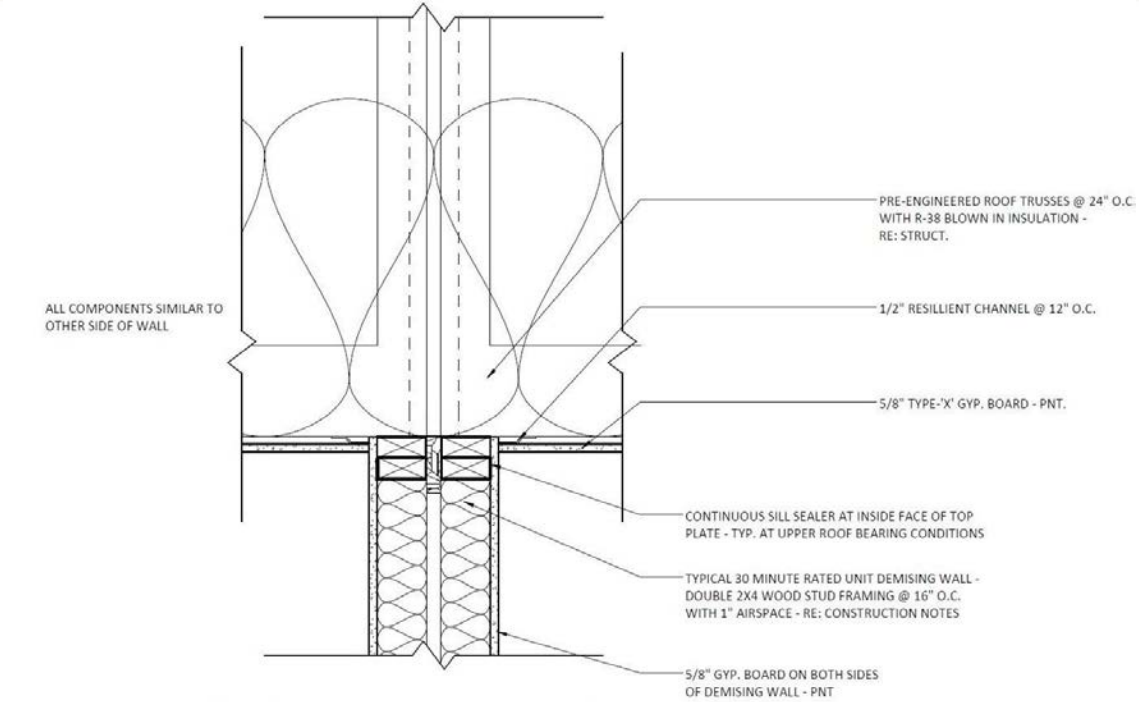




Floating wall – challenging detail



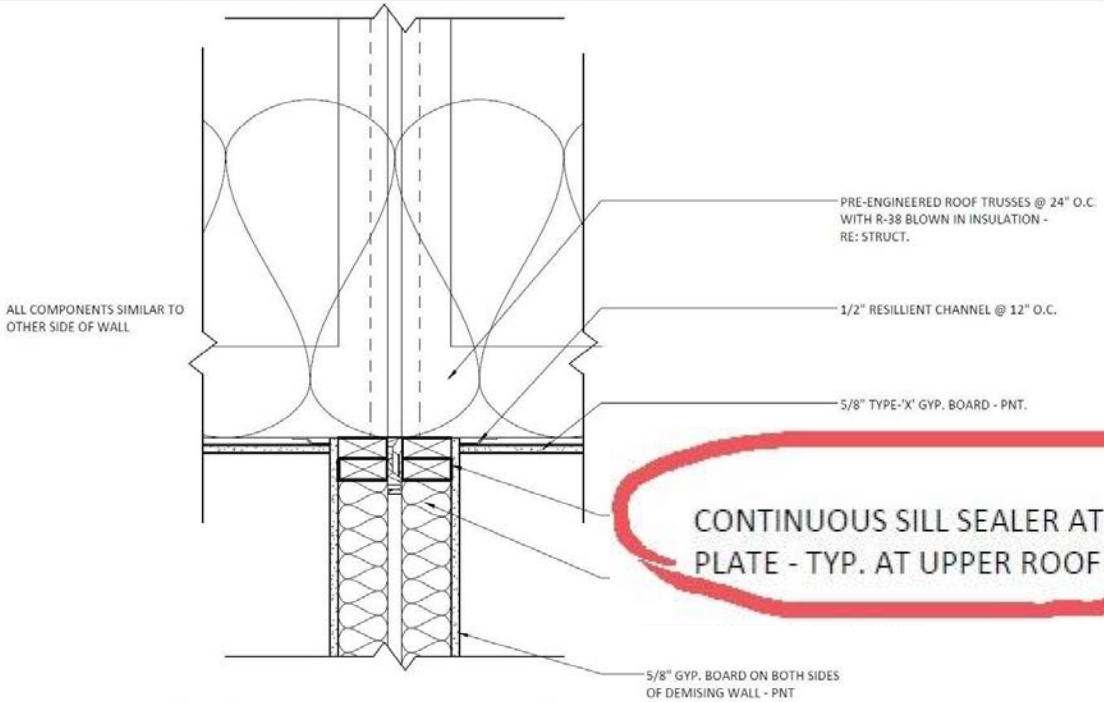
One hour wall assembly - attic



3 / A7.2 **DEMISING WALL @ ROOF BEARING - TYP.**

SCALE: 1 1/2" = 1'-0"

One hour wall assembly - attic



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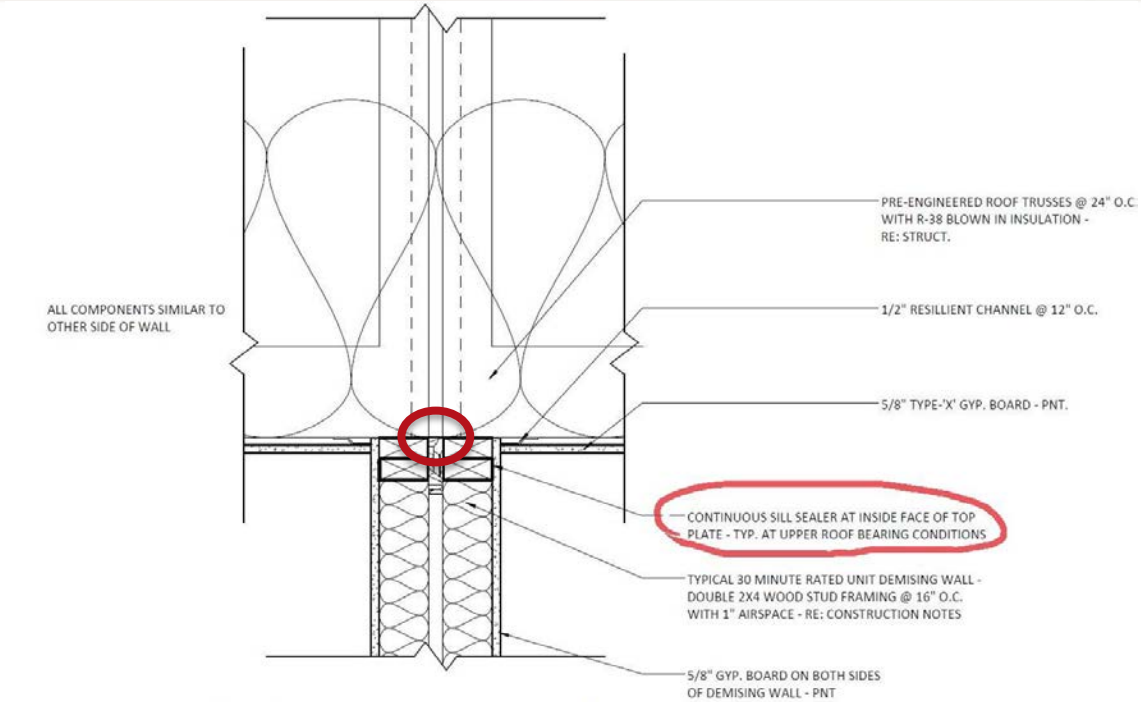

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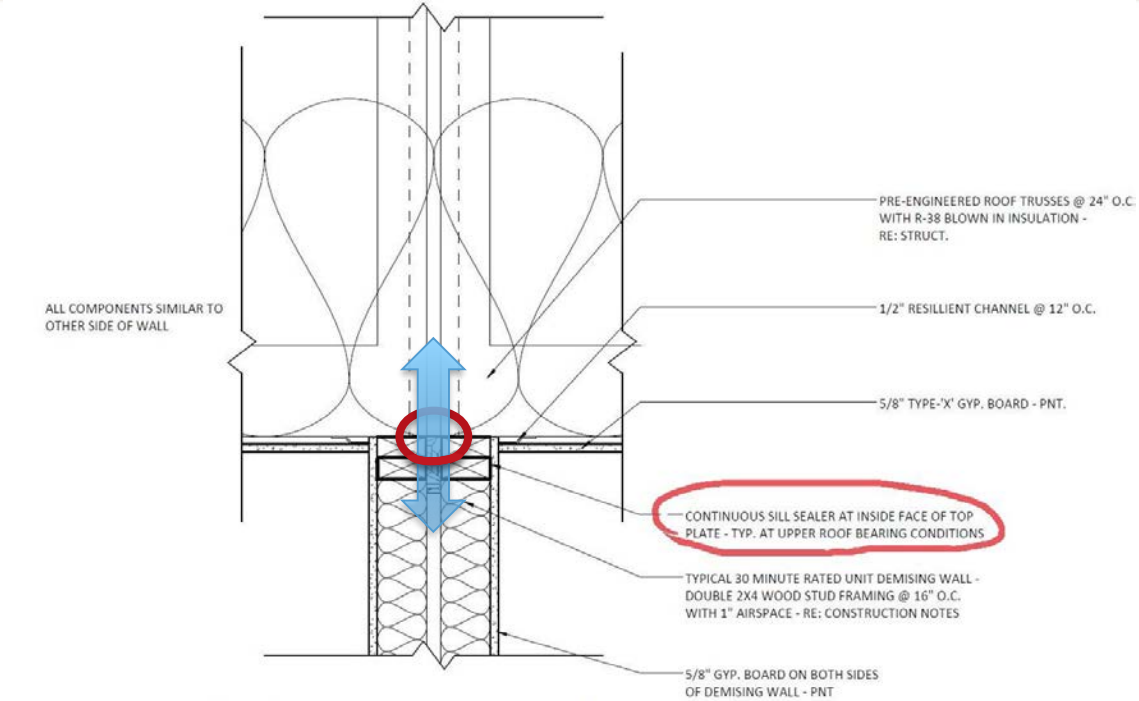

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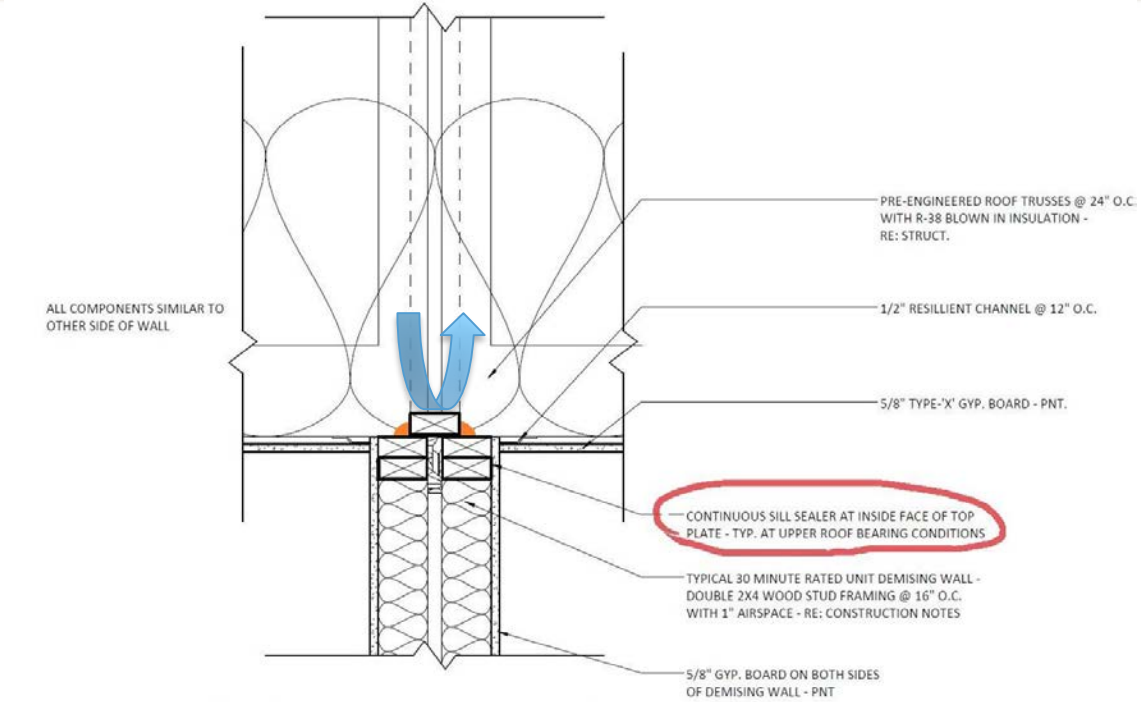


3 / A7.2 **DEMISING WALL @ ROOF BEARING - TYP.**

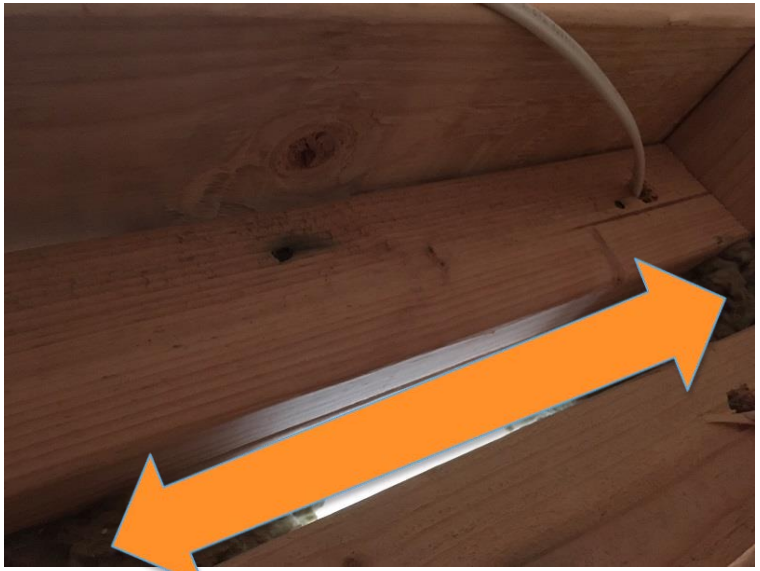
SCALE: 1 1/2" = 1'-0"

One hour wall assembly - attic

Looking up at top plate – gap chinked with mineral wool for draft stop.

Looking down from above. Chinking removed shows direct connection with attic.

One hour wall assembly - attic



Foam seal or blocking above chinking will minimize pathway for air into wall.

Scope of work – it's in the details




Define early in the project whose scope of work entails caulking penetrations to drywall & sealing fixtures.

Scope of work – it's in the details

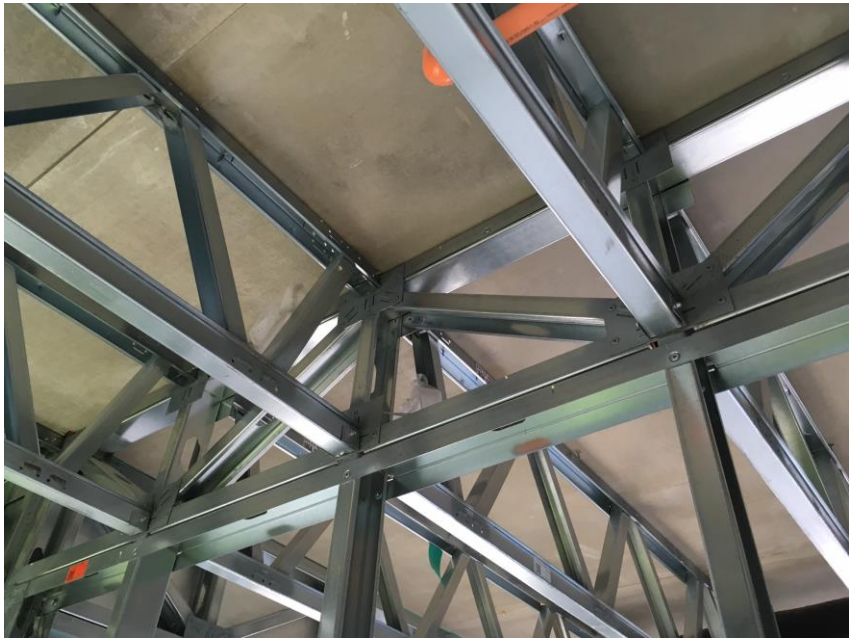
QC checks are critical. Pictured right, a pathway through wall from unit to unit during construction has damaged the putty compromising fire & air seal.

City of Fort Collins

Challenges & lessons learned

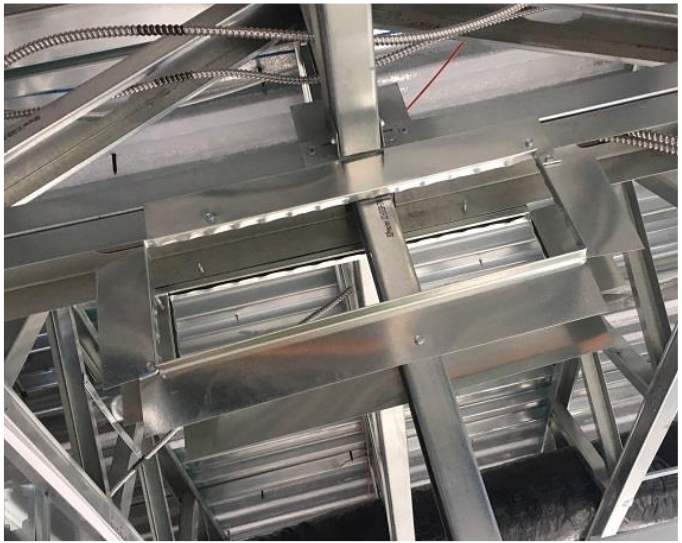
5/16/2017

Not all construction is the same



It’s complicated out there

Can you spot the area of concern in pic at right?



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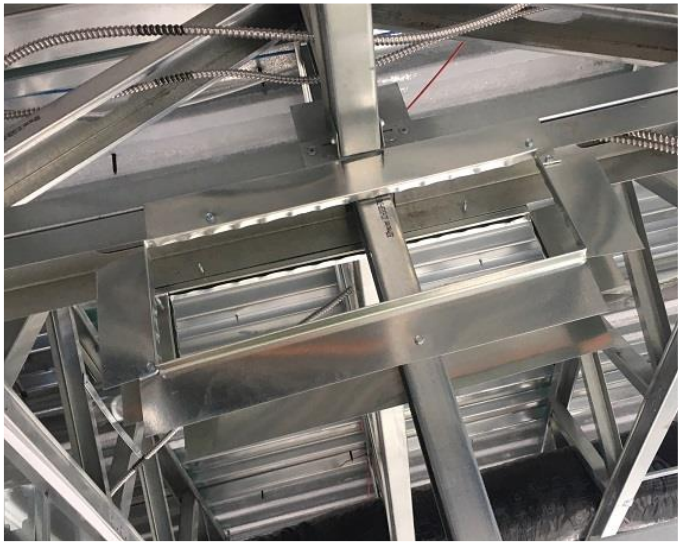

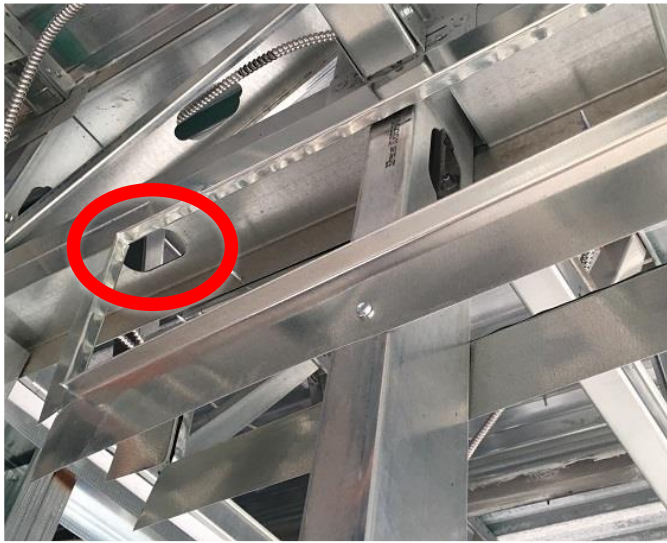

Hole in top plate at transfer grill allowed air from interstitial space above into unit(s).

It’s complicated out there

Expensive and time intensive to correct

Summary

- **Steps to success**

-Clearly define plane of air tightness/air barrier on plans.

-Recommend hiring 3rd party air leakage tester early.

-Plan review

-Pre-drywall air barrier inspections

-Air leakage test

-Work with the insulation & air sealing contractor & define scope.

-Identify problems early in the process. Easier & less costly to repair.

-Pre blower door tests are very informative. *best done on 1st building.

Additional resources

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Building America Solution Center

EERE » BTO » Building America » Solution Center » Guides

Solution Center Home
Help

FIND YOUR TOPIC BY:
Building Components
Guides A-Z
ENERGY STAR Certified Homes
Zero Energy Ready Home
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Air Sealing Multifamily Party Walls

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Scope | Description | Success | Climate | Training | CAD | Compliance | More | Sales

Scope

Air seal the common wall between units in a multi-family structure to minimize air leakage and provide a control layer for sound, smoke, fire, and air quality.

- In multifamily buildings, air seal the gap between t
wall) and
at all exte
- Confirm w
sealing m
safety rea
- Possible ai
spray foam for sealing the bottom plate to subfloor and bottom and top plates to sheathing in wood-framed walls, fire-rated caulk around plumbing and wiring, and two-part urethane foam for masonry block walls.

Air seal the common wall between units in a multi-family structure to minimize air leakage.

https://basc.pnnl.gov/resource-guides/air-sealing-multifamily-party-walls

Questions?

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