Tricky Things

(Common tradeoff decisions that make an impact on big buildings)

Phius Pro Forum – Oct 2024

Introduction & Overview

Agenda:
10m – Introductions, Preamble
10m – Stack Effect
15m – Trash Chutes
15m – Laundry Rooms
15m – Kitchen Exhaust
15m – Podium Construction
10m – Conclusions
90m Total

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Audience Poll:

- What type of buildings do you work on? (SF, MF, Commercial non-residential, Community development)

- What is the tallest building you've worked on?

- What foundation types have you worked on?
  - slab on grade? basement? podium?

- Direct exhaust range hood or recirc?

- What was number one challenge?

Context

Interviews with Multifamily Building Practitioners

- Pool knowledge and experiences
  - Create "guide" with potential solutions for passive building community
  - Continually evolving, updating
  - Integrating into professional training
- We want to hear from more people!
  - See "sign up" sheet at back
- Work In progress, stay tuned

"We wrestle with this decision on every project"

Who we talked to:

Galen Staengl
Staengl Engineering
Phius Tech. Committee

Russell Richman
University of Toronto
Phius Tech. Committee

Carmel Pratt
Bright Power

Michael Hindle
Passive to Positive

Tony Lisanti
Integral Building + Design
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John Woelfling
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Thornton Tomasetti
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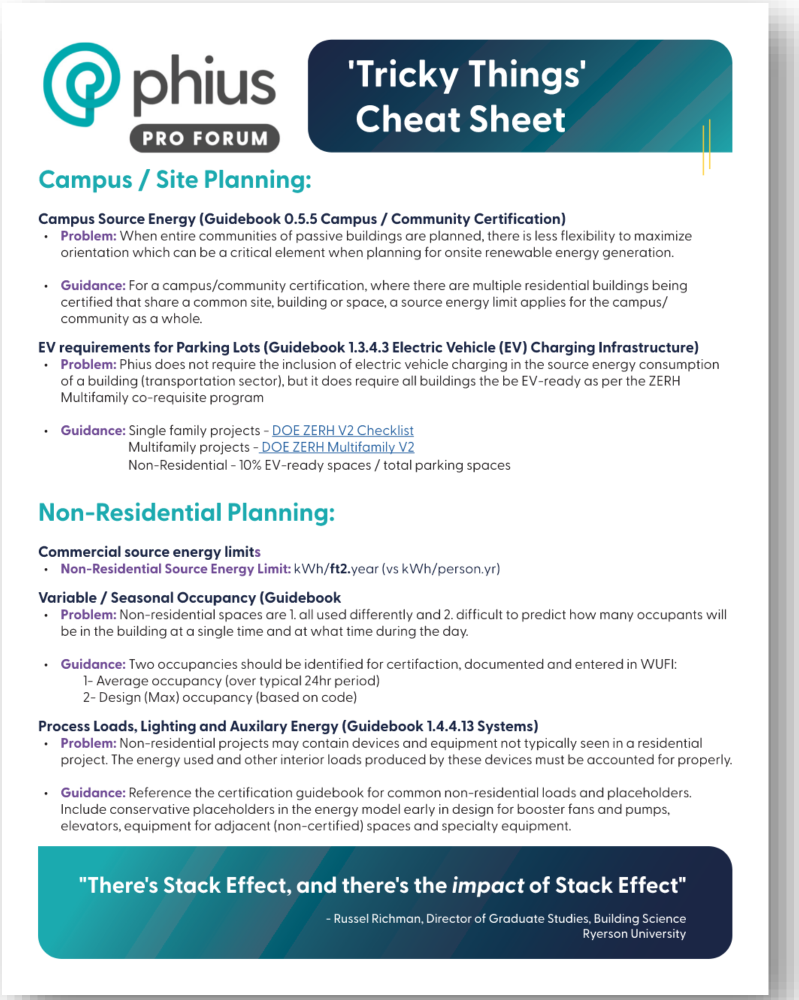
Michelle Apigian
Icon Architecture

Maciej Konieczny
New Ecology

‘Tricky Things’ Cheat Sheet



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'Tricky Things' Cheat Sheet

Campus / Site Planning:

Campus Source Energy (Guidebook 0.5.5 Campus / Community Certification)

- **Problem:** When entire communities of passive buildings are planned, there is less flexibility to maximize orientation which can be a critical element when planning for onsite renewable energy generation.
- **Guidance:** For a campus/community certification, where there are multiple residential buildings being certified that share a common site, building or space, a source energy limit applies for the campus/ community as a whole.

EV requirements for Parking Lots (Guidebook 1.3.4.3 Electric Vehicle (EV) Charging Infrastructure)

- **Problem:** Phius does not require the inclusion of electric vehicle charging in the source energy consumption of a building (transportation sector), but it does require all buildings the be EV-ready as per the ZERH Multifamily co-requisite program
- **Guidance:** Single family projects - DOE ZERH V2 Checklist
  Multifamily projects - DOE ZERH Multifamily V2
  Non-Residential - 10% EV-ready spaces / total parking spaces

Non-Residential Planning:

Commercial source energy limits

- **Non-Residential Source Energy Limit:** kWh/**ft2**.year (vs kWh/person.yr)

Variable / Seasonal Occupancy (Guidebook

- **Problem:** Non-residential spaces are 1. all used differently and 2. difficult to predict how many occupants will be in the building at a single time and at what time during the day.
- **Guidance:** Two occupancies should be identified for certifaction, documented and entered in WUFI:
  1- Average occupancy (over typical 24hr period)
  2- Design (Max) occupancy (based on code)

Process Loads, Lighting and Auxilary Energy (Guidebook 1.4.4.13 Systems)

- **Problem:** Non-residential projects may contain devices and equipment not typically seen in a residential project. The energy used and other interior loads produced by these devices must be accounted for properly.
- **Guidance:** Reference the certification guidebook for common non-residential loads and placeholders. Include conservative placeholders in the energy model early in design for booster fans and pumps, elevators, equipment for adjacent (non-certified) spaces and specialty equipment.

"There's Stack Effect, and there's the *impact* of Stack Effect"

- Russel Richman, Director of Graduate Studies, Building Science Ryerson University

Other ‘Tricky Things’ addressed directly in the Phius Certification Guidebook

- Campus / Site Planning
- Non-Residential Buildings
- Building Enclosure Design

Definitions

Boundaries

- Thermal boundary
- Airtight Boundary
  - For Phius airtightness test
- Phius Certified model boundary
- **Ideally all of these align**

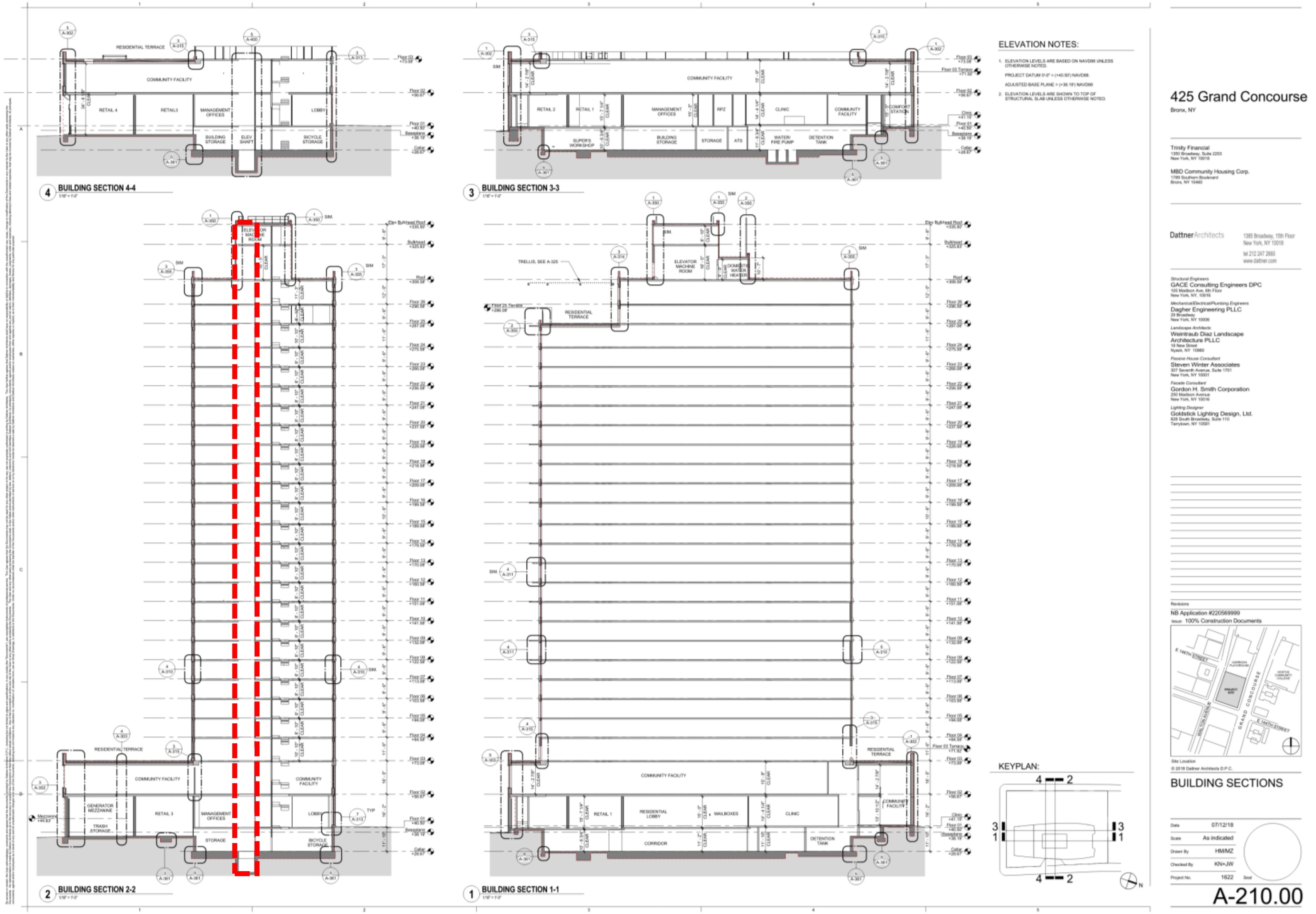
Airtightness Testing Guidebook Appendix C-2.3

- **Enclosure Durability Test**
  - Used for pass/fail
  - Tape off non-threatening leakage
- **Operational Test**
  - Untaped
  - Everything in "natural" position

Stack Effect and the Phius Envelope

‘Stack Effect’ and Tall Buildings

425 Grand Concourse – Dattner Architects (26 stories)



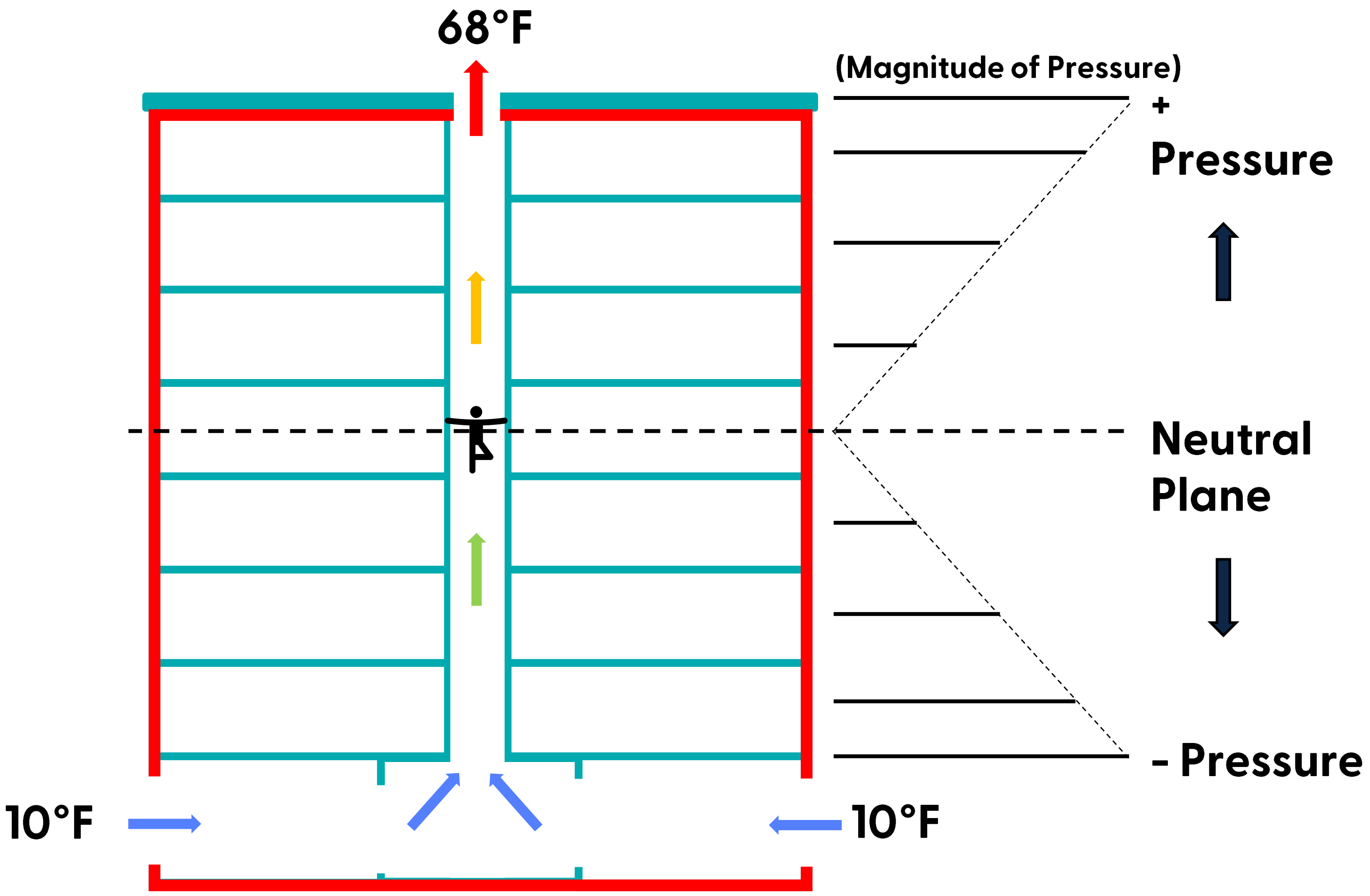
‘Stack Effect’ and Tall Buildings

The Effect:
Air movement caused by thermal differences, usually in an enclosed vertical shaft.

- Hot air is less dense, rises
- Pressure difference created

The Problem:
<u>If not planned for</u>, can impact:

- Airtightness testing
- HVAC distribution
- Envelope durability

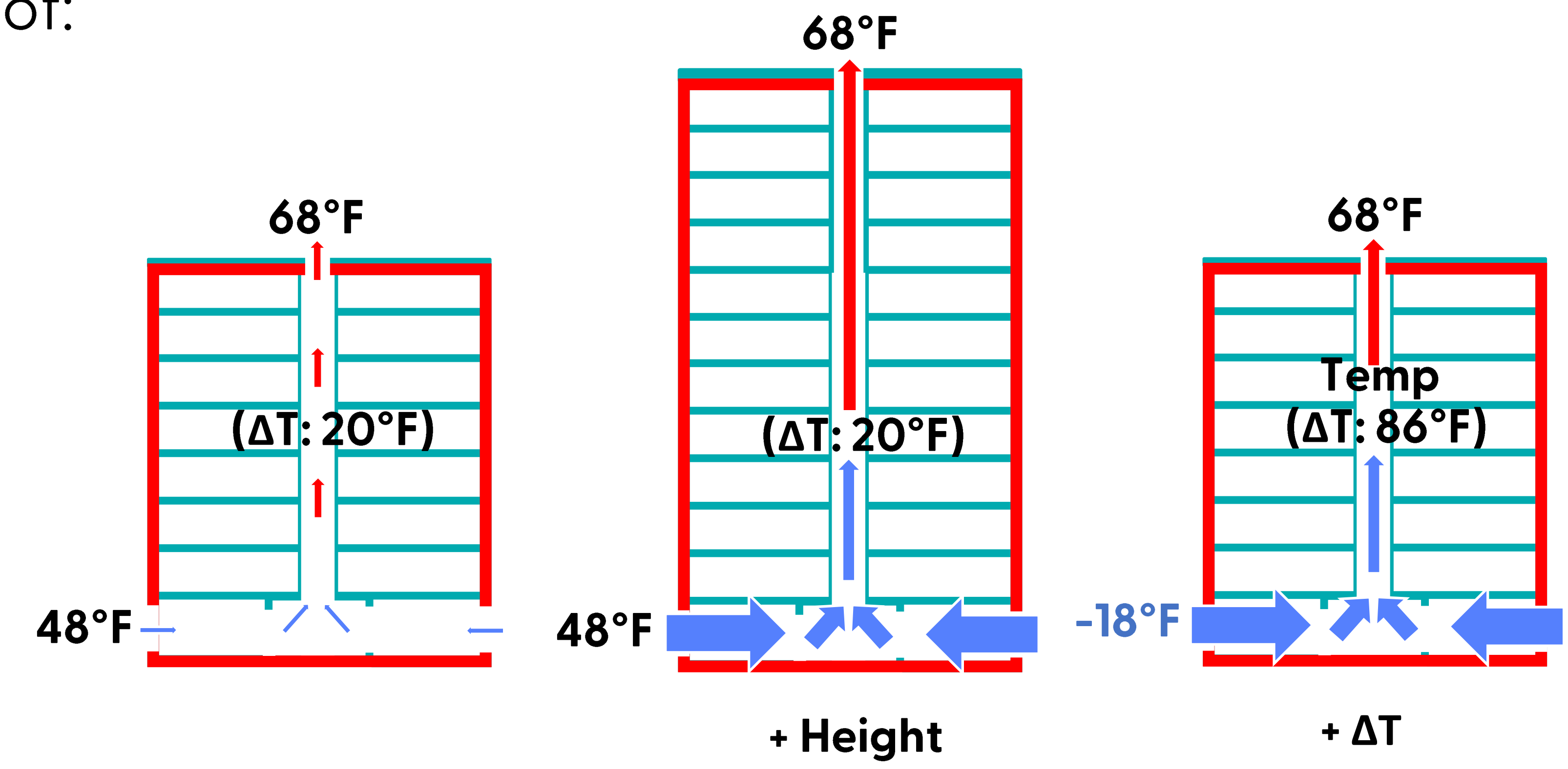


‘Stack Effect’ and Tall Buildings

Considerations:

- Stack effect is a function of:
  - Height of the shaft
  - Difference if temp.

- Phius buildings are <u>**less impacted**</u> by stack effect
  - 0.08cfm/ft2 limit (5+ stories)
  - Attention to detail in design
  - Onsite verification



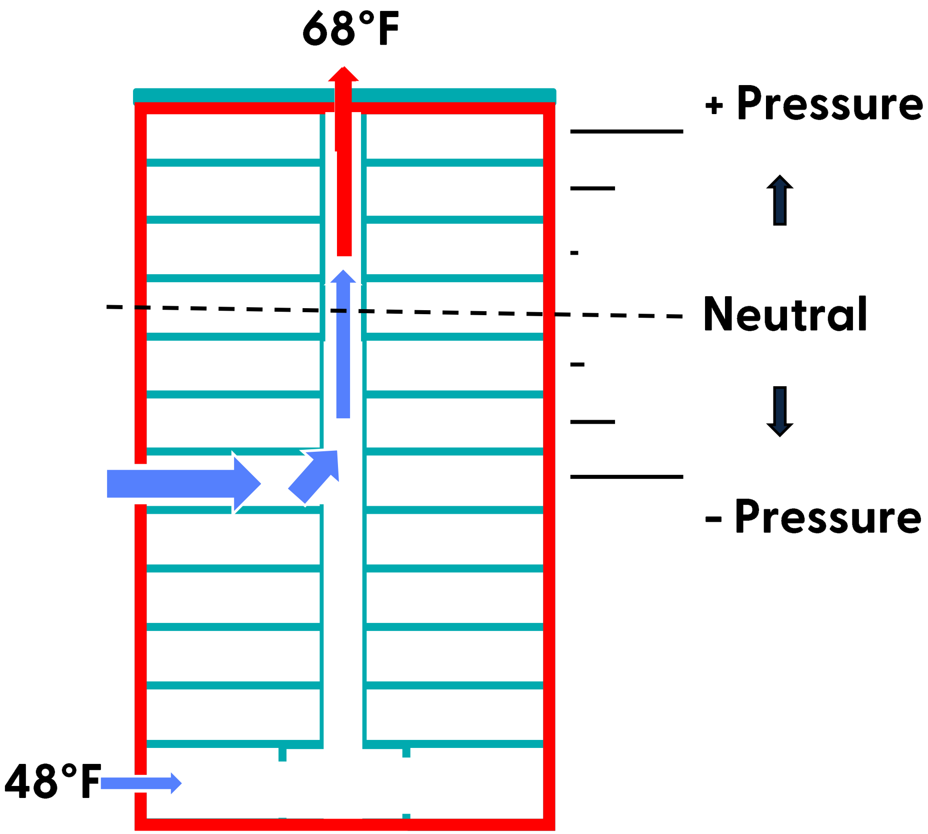
‘Stack Effect’ and Tall Buildings

Considerations:

- <u>Its going to happen</u>
- Single open window can provide equivalent area to whole-building envelope leakage (ft2)

Best Practices:

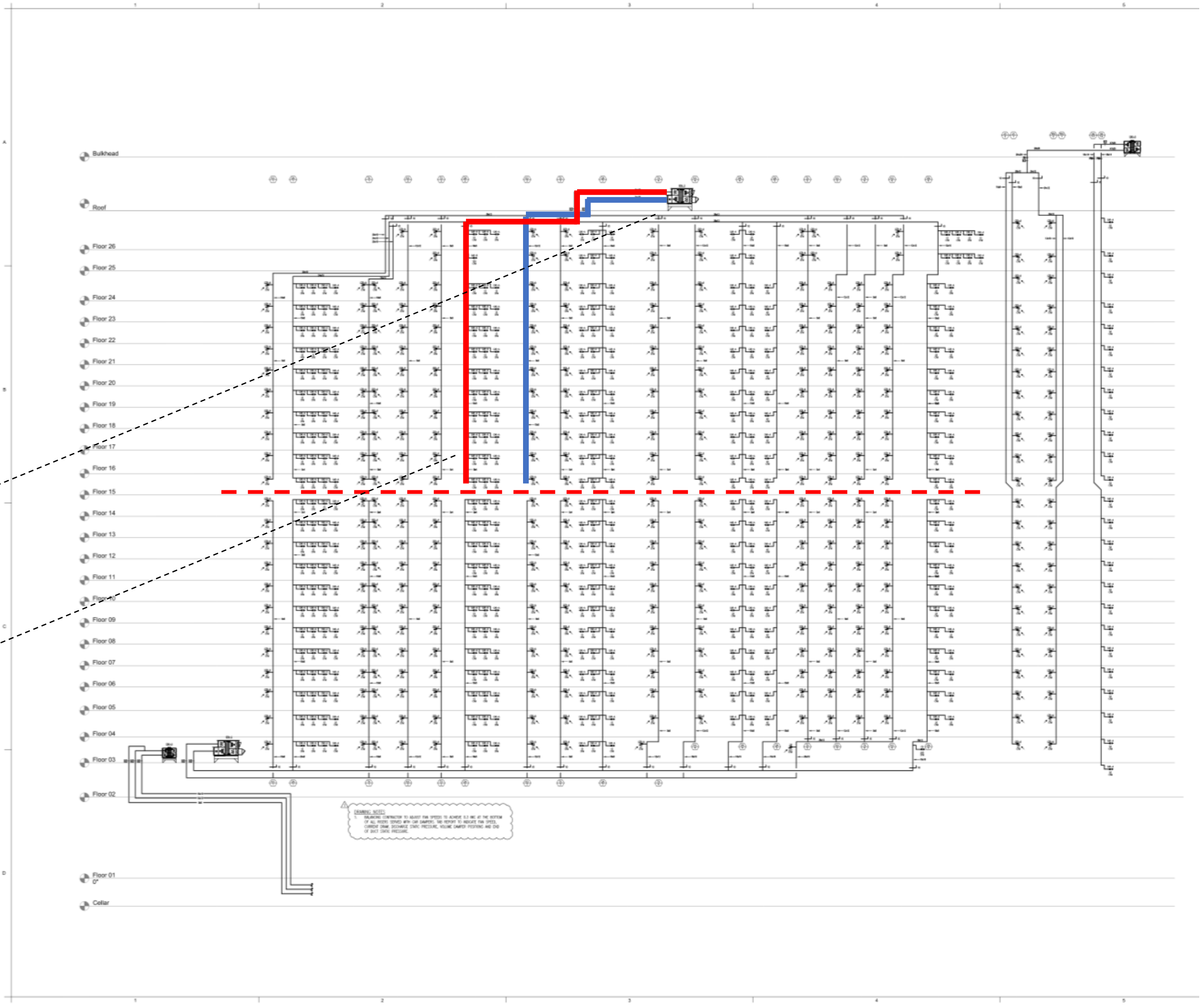
- Compartmentalization
- Stop-floors for vertical shafts
- Semi-centralized systems



‘Stack Effect’ and Tall Buildings

Option 1: Centralized Equipment:

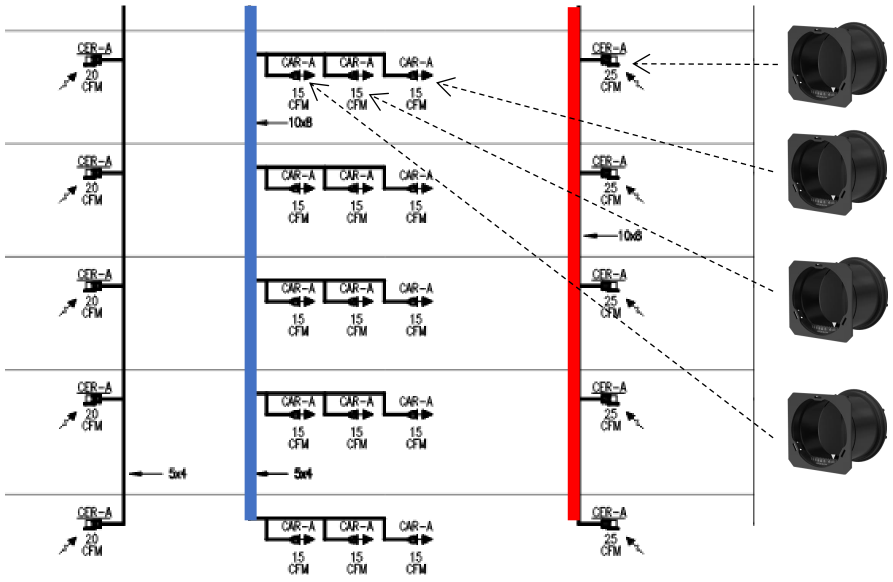
- The taller the duct shaft, the more susceptible it is to stack effect
- Constant Airflow Regulators (CAR dampers)
    - At terminations
    - Off main trunk (manual damper)



'Stack Effect' and Tall Buildings

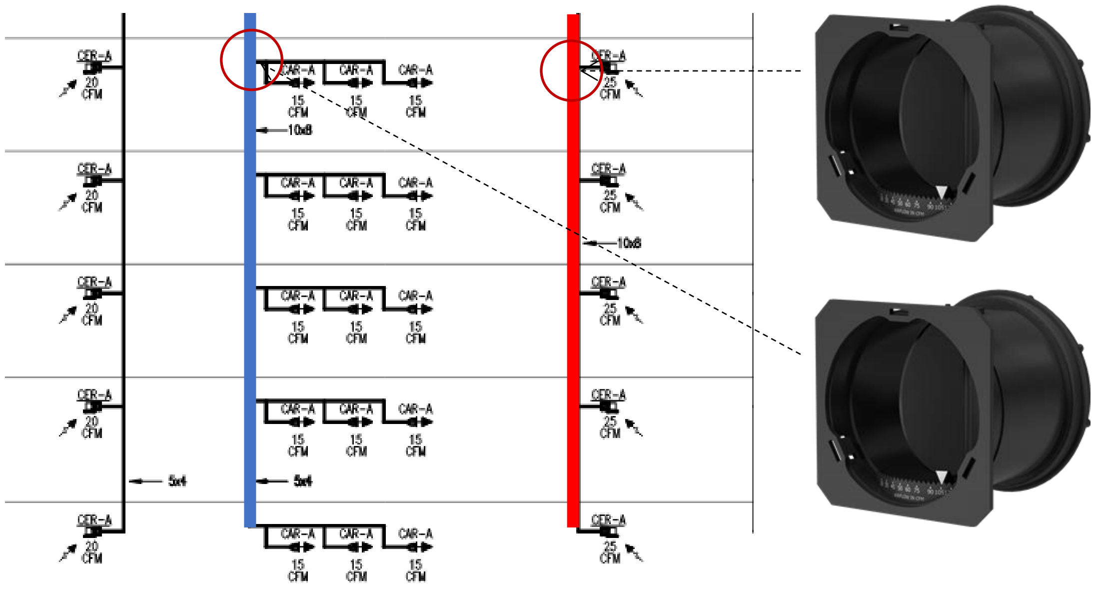
Option 1a: 'Petersen approach'

- Automatic balance damper (CAR) at each termination



Option 1b: 'BEC approach'

- Manual damper (CAR) for each units (off trunk)



Challenges: Proper testing and verification? Protocol? Equipment for testing this?

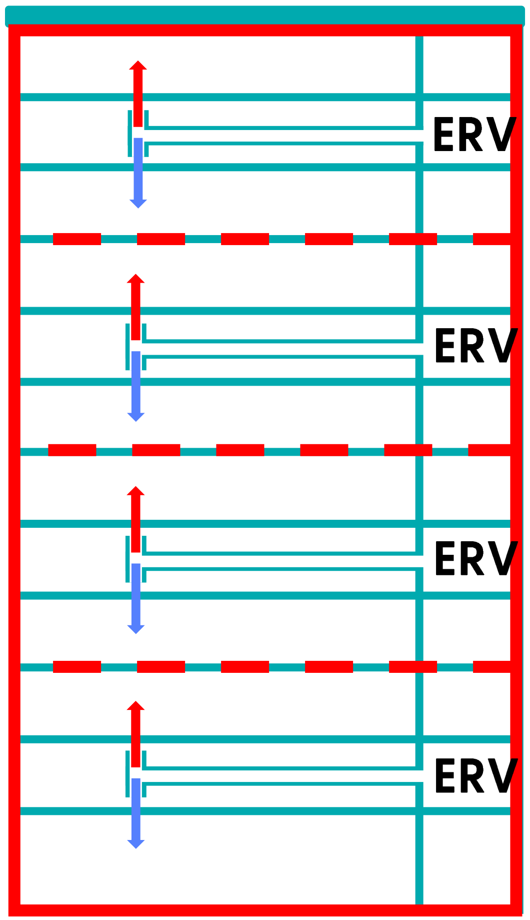
‘Stack Effect’ and Tall Buildings

De / Semi-Centralized Equipment:

- Equipment placed at every floor or every few floors to compartmentalize impact of stack effect

Challenges:

- Accessing exterior penetrations on large buildings



‘Stack Effect’ and Tall Buildings

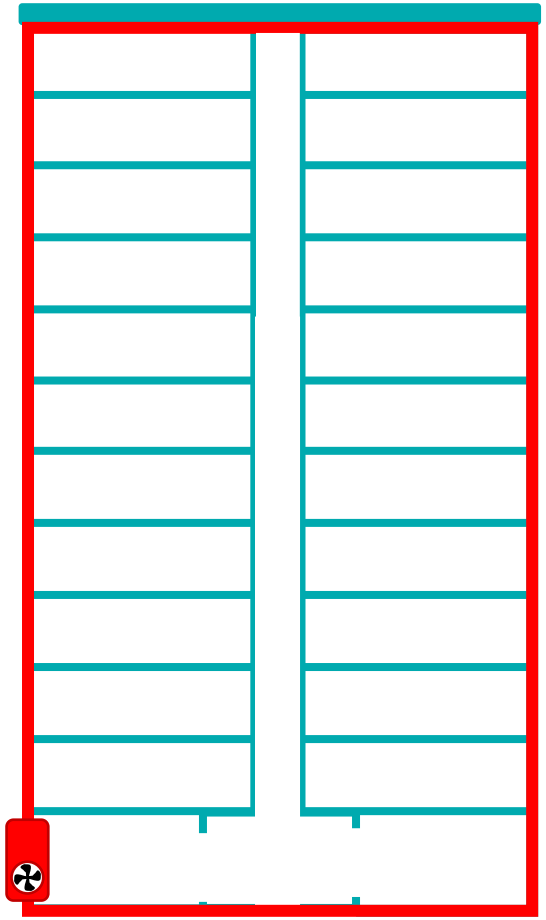
Important Differentiation:

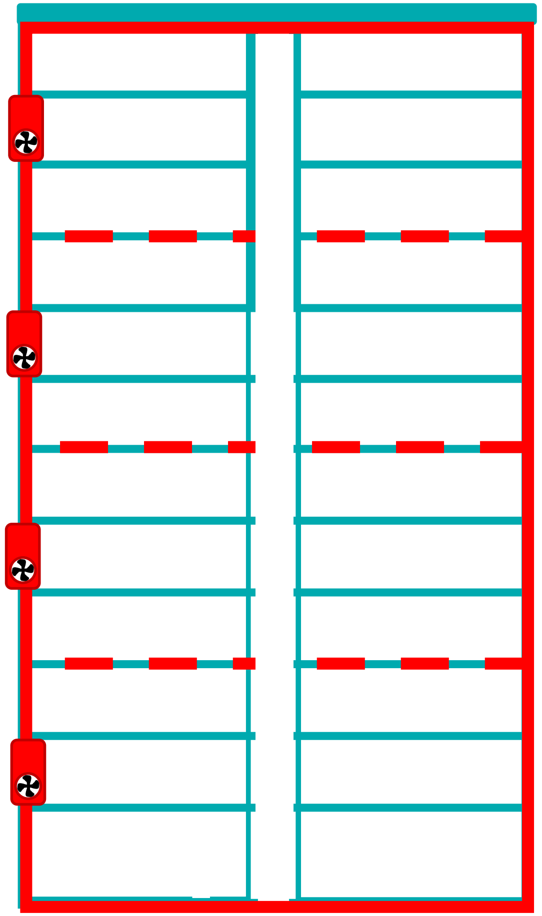
A: Whole-building Testing

- Reporting required for WUFI and Phius certification

B: Guarded Testing

- Floor ‘sampling’
- Allows more detailed inspection of isolated areas of work

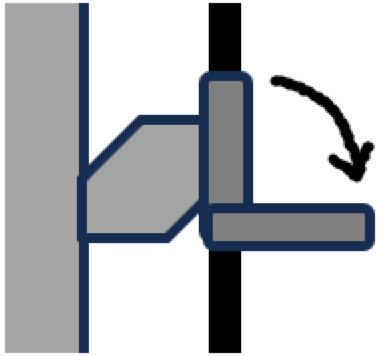


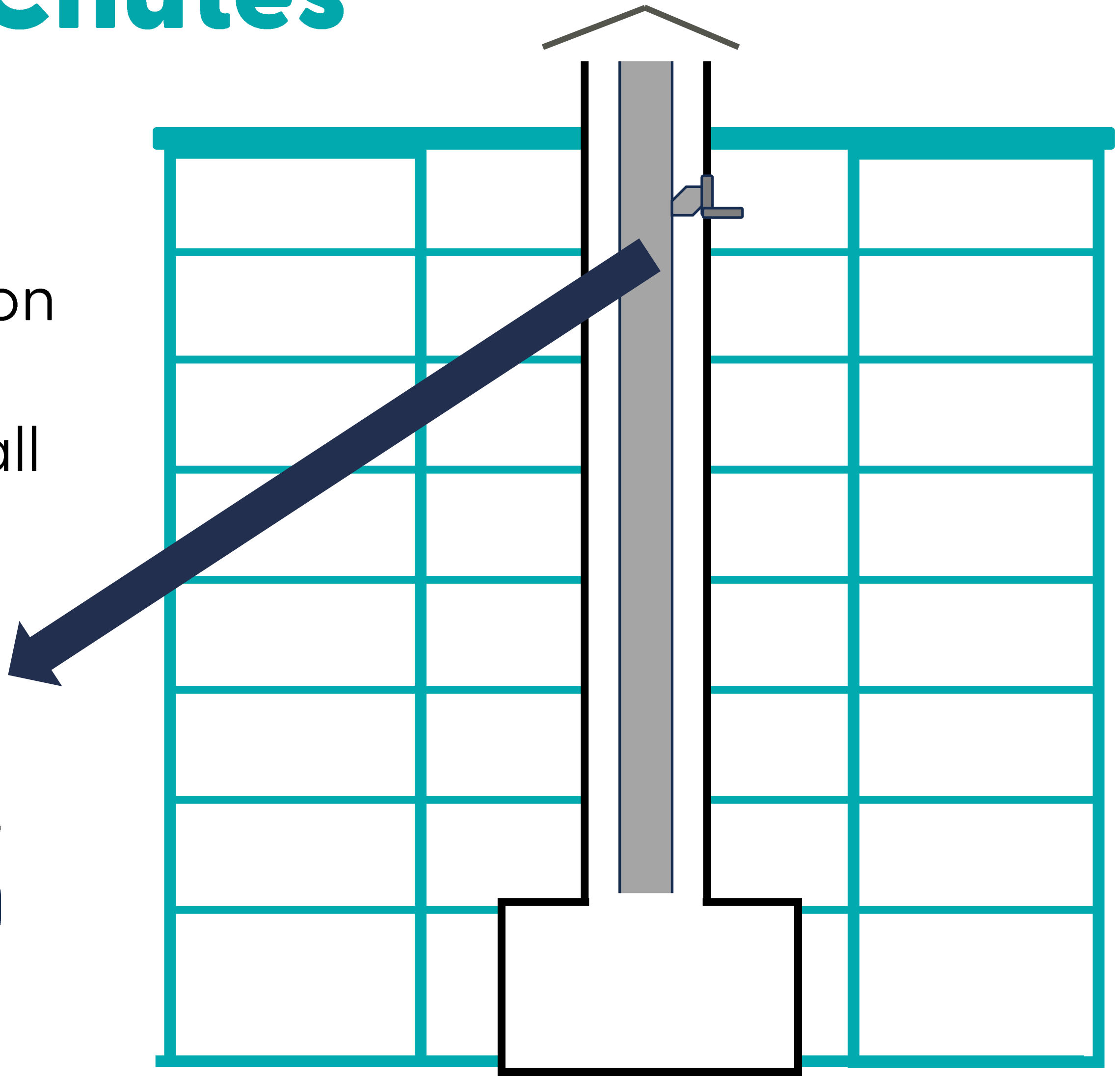


Trash Chutes

Challenges with Trash Chutes

- Huge "donut hole" cut into the building
- Must keep at a negative pressure
  - Requires continuous exhaust ventilation
  - Important for odor control
- Frequently accessed by tenants with small access doors on each floor
- **Where do you air seal?**





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OPTIONS: ALL IN or ALL OUT

Option 1: ALL IN

- Include trash chute **inside** the thermal envelope

Option 2: ALL OUT

- Cut trash chute **outside of** the thermal envelope

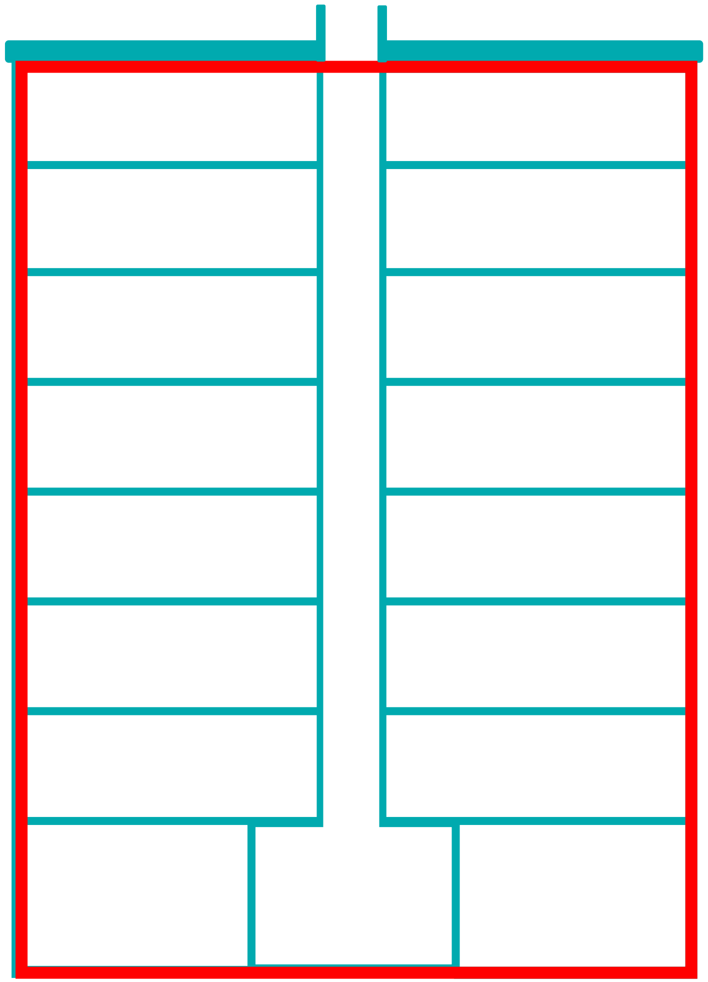
OR Don’t do them!

- Suggest trash closets or concierge service?

Option 1: Trash Chute Inside Thermal Envelope

PROS

- Simplifies details for air sealing
  - Including planning for services that run through compactor room
- Simplifies airtightness testing
- Reduces total “exposed” enclosure area

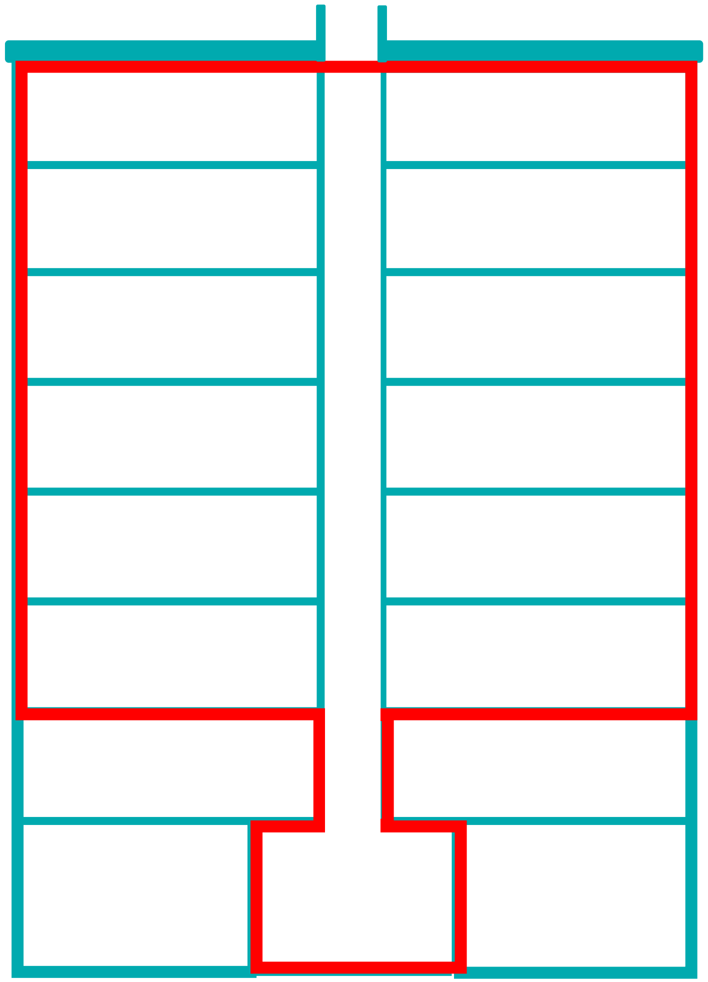


CONS

- Risk of odor transfer
- Airtight doors required in compactor room at bottom of shaft
  - Could be a challenge with larger garage type doors
- Energy penalty from continuous exhaust air
- Pulls air from interior space through exhaust fan at top
  - May require additional supply ventilation air to keep whole building in balance

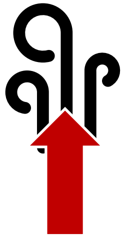
Option 1: Trash Chute Inside Thermal Envelope

Other potential configuration, if podium construction



Trash Chute Inside Airtight Enclosure

ONE SOLUTION:

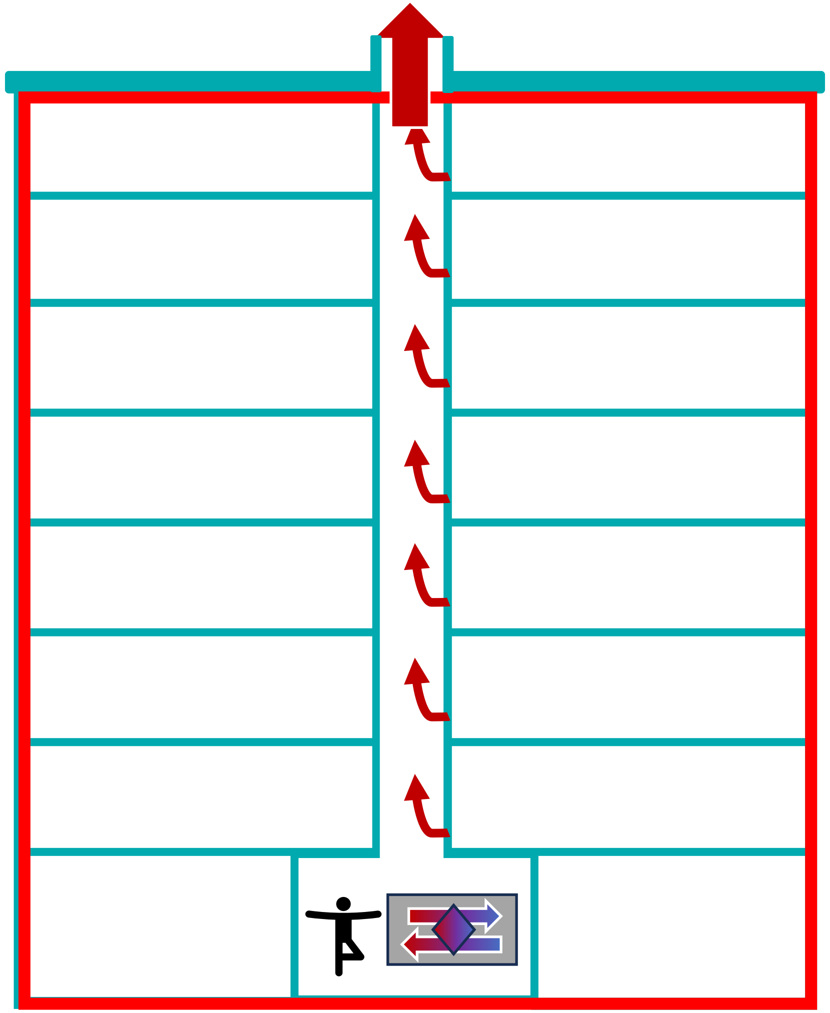


Ventilation

- Exhaust air vent fan at top of chute, running continuously
  - Pulls some interior air through leaks trash chute access doors
- Separate ERV at bottom of shaft in compactor room to satisfy exhaust air requirements
  - Balances room separately, eases effects of negative pressure on chute access doors

Airtightness

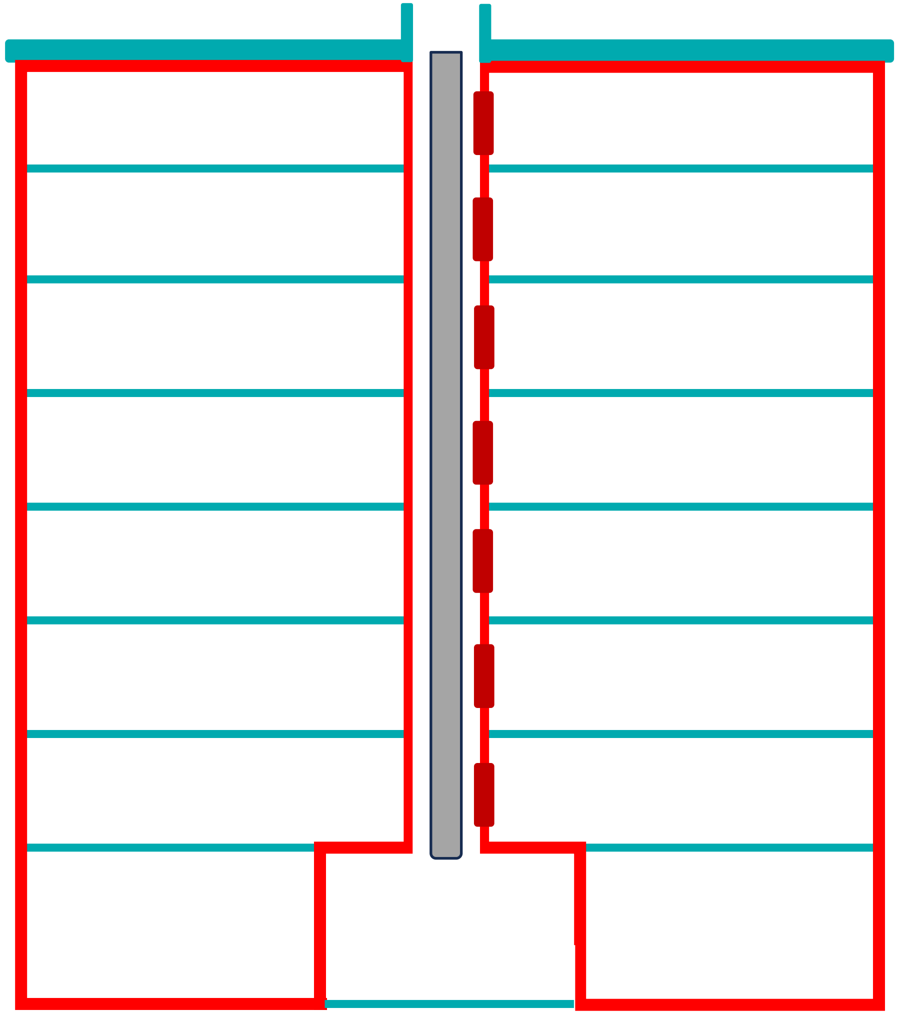
- Airtight doors from compactor room to outside
- Building airtight boundary stays in line with thermal boundary



Option 2: Trash Chute Outside of Airtight Boundary

PROS

- Minimizes potential odor transfer
- Minimizes thermal loss impact of continuous exhaust

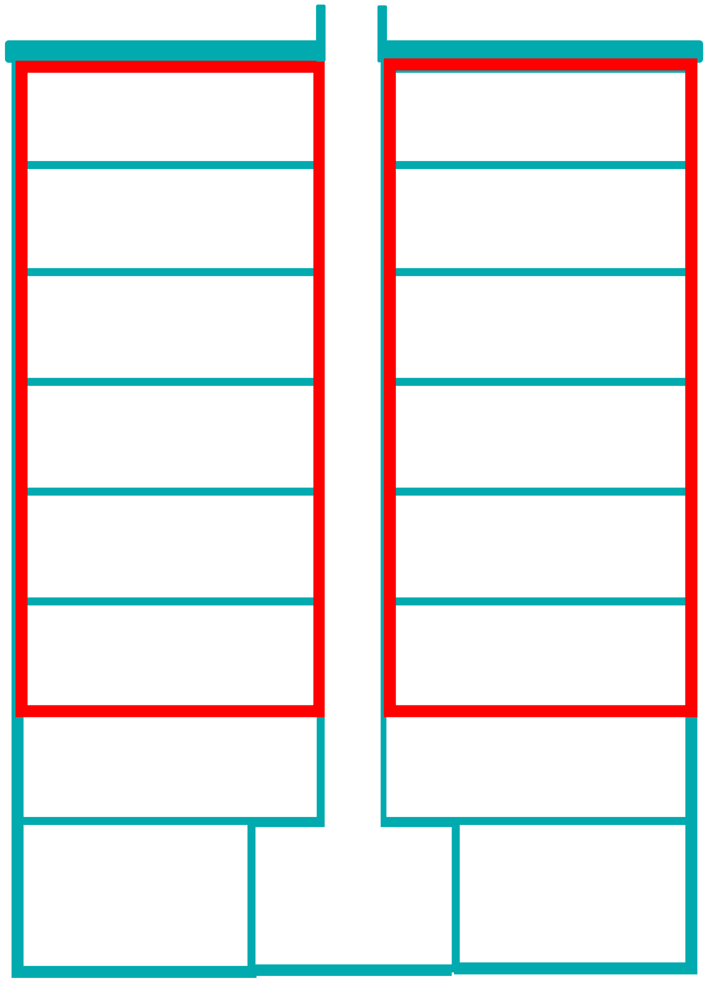


CONS

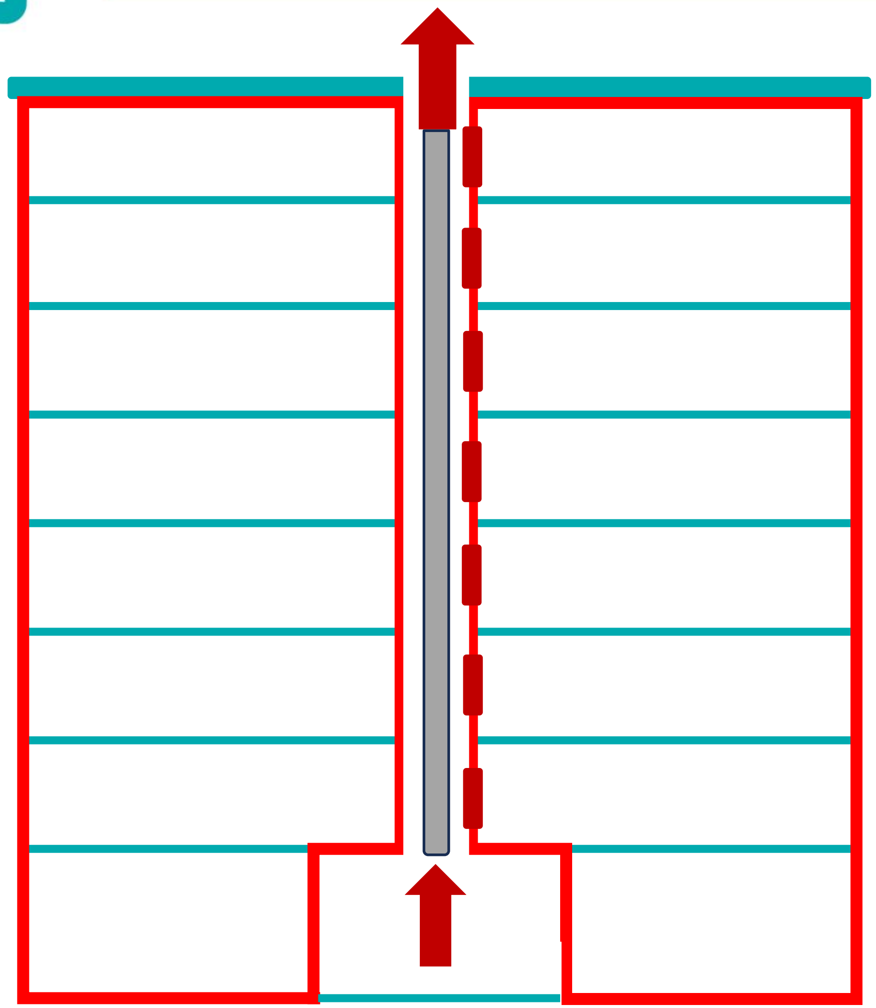
- Airtight (and insulated?) chute access doors required on each floor
- More "exposed" enclosure area
- Trickier airtightness testing boundary
- Tricky detailing at base/ compactor room with potential services or other equipment

Option 2: Trash Chute Outside of Airtight Boundary

Other potential configuration, if podium construction



Trash Chute Outside of Airtight Boundary



ONE SOLUTION

Ventilation

- Exhaust air vent fan at top of chute, running continuously (*same as other solution*)
- Direct exhaust at compactor room to satisfy code req.

Airtightness

- Air-sealed trash shaft
  - Seal from the inside of shaft, hit 3 sides of 4 before enclosing
- Airtight doors at each level for trash chute access
- Attention to detail at walls/roof enclosing compactor room
  - Attention to detail where services may run through new air-tight boundary at compactor room

Elevators

Not really that tricky.

Building code doesn't require a big hole in the top anymore – big help!

But still an *almost unavoidable* contributor to stack effect.

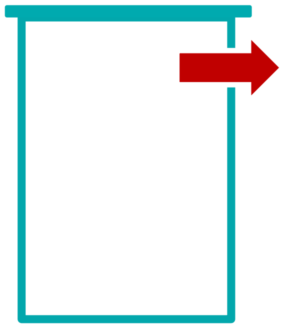
Needs its own pit, footing, potentially sump pump.

Potential thermal bridge.

Energy use is tricky to estimate. Lots of variables.

Laundry Rooms in Multifamily Buildings

Challenges:

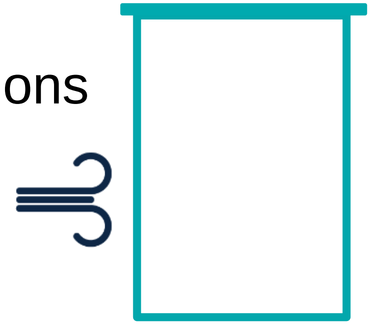


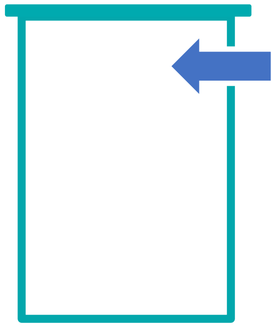
Exhaust Air Losses

- Lots of exhaust air in one space in an airtight, balanced vent building
  - Causes localized depressurization
  - If this causes > 5 Pa pressure difference, you need makeup air

Airtightness

- Lots of enclosure penetrations
  - Exhaust ducts
  - Makeup air
- What can you tape?
- What is always open?





Makeup Air

- Where do you bring it in?
- How much do you bring in?
- How is that makeup airflow rate managed?
- Do you condition it? How, when?
- How is it air sealed?

Equipment Leasing

- Limited options
- Most large buildings lease the dryer equipment from vendors that only carry standard direct exhaust dryers

Exhaust Dryer Laundry Room Solutions

IN **OR** ***OUT ?***

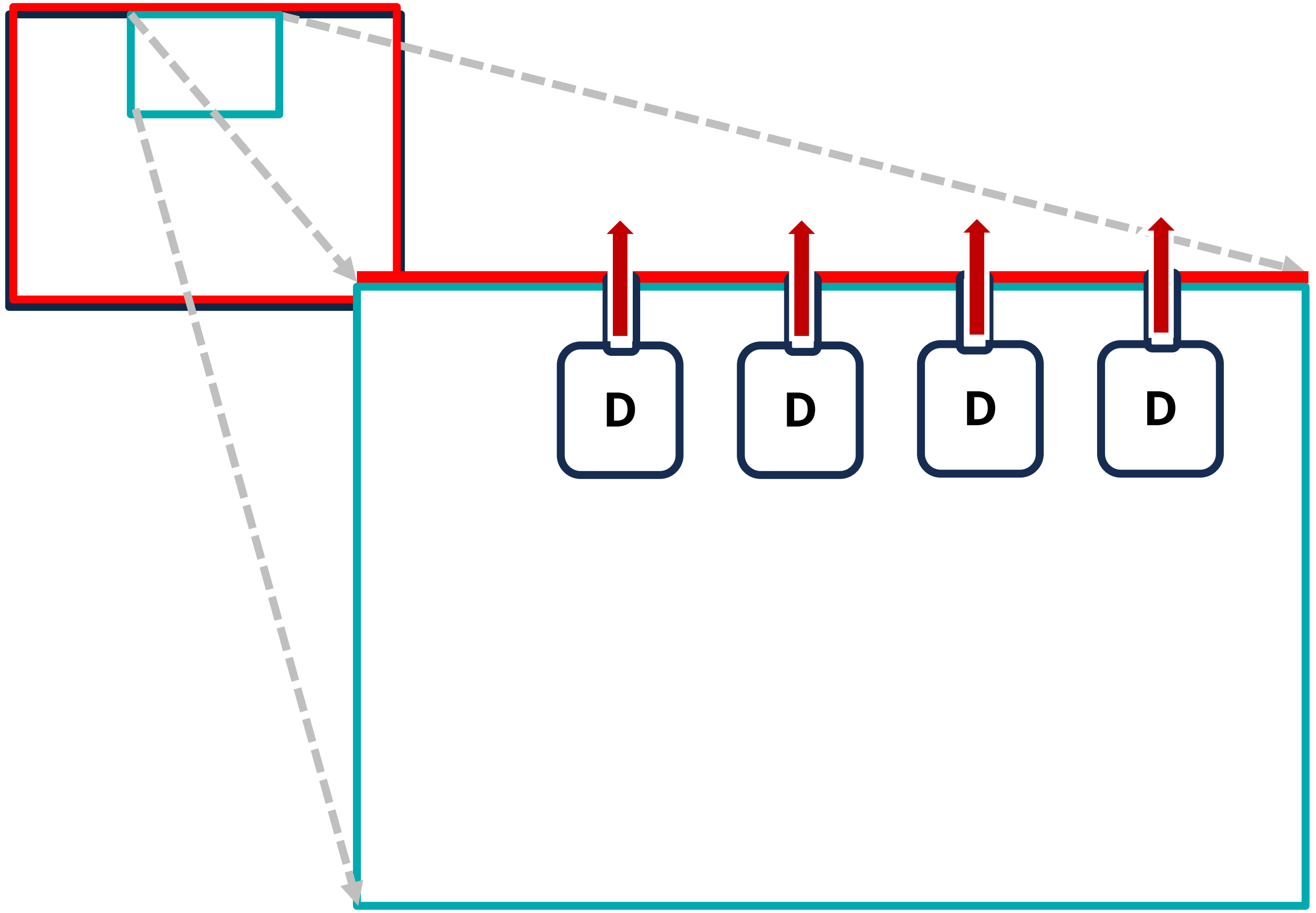
Option 1A: ALL IN

Option 1B: MOSTLY IN, WITH PLENUM

Option 2: ALL OUT

Exhaust Dryer Laundry Room Solutions

Option 1: ALL IN



PROS

- Simplifies whole building air sealing strategy
  - Does not require sealing of internal floors/ceiling/walls
- Simplifies airtight boundary

CONS

- Lots of holes in enclosure for dryer exhaust, attention to detail required at seal
  - Not continuously operating, cannot tape for airtightness test
  - Maybe not a big hit if dryers are installed during airtightness testing
- Likely need makeup air system
  - Must control how much, when/how?

Exhaust Dryer Laundry Room Solutions

Option 1: ALL IN

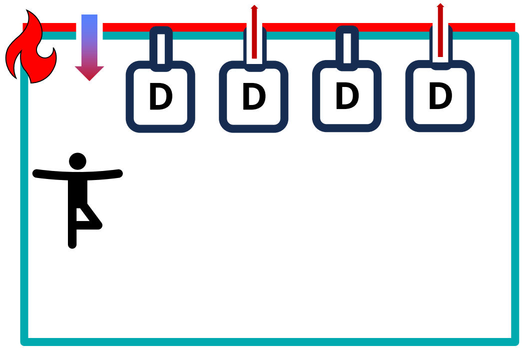
ONE SOLUTION

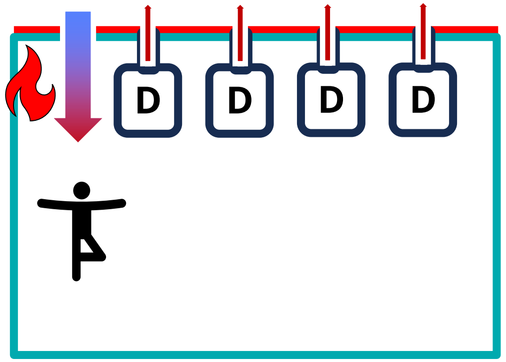
Air Sealing

- Seal at dryer exhaust, maintain continuous exterior airtight boundary

Makeup Air

- Use variable speed makeup air fan
- Pre-heat incoming air with in-line electric resistance heater based on outdoor air temp





HOW MUCH MAKEUP AIR?

One Option

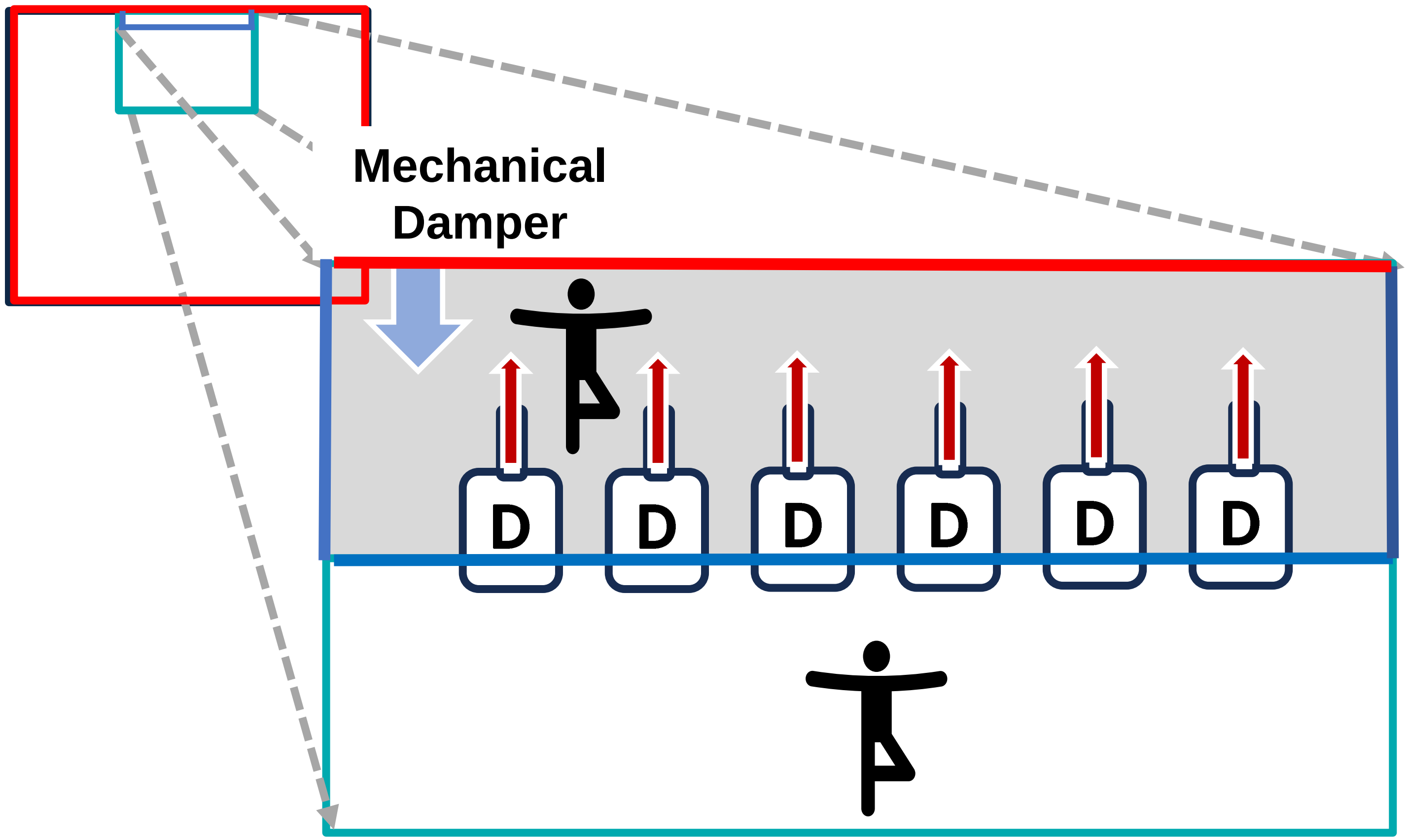
- Tie airflow rate of makeup air to number of dryers running based on amperage
  - A bit more electrical work

Another Option

- Tie airflow rate of makeup air to number of dryers running based on pressure differential sensor
  - Sensor may fail
  - Mixed success

Exhaust Dryer Laundry Room Solutions

Option 1B: MOSTLY IN, WITH PLENUM



PROS

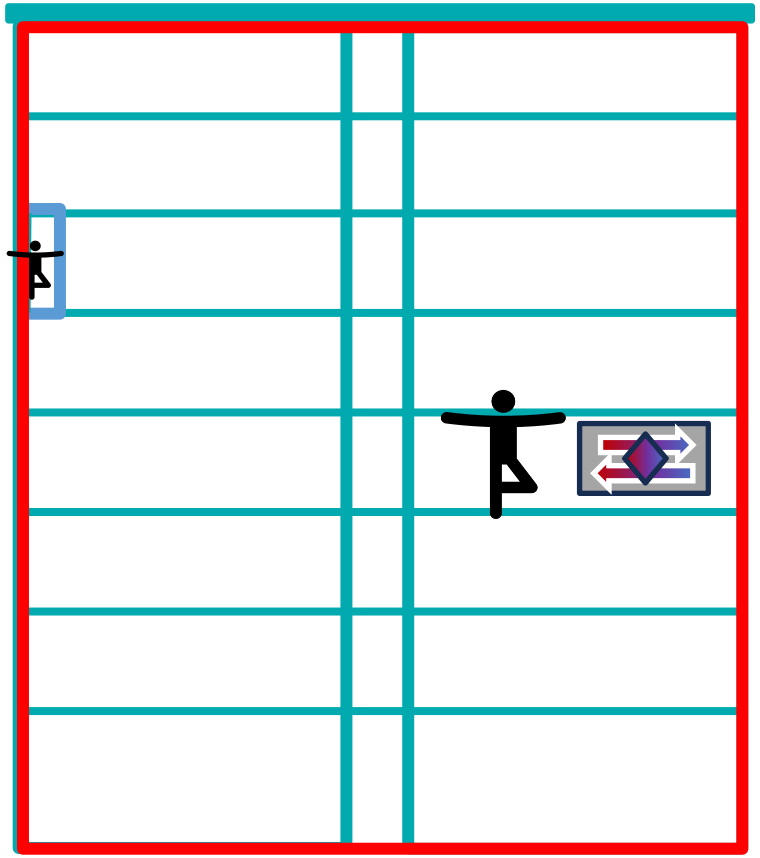
- Simplifies air sealing at exterior wall and internal floors/ceiling
- Makeup air is mostly isolated to the dryers
  - Reduces space conditioning needs for makeup air
- Improved comfort in space

CONS

- Doesn't benefit Phius energy model
- May still have to heat makeup air
- Relying on gasketing around machine to "false wall" to isolate the exhaust and makeup air

Exhaust Dryer Laundry Room Solutions

Option 1B: MOSTLY IN, WITH PLENUM



ONE SOLUTION

Air Sealing

- Gasket seal around equipment using "false wall", backs up to plenum
    - Equipment face accessible to laundry room
- Plenum is "compartmentalized"
- Maintain same continuous exterior airtight boundary

Makeup Air

- Mechanical damper – opens when dryers come on
- Plenum space maintains pressure balance
- Reduces mixing of makeup air with interior space, improves comfort and lowers energy use on heating/cooling system

Exhaust Dryer Laundry Room Solutions

Option 1: ALL IN → Other Considerations

Pooling / Ganging Combining Exhaust

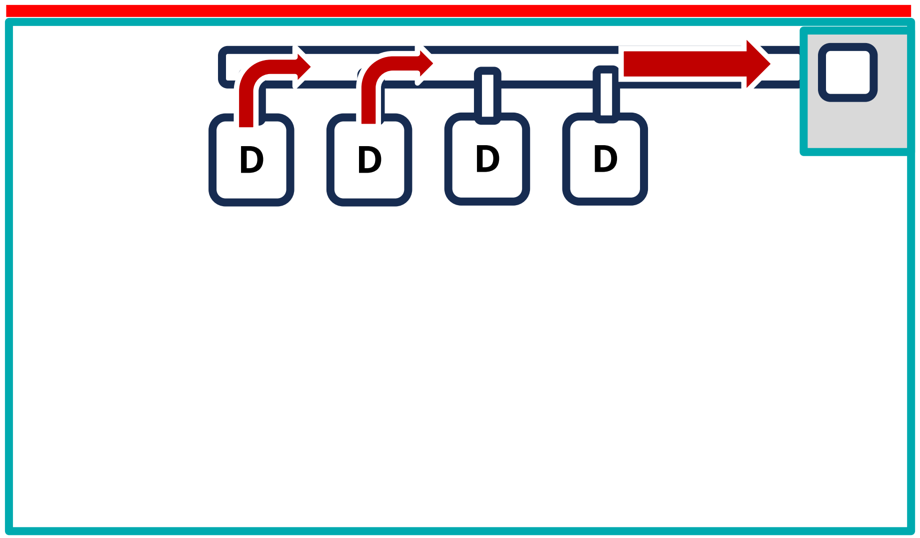
- Common in larger buildings

PROS

- Reduces number of envelope penetrations

CONS

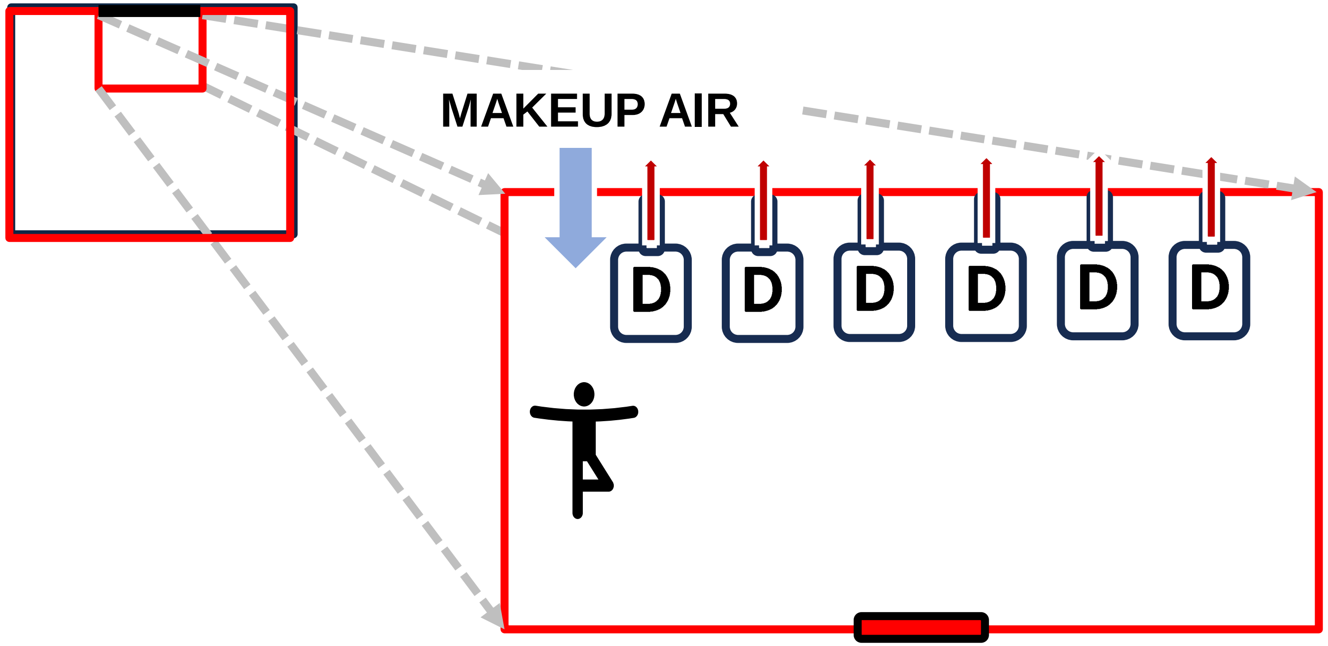
- Forces exhaust into commercial code reqs.
  - Exhaust fan must run continuously, no matter if dryers are on
  - Cannot use dampers



Exhaust Dryer Laundry Room Solutions

Option 2: ALL OUT

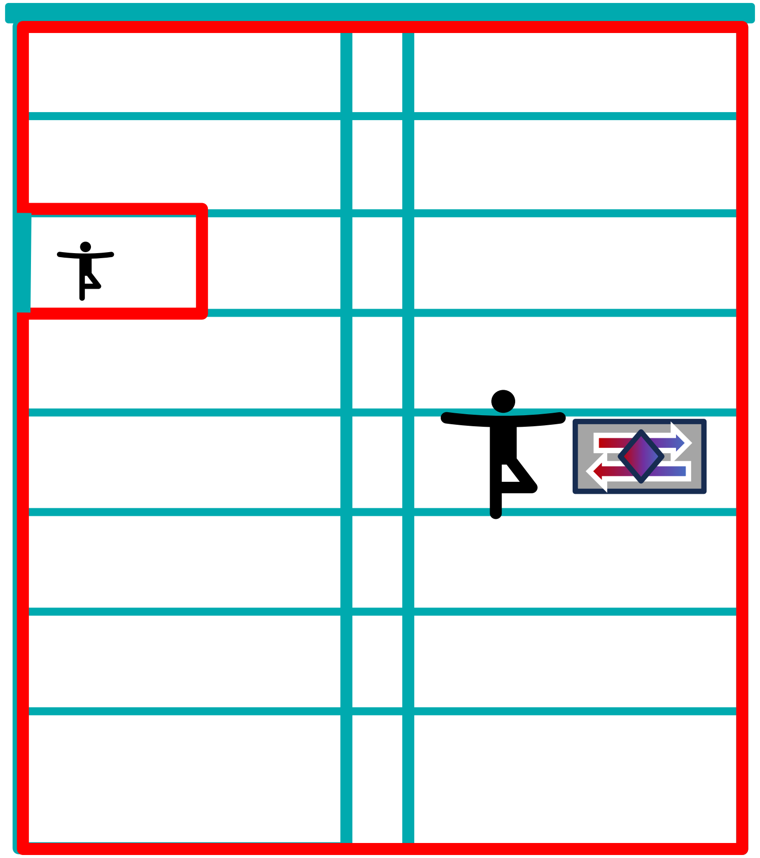
PROS
- Isolates thermal impact of dryer exhaust from rest of building
- Isolates dryer vent exhausts from airtightness testing
- Reduced internal gains from equipment



CONS
- Complicates air sealing details by including interior partitions
- Airtight door to laundry room required
  - Only effective if door remains closed
- Increases enclosure area for air leakage
  - 5 sides of cube vs. 1 “exposed”

Exhaust Dryer Laundry Room Solutions

Option 2: ALL OUT



ONE SOLUTION

Air Sealing

- Seal at laundry room enclosure
- Sealing 5 of 6 sides of cube now, instead of 1 (exterior wall)
- Airtight laundry room door required

Makeup Air

- Most likely required
- Maybe can just get away with a mechanized damper
- Has minimized thermal impact on the rest of the building
  - Pre-heat or temper based on outdoor temperature

Kitchen Exhaust in Multifamily Buildings

Kitchen Exhaust: General

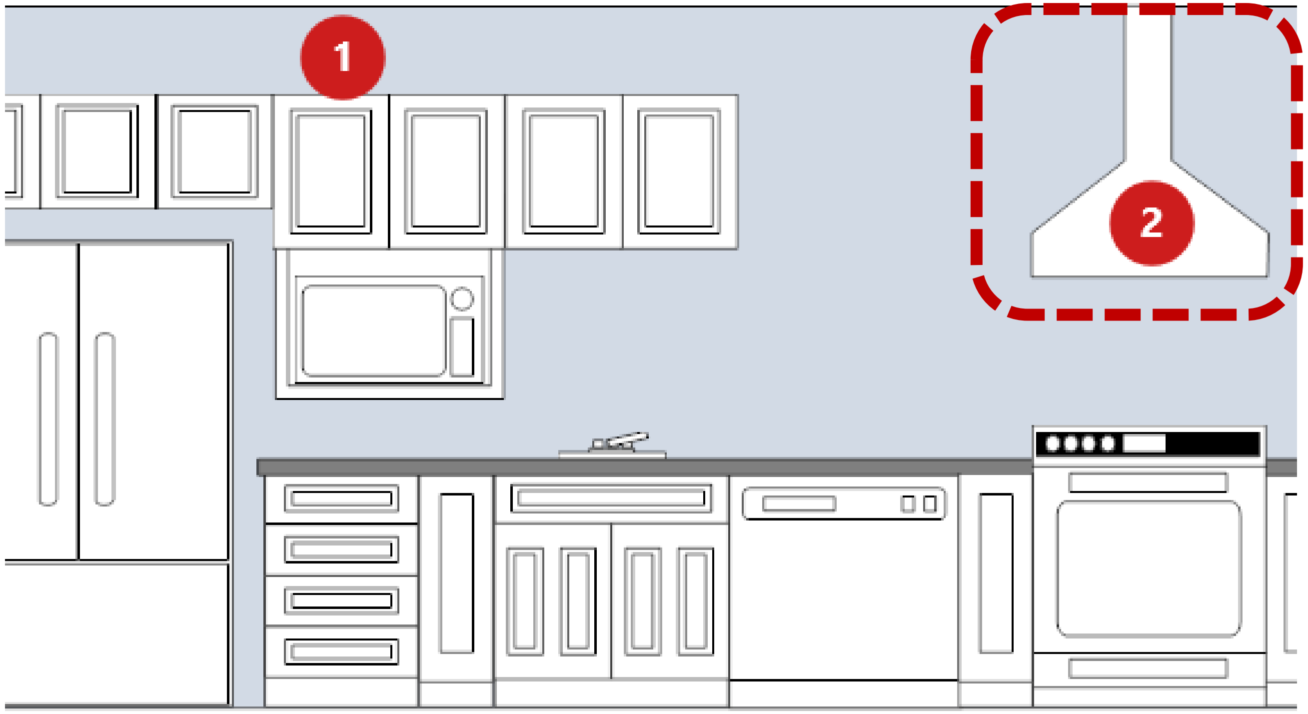
Two exhaust locations in kitchens

1 Continuous exhaust, greater than 6’ from cooktop

- Low flow (typically ~25-30 cfm in multifamily projects)
- *Note: Increased to 50 cfm for 2024 IMC*

2 Localized, intermittent exhaust above range hood

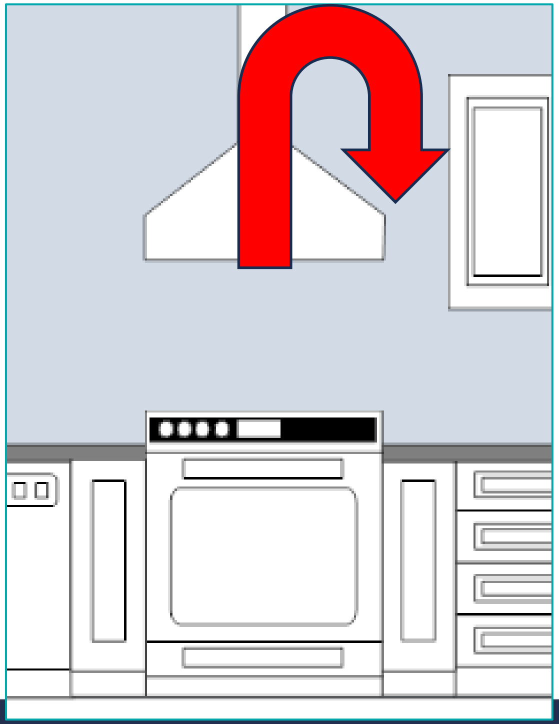
- Recirculation hood OR
- Direct exhaust hood



Kitchen Range Hood Options in MF

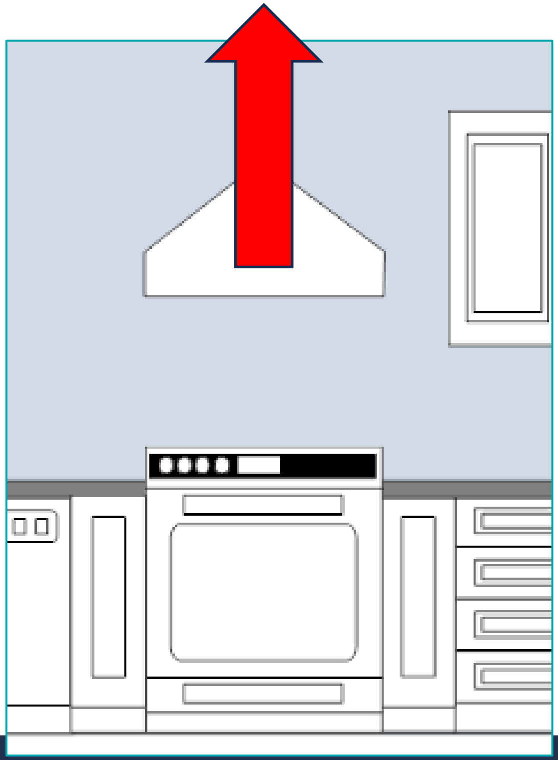
Recirculation Range Hoods

→Most commonly used in multifamily Phius projects



Direct Exhaust Range Hoods

→ Rarely used in multifamily Phius projects



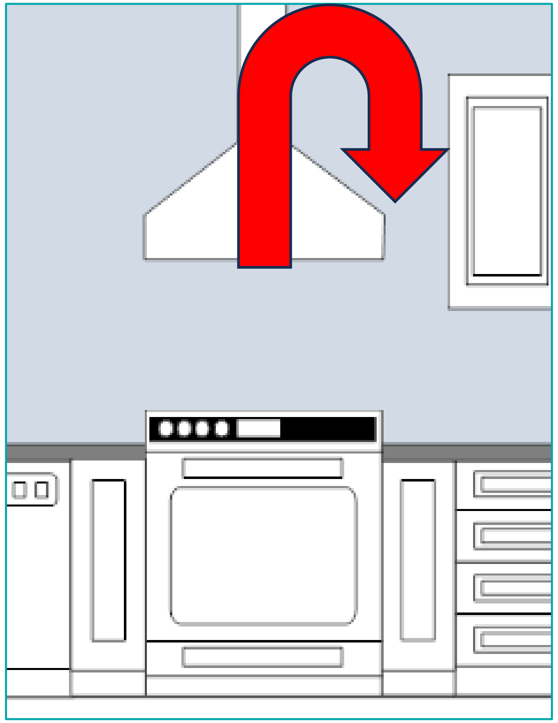
Recirculation Range hoods

PROS

- Simple design
- Effective at removing the large particulate matter *before* those enter the ERV
    - *(Note: For Phius, required to have MERV 3 or washable mesh filter for trapping grease on ERV inlet as well)*

CONS

- Not as effective as direct exhaust for indoor air quality



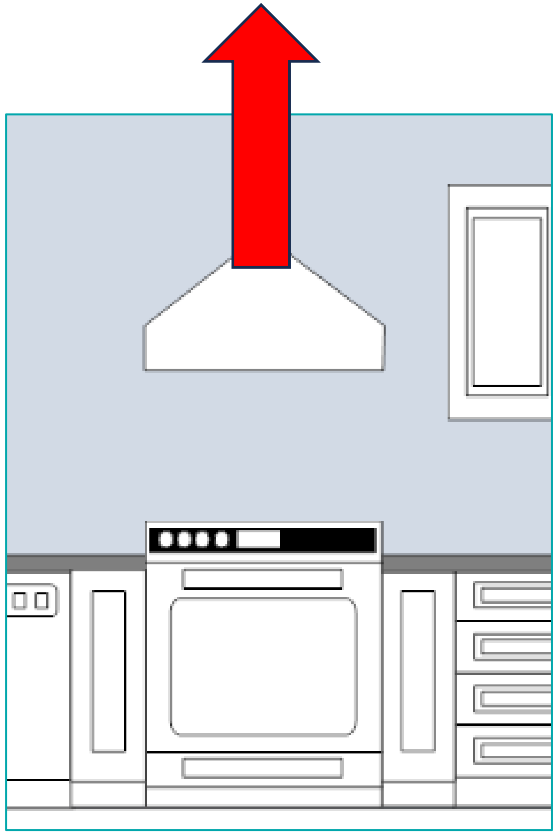
Direct Exhaust Range Hoods in MF

PROS

- Improved indoor air quality

CONS

- More ductwork
  - Kitchens usually far from exterior wall, long ducts out
- More enclosure penetrations
- Makeup air likely required
  - Energy penalty AND maybe another duct + enclosure penetration
  - Pre-condition air?



Direct Exhaust Range Hoods in MF

Makeup Air Options:

1. Over-supply to corridors
    1. How much?
    2. Keeps “whole building” in balance?
    3. Effective enough is with compartmentalized units ? Hall doors leaky?

2. If unitized ERVs, maybe boost mode tied to range hood operation
    1. BUT, depends on capacity of unit ERV → huge mis-match in airflows

Other Kitchen Exhaust Considerations

Actual Occupant Use of Range Hoods

→ Maybe a bigger step for IAQ is to tie these into the use of the cooktop?

EPA Indoor airPLUS v2 – Requires* direct exhaust in single family, duplex.

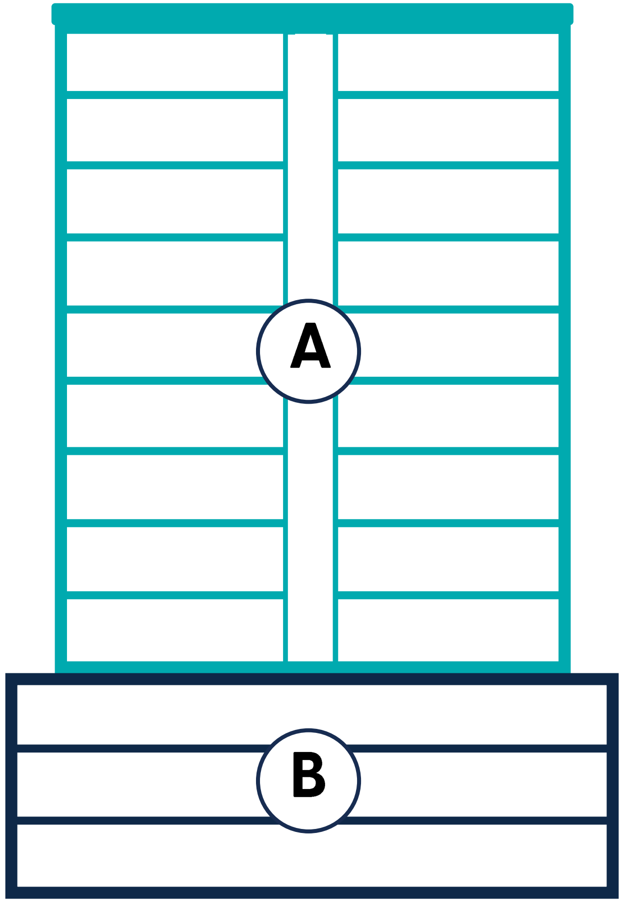
*Exception for electric cooktop in Multifamily Buildings

Podium Construction

Podium Construction

'Pedestal' or 'Platform'

- Categorized by a division between top and bottom
- Podium (A) usually constructed of steel or concrete

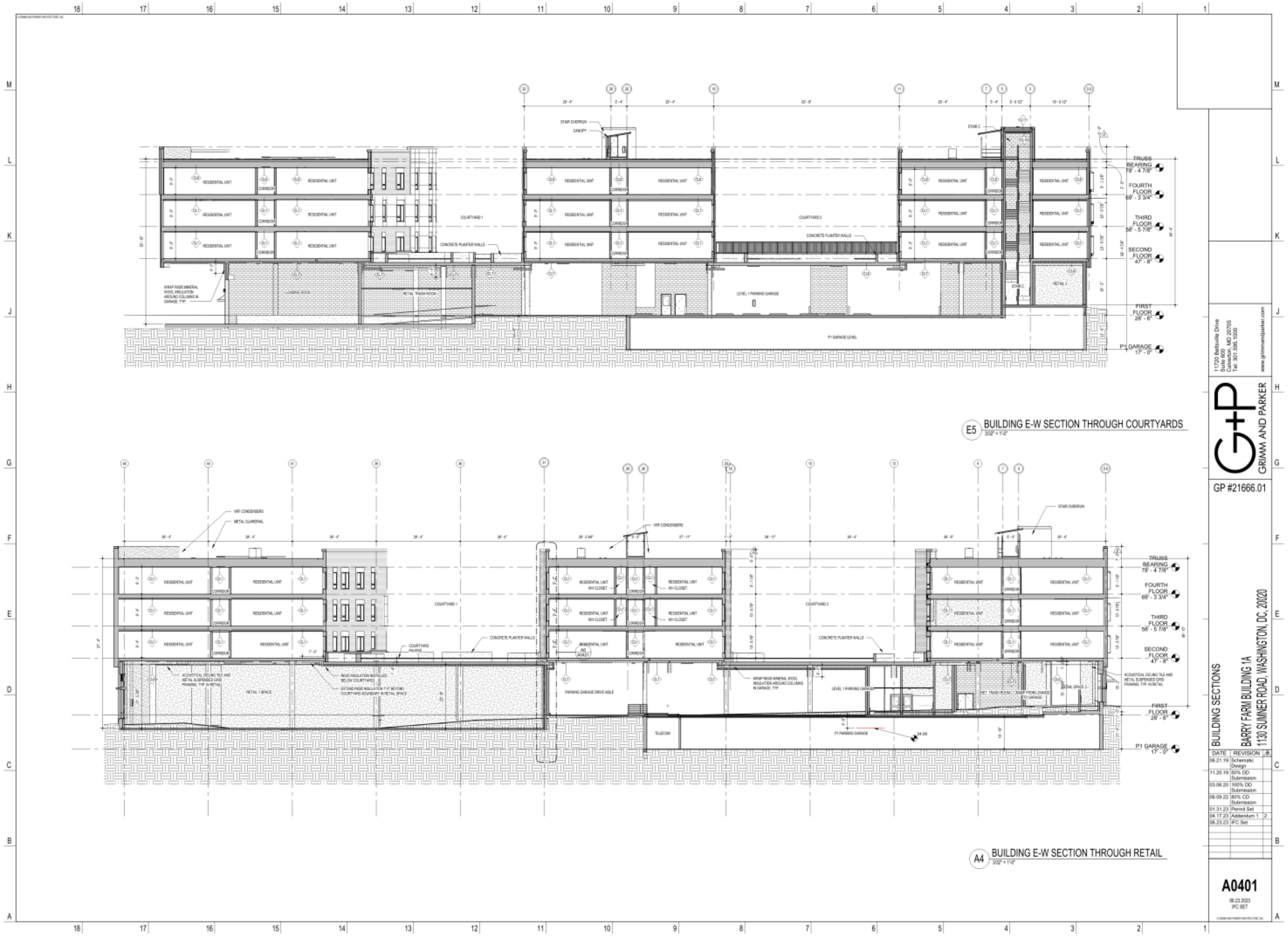


Podium Construction

The Problem:
Traditionally, most utilities are run on the underside of the podium, but that messes with the insulated box

The Solutions:

- Insulate on top
- Insulate below



Barry Farm 1a – Grimm and Parker / Passive to Positive

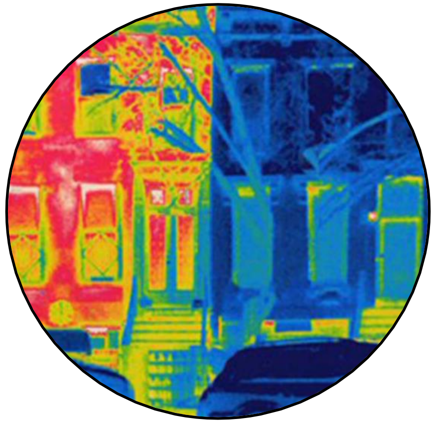
Podium Construction

Structure

Fireproofing

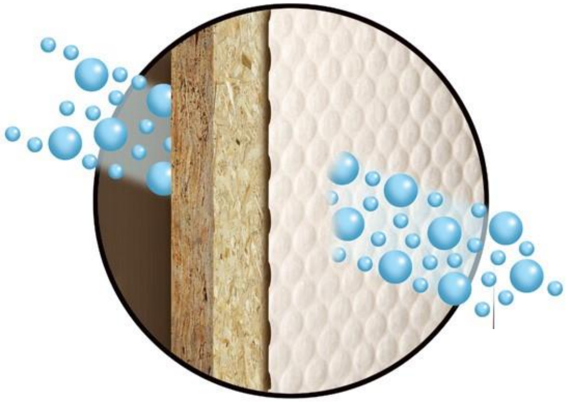
Plumbing

Electrical



Thermal control

Airtightness



Vapor Control

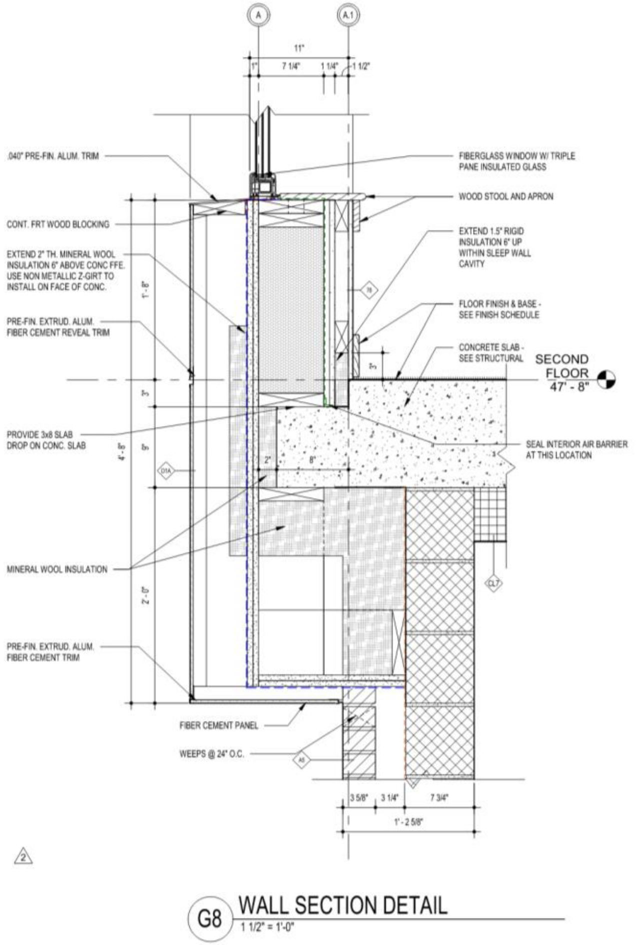
Podium Construction

It's all in the Details:

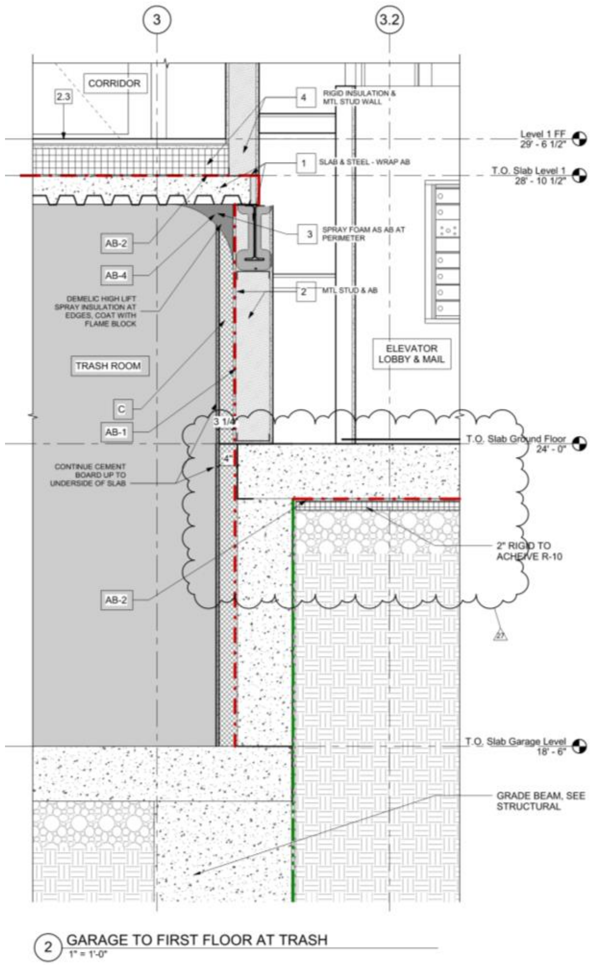
Either way is not perfect – pick your poison

Considerations:

- How to penetrate and seal
- How to deal with corrugated steel deck
- Utility access and maintenance
- Structural alignment (thermal bridging)
- Level of conditioning of adjacent spaces (condensation risk)



Barry Farm 1a – Grimm and Parker / Passive to Positive



Finch Cambridge – Icon Arch

Podium Construction

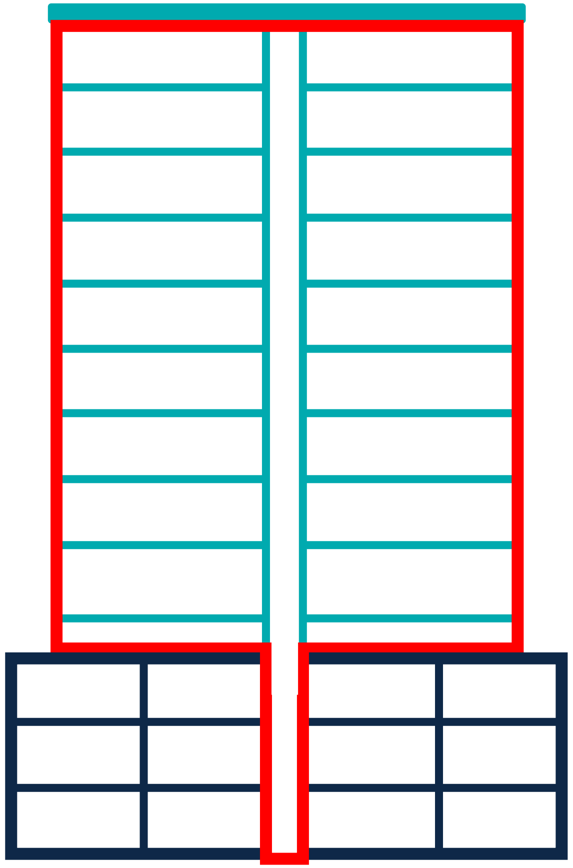
Option 1: Insulate on top

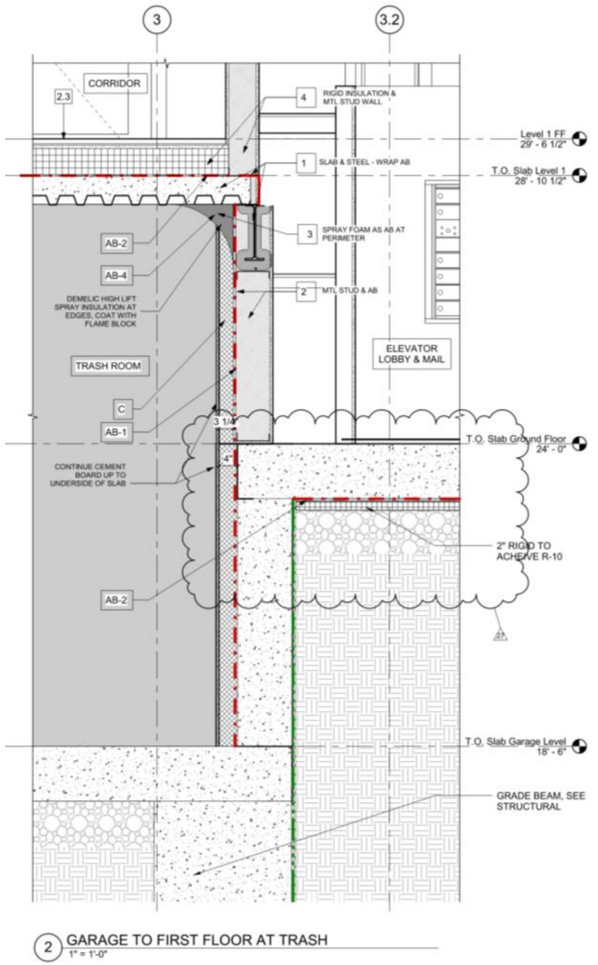
Pros:

- Simplifies air-sealing and thermal continuity
- Forgiving with thermal bridges

Cons:

- ‘Thickened’ floor on top of podium
    - Utilities not accessible from ceiling below (if present)
- Continuity at elevator and other continuous shafts





Finch Cambridge – Icon Arch

Podium Construction

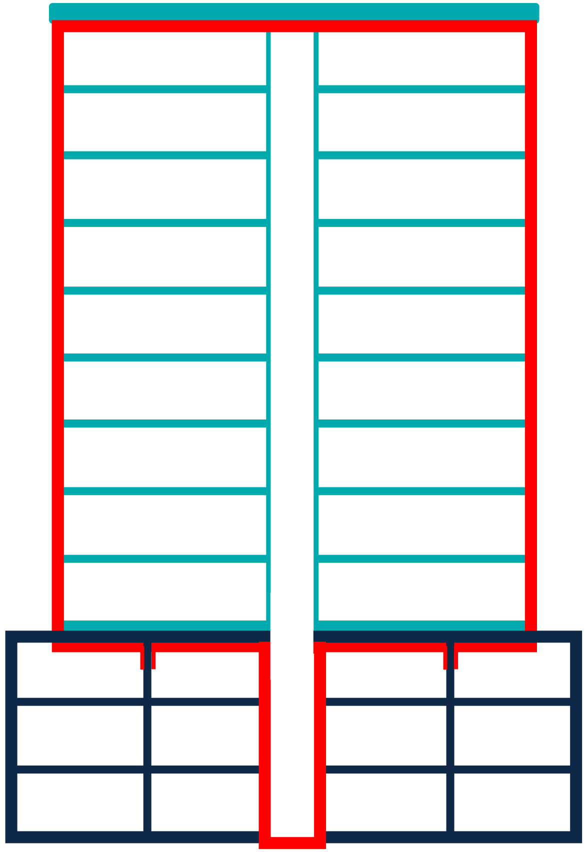
Option 2: Insulate below

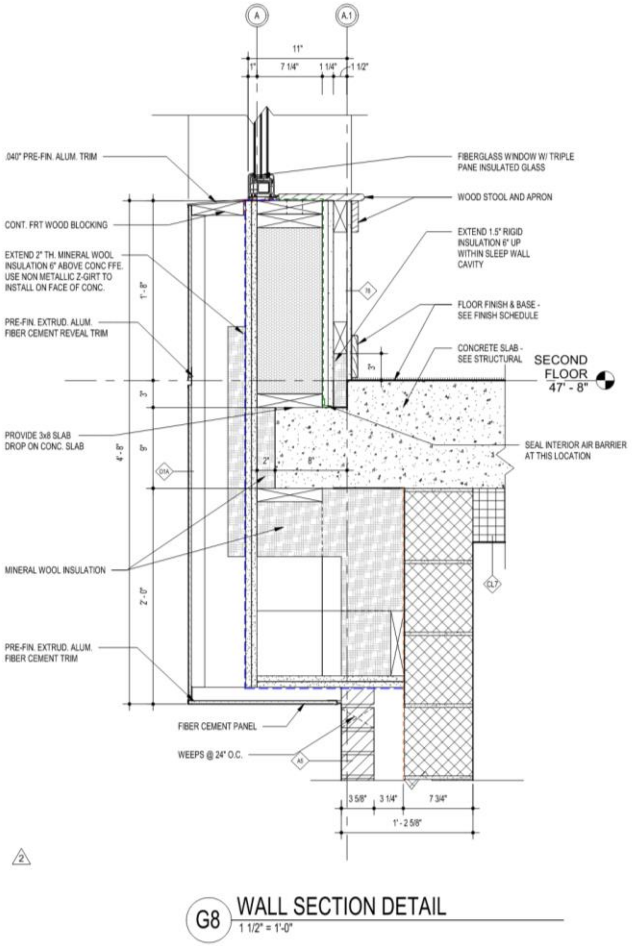
Pros:

- Limits additional building height
- Simple thermal continuity at structure and other vertical connections

Cons:

- Difficult air-sealing around steel deck
- Thermal bridging at continuous structural connections (ES requirements)

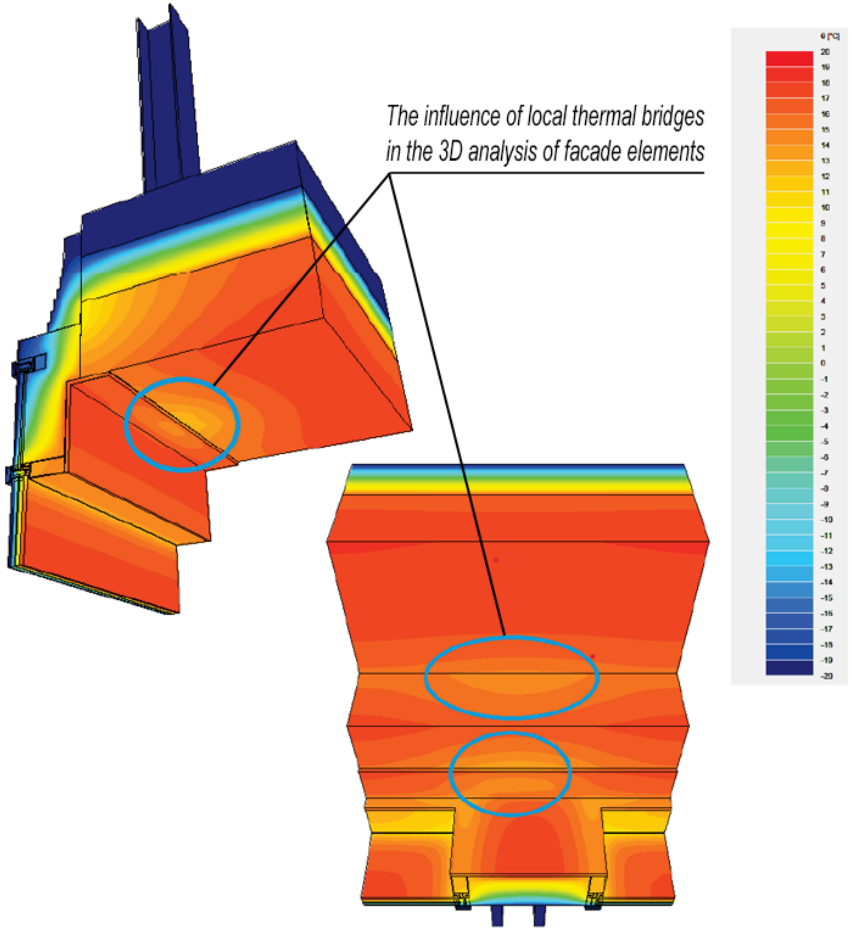


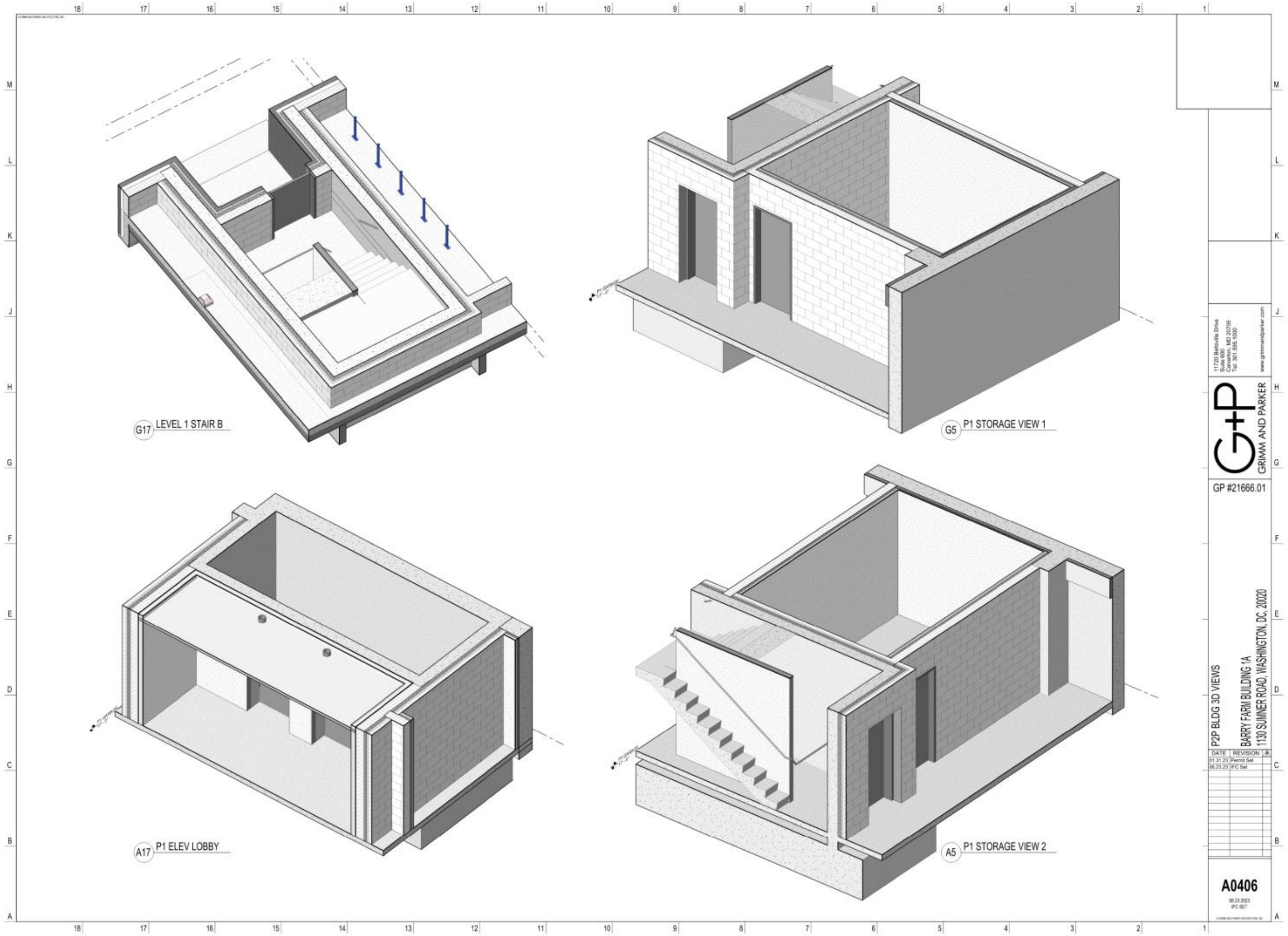


Barry Farm 1a – Grimm and Parker / Passive to Positive

Podium Construction

Design and plan in 3D





Barry Farm 1a – Grimm and Parker / Passive to Positive

Conclusion

Conclusion:

Early coordination between Architect, CPHC, Builder & Verifier to avoid pitfalls in construction

- Identify ways to simplify both design and testing protocols in early design phases
- Ensure everything can be effectively tested in the field
- Early compartmentalization planning
- Establish what is Inside / Outside Phius envelope
- Verifiers are responsible for all co-requisite programs, don't guess
- Clarify the difference between minimum certification requirements and the testing required to produce a high-quality building

CPHCs need to stick around after Design Cert.

- When things change during construction, verify design certification requirements are still satisfied
- CPHCs need to be in the field for continuous learning and improvement

Conclusion:

We'd like to pick your brain!

Other 'Tricky' Topics:

- Unitized ERVs and Impacts to envelope infiltration / WBBD testing
- Overheating and Central VRF sizing / zoning
- Package Terminal Heat Pumps (PTHPs)
- Construction sequencing and verification coordination
- Ventilation balancing for central systems
- Demand control ventilation
- Blower door test approaches for tall buildings
- 'Baked-in' default aux. loads, TBs and vent rates for MF buildings

Please see the sign-up sheet or reach out directly

Thanks!

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