



Construction Manager/  
Subcontractor/Tradesperson Training Session 2:  
**MEP – HVAC, PLUMBING, ELECTRICAL**

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Our services include:

- Energy Conservation and Management
- Sustainability Consulting
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# Upon Completion of Module

You will receive the following items via email:

- AIA Certificate of completion-can also be used for:
  - **NYS PE CEUs**
- PDF of final presentation
- Link to the webinar recording



## CERTIFICATE OF COMPLETION

THIS CERTIFICATE IS TO CERTIFY THAT

**Katie Zoppo**

PARTICIPATED IN

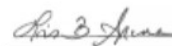
**Module 1: Overview of PH/Net Zero Building Concepts,  
Techniques and Benefits**

COURSE NUMBER  
**M10OPHNZBCTAB**

ON  
**February 11<sup>th</sup>, 2020**

LOCATION  
**New Paltz, NY**

EARNING  
**4 AIA CES Learning Unit/HSW**



Lois B. Arena, PE  
Director, Passive House Services  
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Steven Winter Associates, Inc.  
61 Washington Street  
Norwalk, CT 06854  
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# Learning Objectives

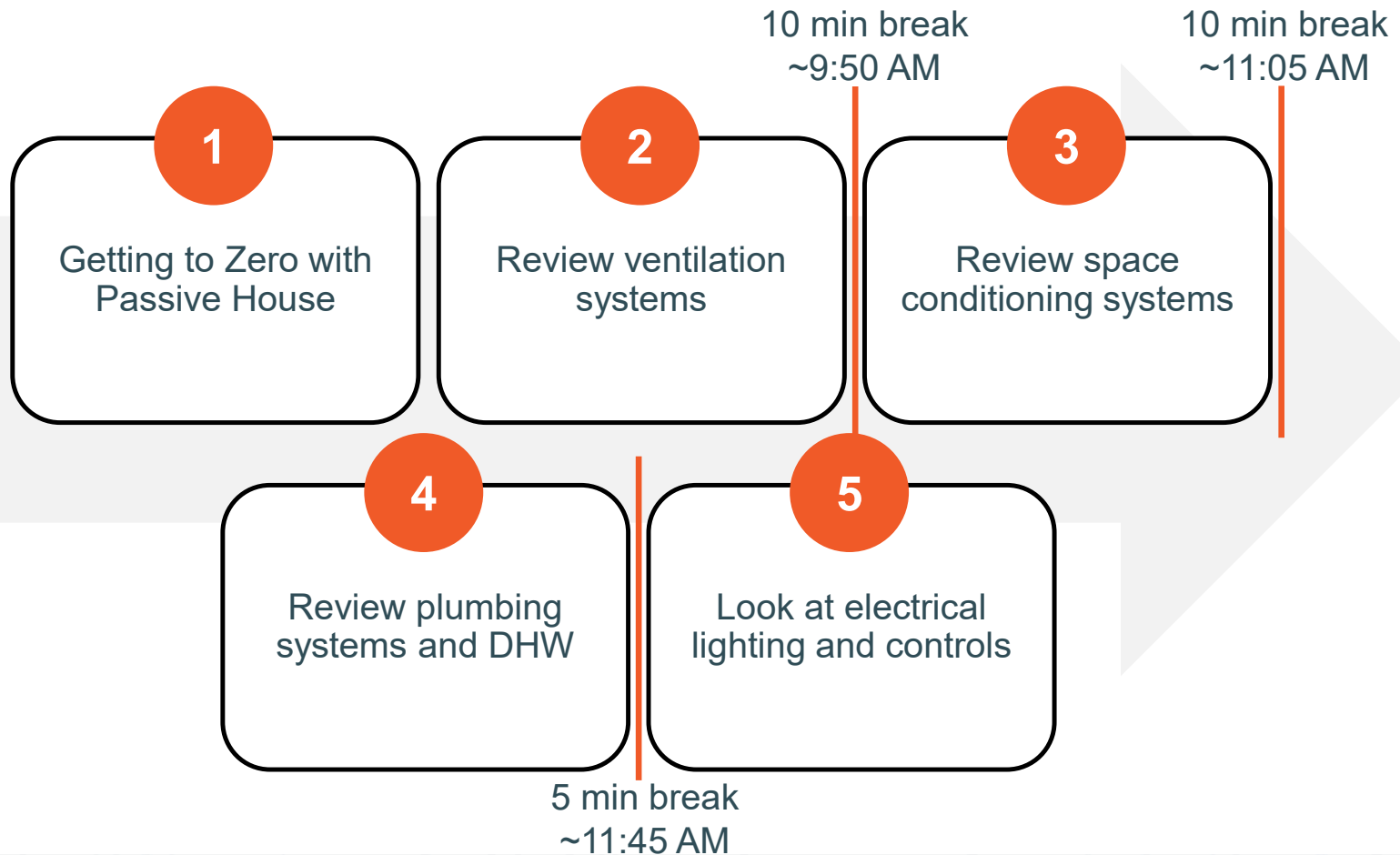
**Understand**  
net zero  
carbon  
goals for  
SUNY

**Discuss**  
ventilation  
system  
types and  
installations

**Review**  
plumbing  
layouts and  
insulation  
installs

**Examine**  
electrical  
lighting  
systems  
and controls

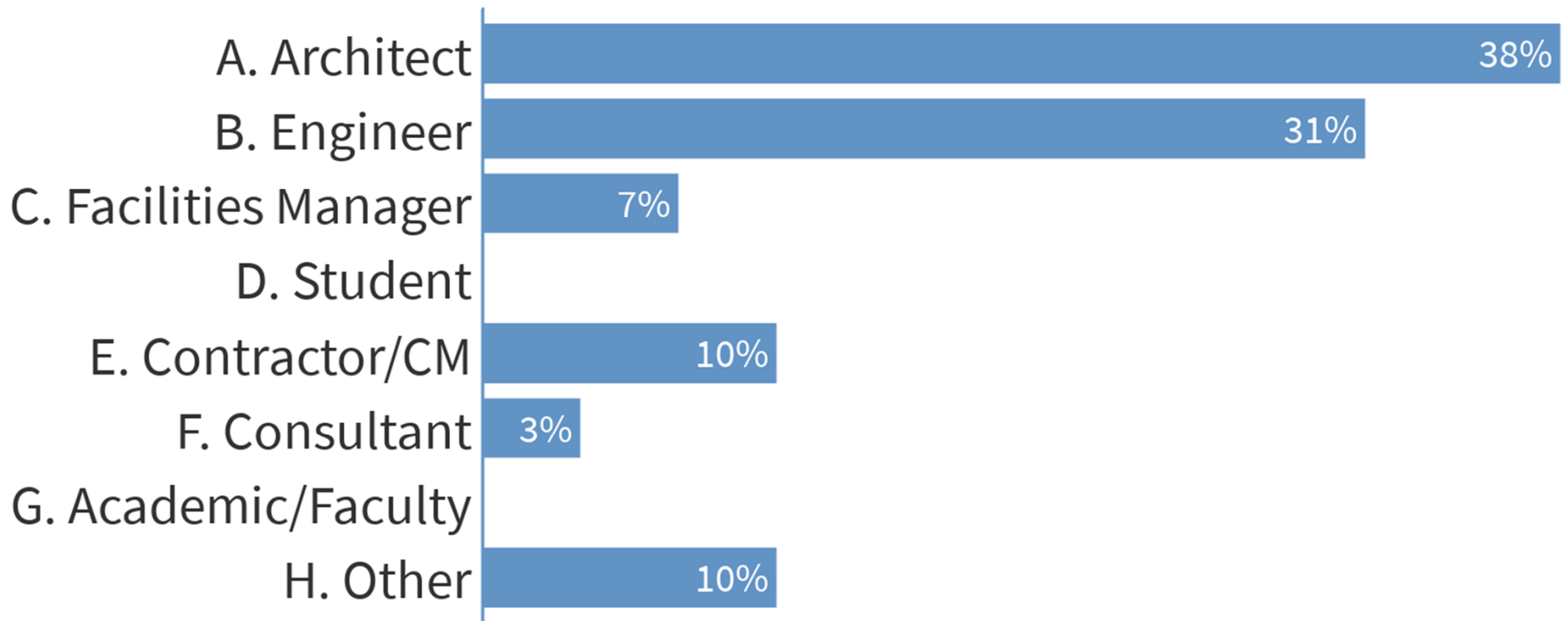
# Overview of Presentation



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## What is your profession?



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# What is the one thing you were hoping to learn about today?



*Coykendall Science Building*



## Why we are here: Directive 1B-2

- 2018 Chancellor calls for all new buildings to be zero-net-carbon & deep energy retrofits for existing buildings
- 2018 SUCF issued Directive 1B-2
  - Purpose: define and identify goals for Net Zero Carbon (NZC) new buildings and Deep Energy Retrofits (DER) of existing buildings.
  - Function: outlines the project target goals and provides direction for project designs.
  - Metrics: Site Energy as the measure of performance and energy consumption.

## Why we are here: Directive 1B-2

- Design and construct highly energy efficient buildings which **significantly reduce energy consumed** below an energy code standard for new buildings or energy usage for an existing building.
- In the case of insufficient project funding, the design goal will be to design the building as NZC “capable” where: the design achieves the energy use intensity **(EUI) limit using HVAC equipment** and systems that can be electrically powered from **renewable energy sources**.

### **New Building Performance goals:** Site Energy Use Intensity (EUI) limits

Classroom building	50 kBTU/ft <sup>2</sup> /year
Office building	50 kBTU/ft <sup>2</sup> /year
Laboratory building	150 kBTU/ft <sup>2</sup> /year
Residence Hall	32 kBTU/ft <sup>2</sup> /year

# These Trainings

- **Module 1:** Overview of PH and Net Zero
- **Module 2:** Construction Methods and High-Performance Products and Details
- **Module 3:** Air Barrier Development & Implementation
- **Module 4:** Net Zero HVAC Strategies and Controls + DHW
- **Module 5:** Construction Documents and Bidding
- **Module 6:** Deep Energy Retrofits
- **Module 7:** Refrigerant Management in Design, Construction, and Operations
- **Module 8.1:** Building Envelope
- **Module 8.2:** Net Zero Mechanical, Electrical, and Plumbing
- **Module 8.3:** QA/QC Techniques for Ensuring Success
- **Module 8.4:** Field Training & Mock-Up

# Clarifications

We may use Passive House and Net-Zero interchangeably

Passive House principles are a great pathway to achieving Net-Zero

# Getting to Zero with Passive House

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## What is Passive House (PH)?

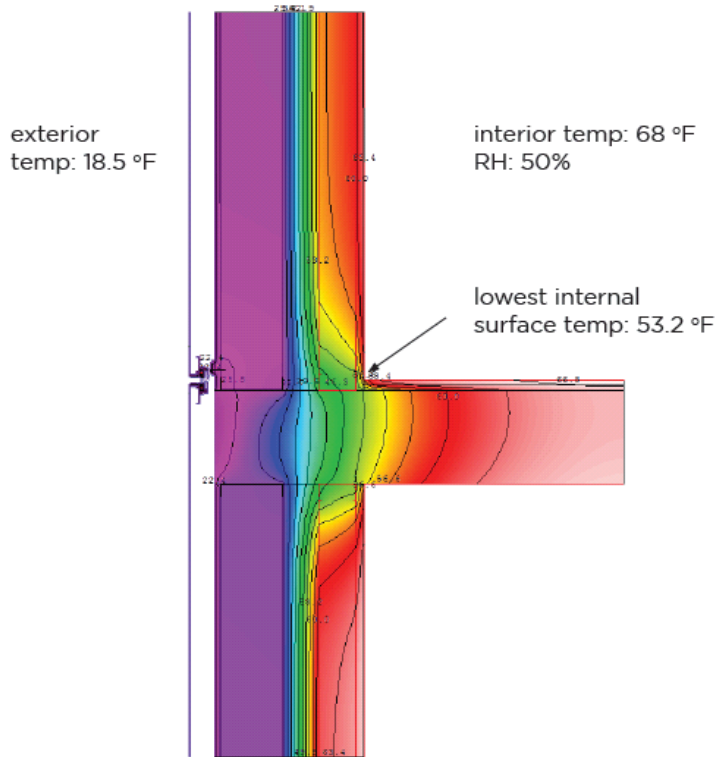
- PH is a building standard
- Applies to new & existing buildings
- The most rigorous energy efficiency certification available
- Performance-based approach
- Attention to insulation continuity and reduction of thermal bridges
- Emphasis on balanced ventilation

## Goals of PH

- Building durability
- Energy \$ reduction
- Optimal thermal comfort
- Superior indoor air quality
- Carbon emissions reductions



## Comfort Criteria

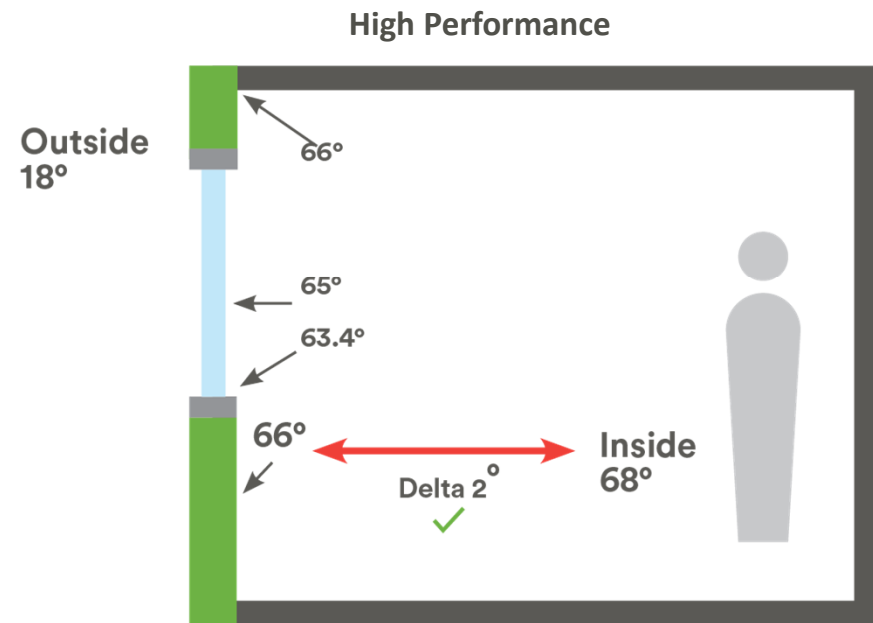
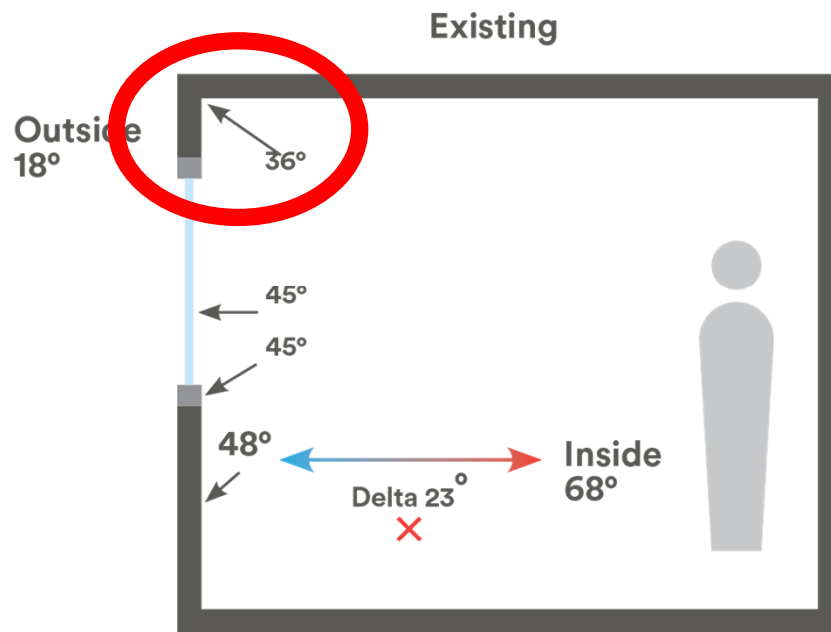


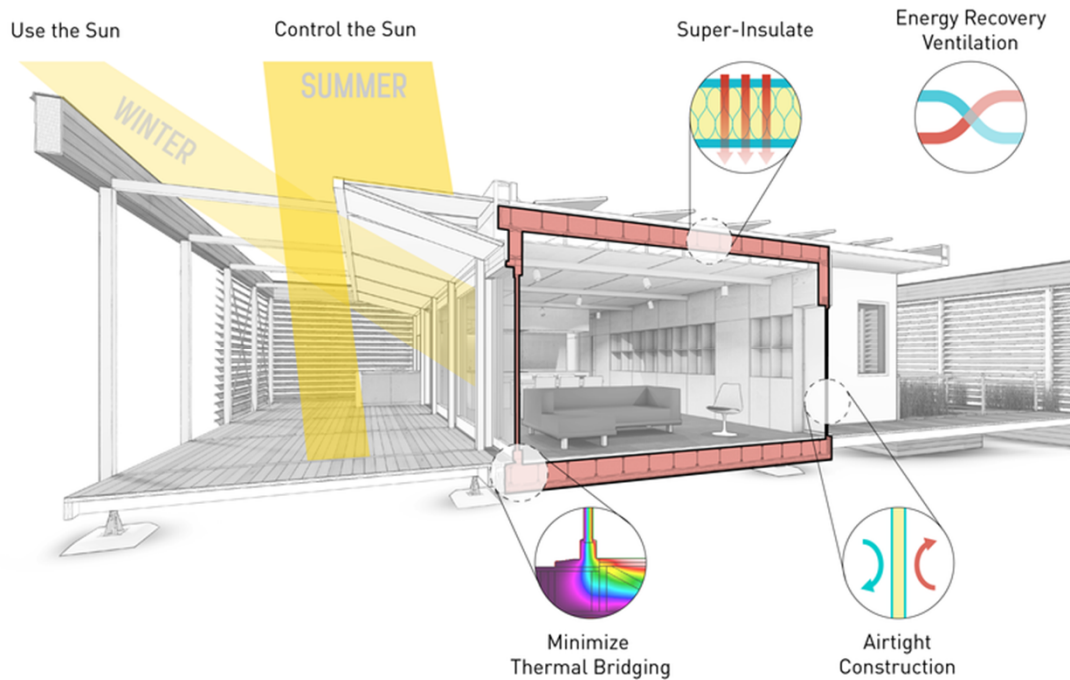
A-11 Option 2  
At risk for condensation

- Interior surface temperatures should not deviate by more than 7.6°F from the average operative temperature on the inside;
- the surface temperature must not be lower than 55.4°F or greater than 132°F at any point;
- the surface temperature of the floor must be between 66°F and 81°F.

# Comfort

## Thermal Comfort and Interior Temperatures





The SURE House

Winner of the 2015 D.O.E. Solar Decathlon

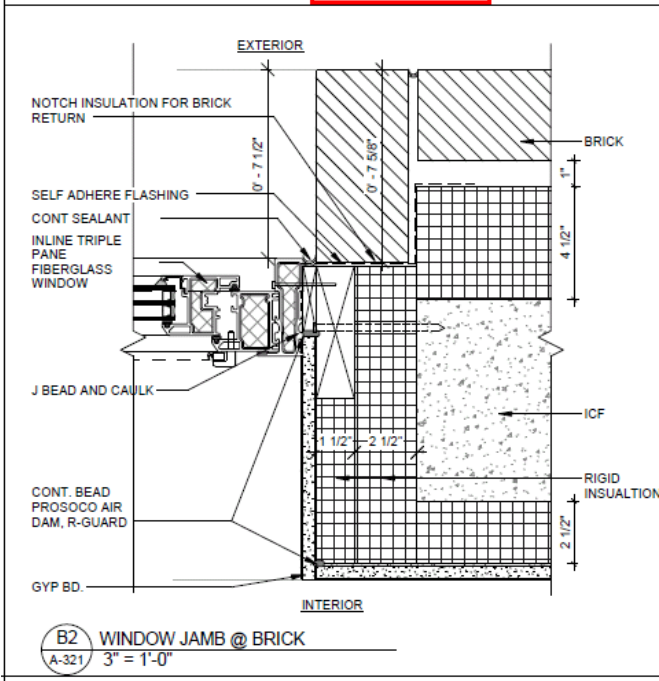
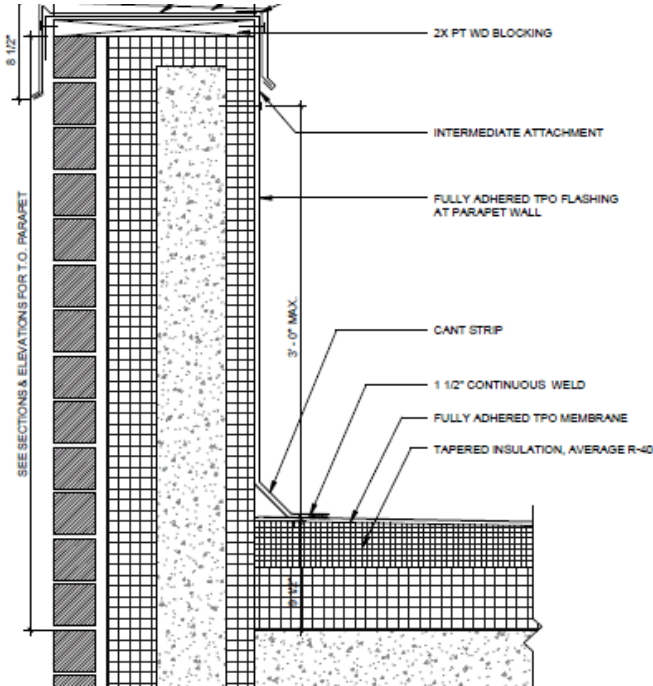
[www.surehouse.org](http://www.surehouse.org)

## Passive House Principals

- Thermal insulation continuity
- Thermal bridge free construction
- Solar control
- Airtightness
- Balanced mechanical ventilation



# Continuous Insulation



- Basic Components

- Gauge (manometer)

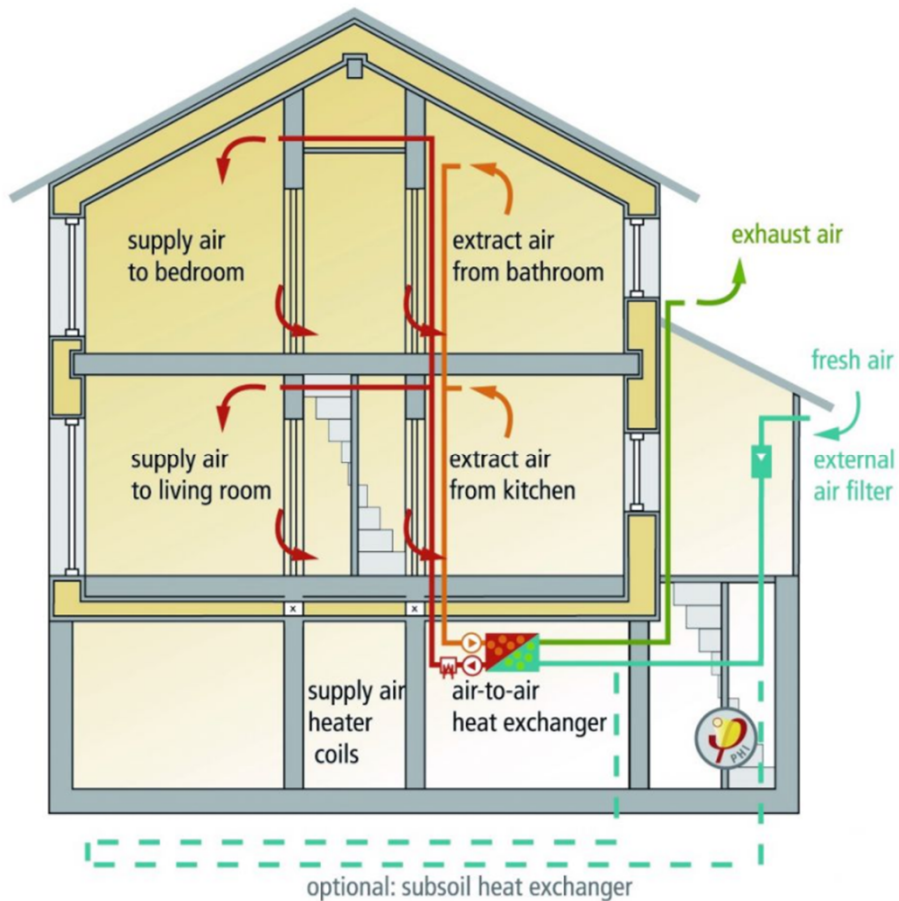
- Shroud

- Frame

- Fan

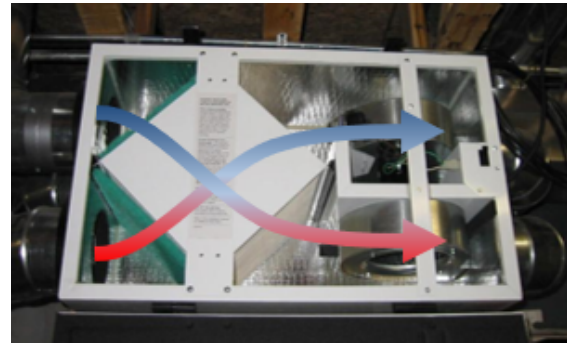


## Air-Tightness Blower Door Testing



## Balanced Ventilation and Heat/Energy Recovery

- Provide fresh, filtered air 24 hours a day
- Heat exchanger +75% Efficient
- Highly insulated and air-sealed ductwork



Questions?



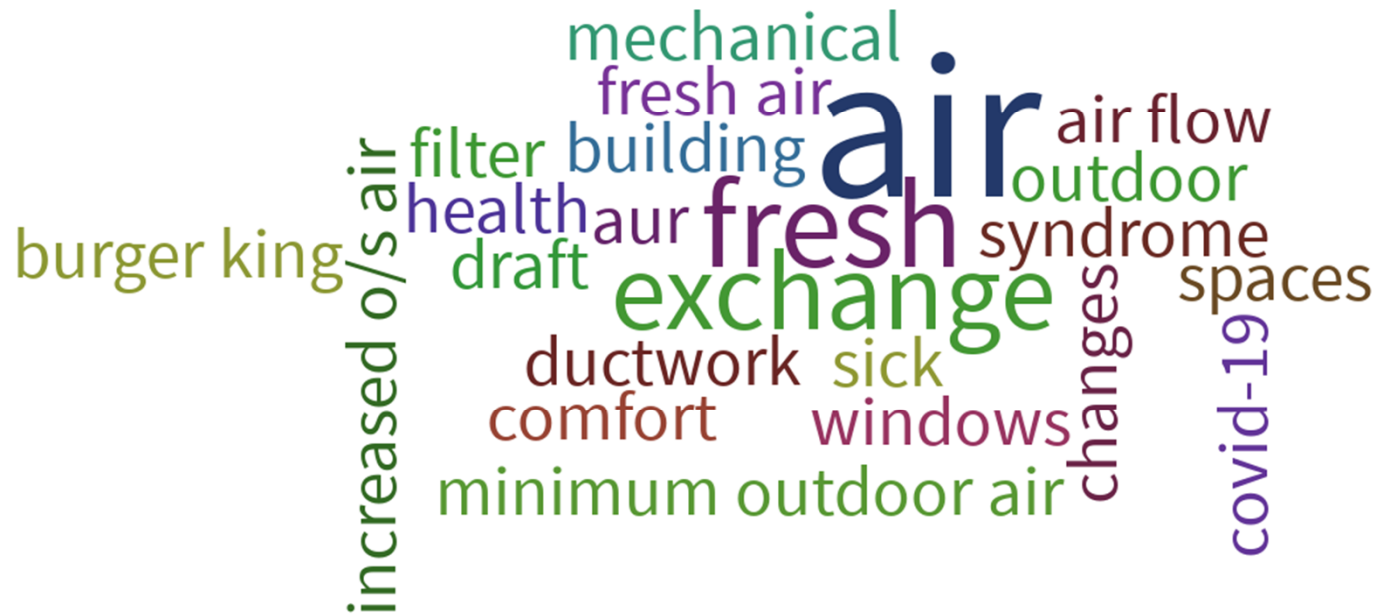
# Ventilation Systems

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# What do you think when you hear the word Ventilation?



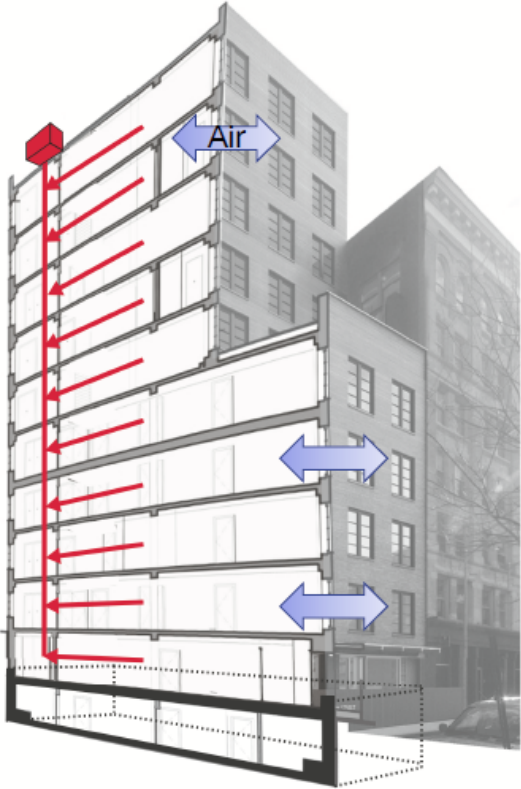
# Ventilation

- Ventilation is a critical component of a Passive House project
- Balanced ventilation vs. exhaust only systems
- Air quality (less carbon dioxide, filtered air)
- High performance buildings with PH airtightness need balanced ventilation

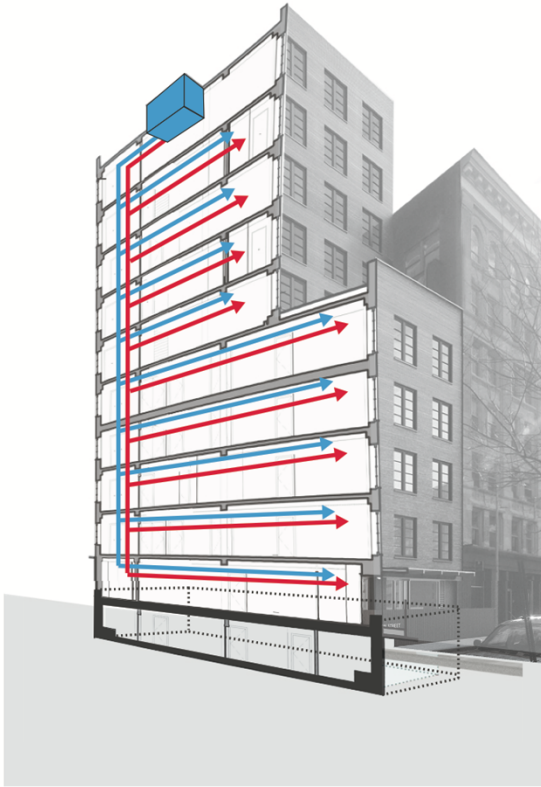
# Ventilation

- With continuous ventilation running costs are higher so you need high efficiency ERV's/HRV's
- Good design keeps in mind Indoor Air Quality
  - Filtered Air
  - Balanced Ventilation
  - Compartmentalization between units
  - Low VOC & healthy materials

# Exhaust Only Ventilation



# Ventilation – Balanced



- Central ERV

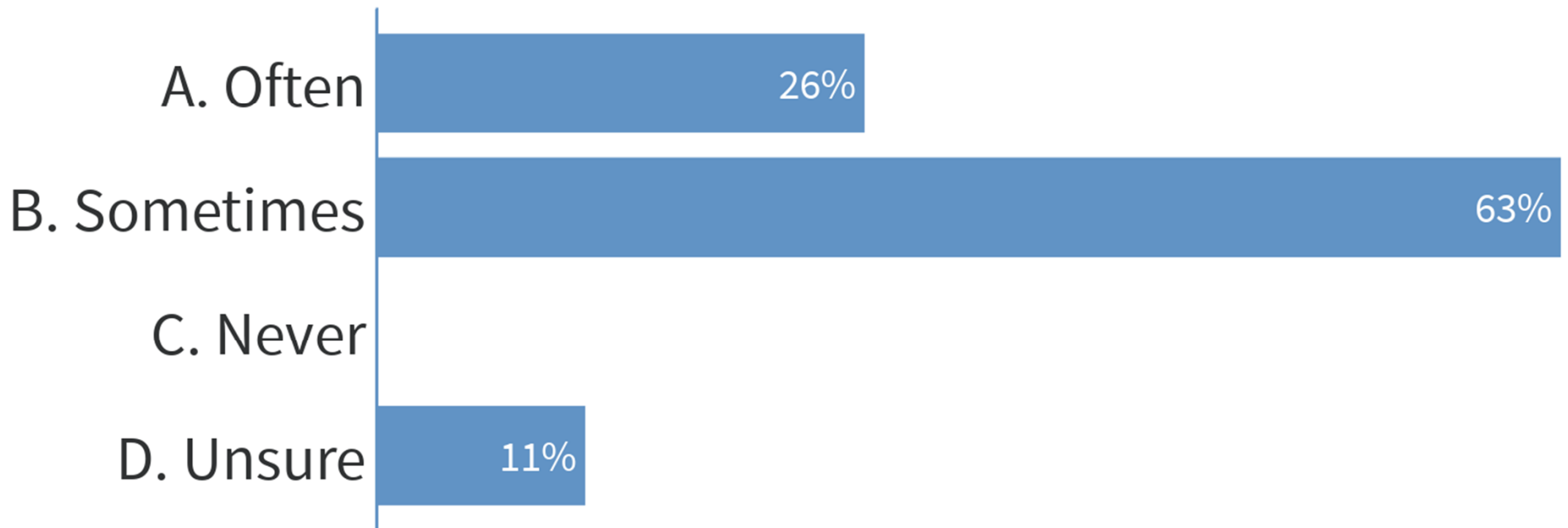


- Individual ERVs

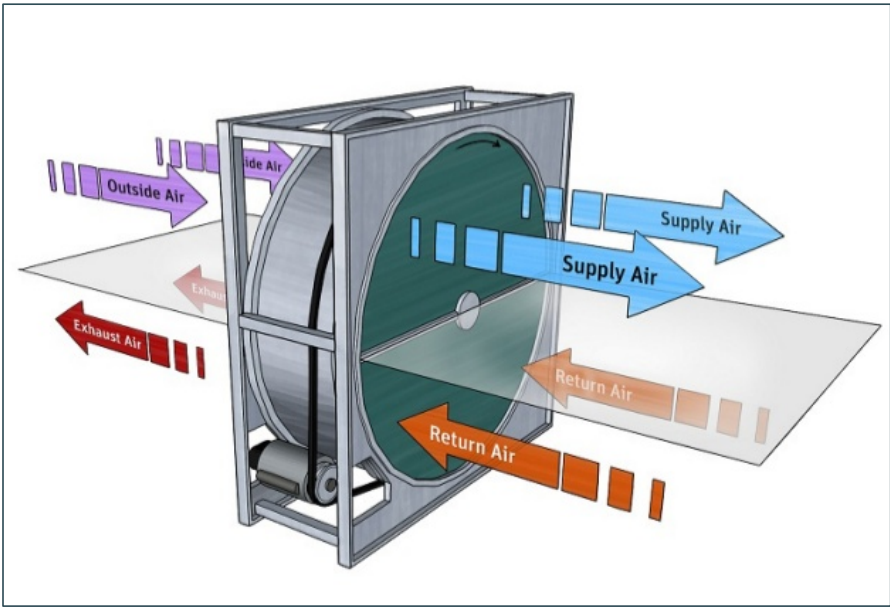
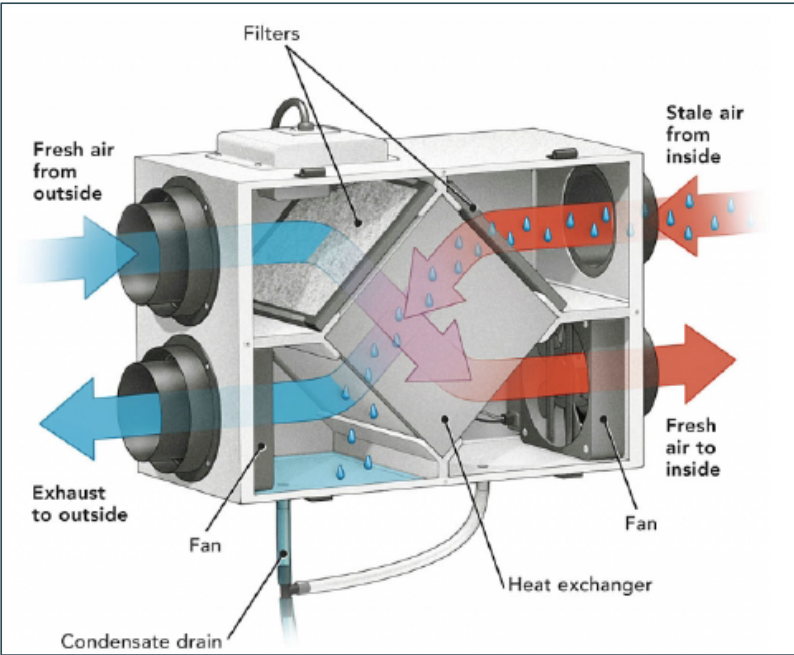
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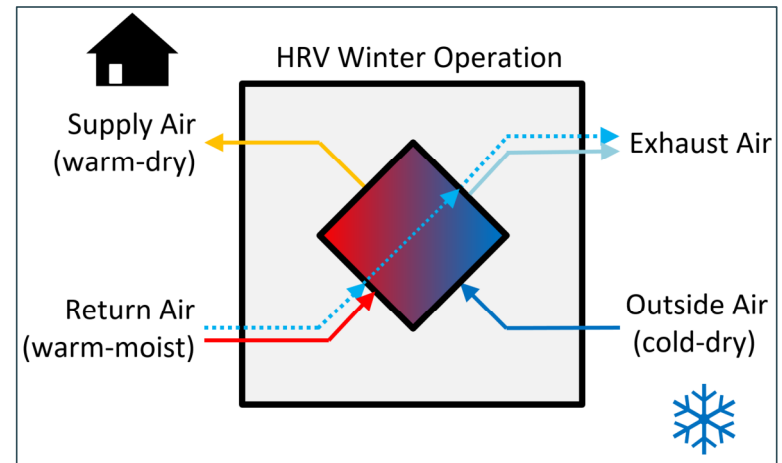
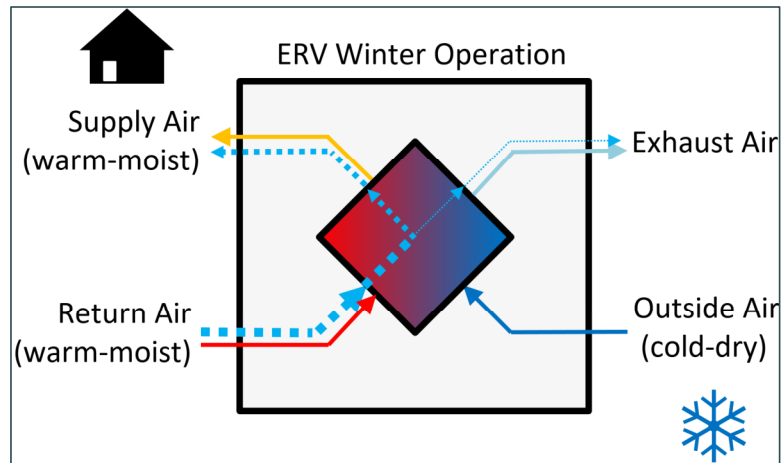
## How often do you see balanced ventilation systems on projects?



# Ventilation – ERV Diagram



# Ventilation – ERV vs HRV



Energy Recovery Ventilators (ERV) transfer heat and moisture from the return air stream to the outside air stream

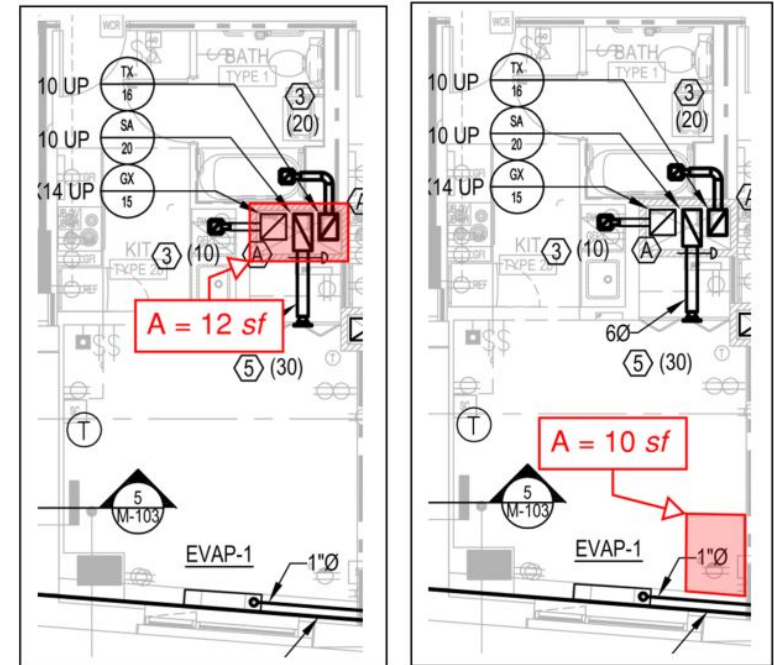
Heat Recovery Ventilators (HRV) that transfer heat from the return air stream to the outside air stream

# Ventilation

- Big Picture Design Questions
- Where do we locate it
  - Central vs. Unitized vs. Semi-Central
  - DX coil and pre-conditioning
  - Common area ventilation requirements
  - Potential ducting layouts



Central vs. Unitized: Wall penetrations from in-unit ERVs



Central vs. Unitized: Shaft area vs. in-unit closet area required

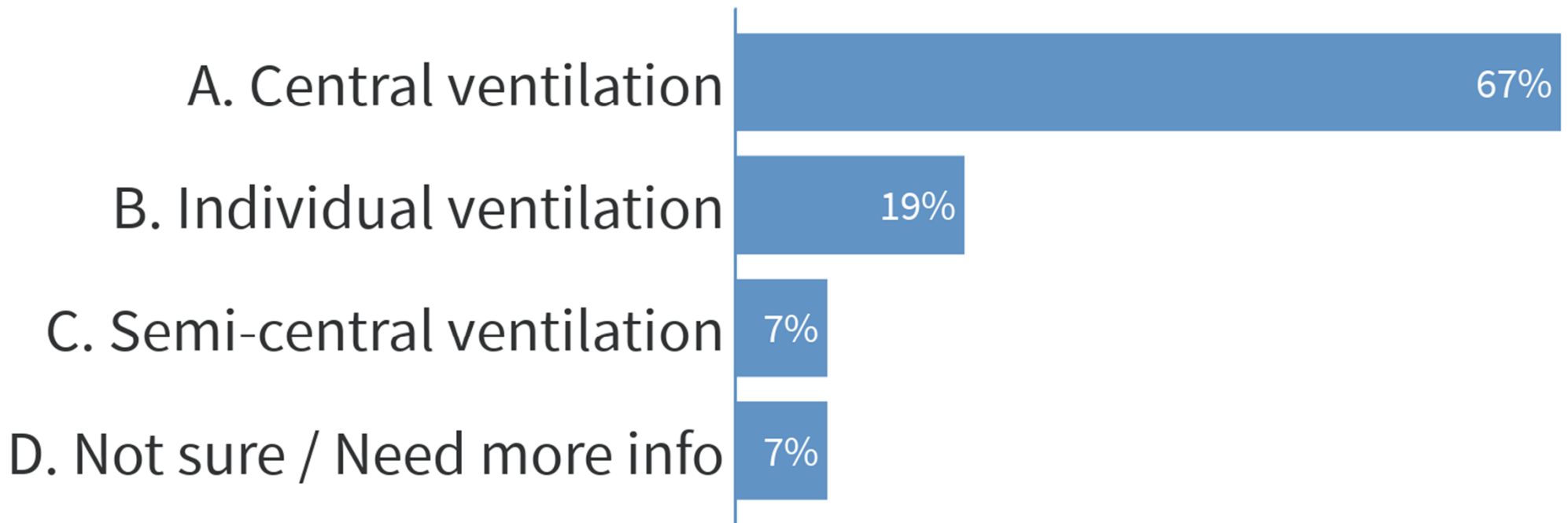
SWA Party Wall Blog Post:

<https://www.swinter.com/party-walls/multifamily-passive-house-ventilation-design-part-1-unitized-or-centralized-hrv-erv/>

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## What do you see as being the most appropriate option for your projects?

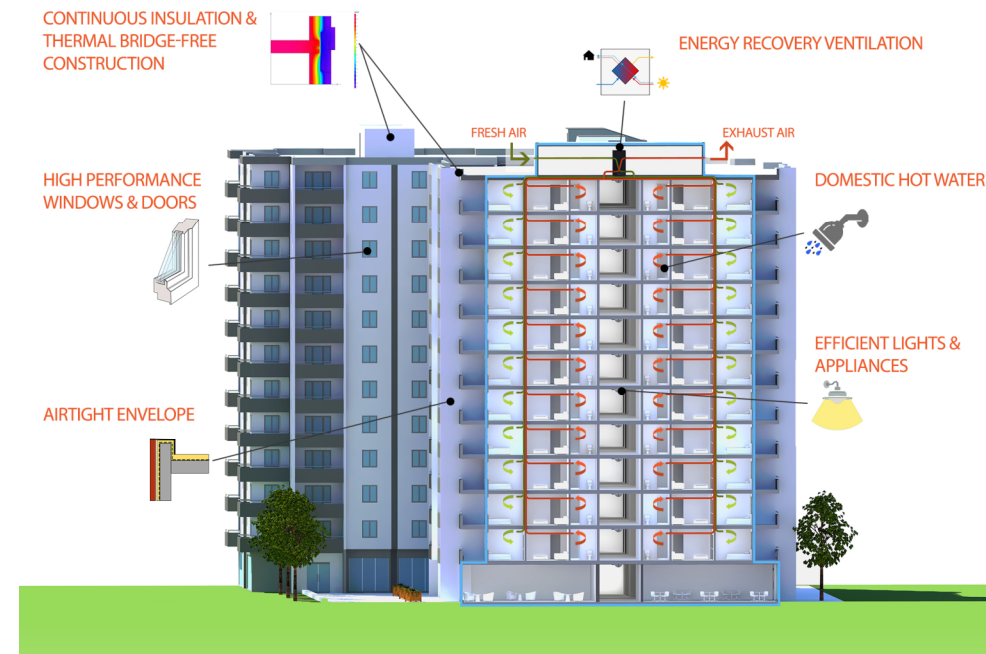


# Ventilation – Design Requirements and Recommendations

1. Balanced supply and exhaust within 10%
2. Supply to all living spaces
3. Exhaust from kitchens and bathrooms
4. Energy recovery > 75%
5. Supply > 62°F on winter design day

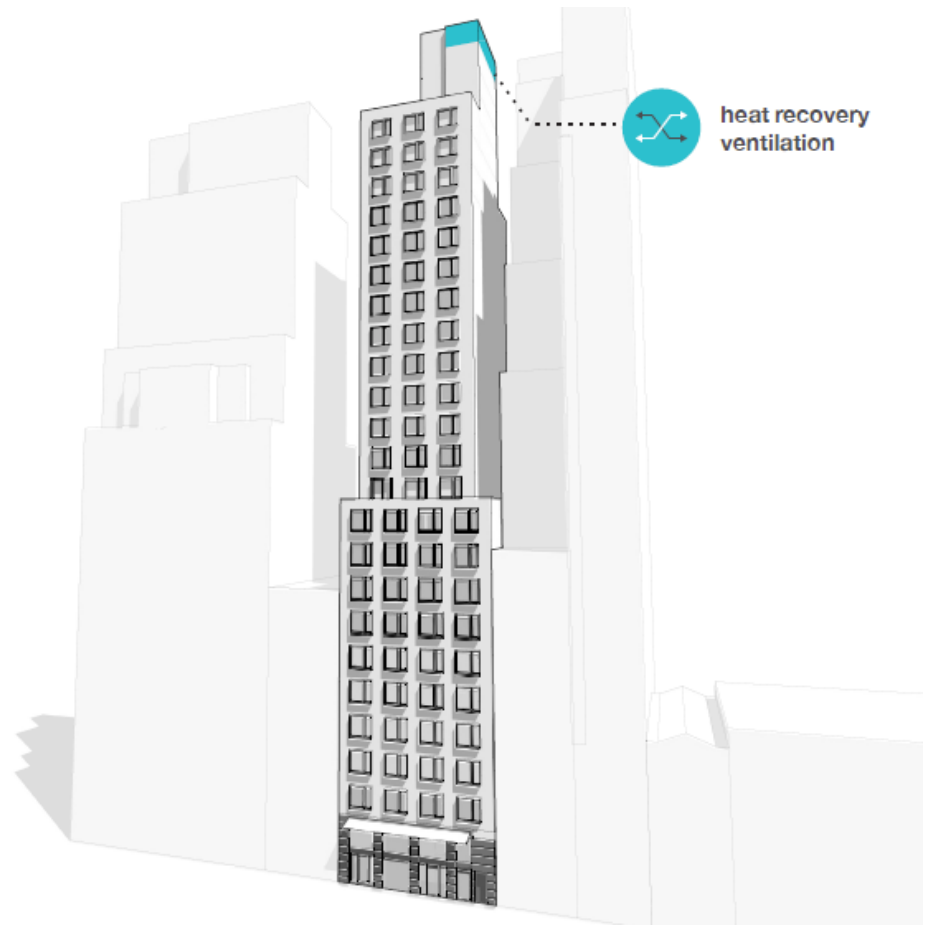
## Passive House Recommendations

1. PH certified unit NOT REQUIRED
2. Fan power efficiency: < 1.0 W/CFM total



# Ventilation (211)

- Central Ventilation
  - Rooftop central ventilation rather than individual unit allows easier maintenance and access
  - High efficiency PH certified unit

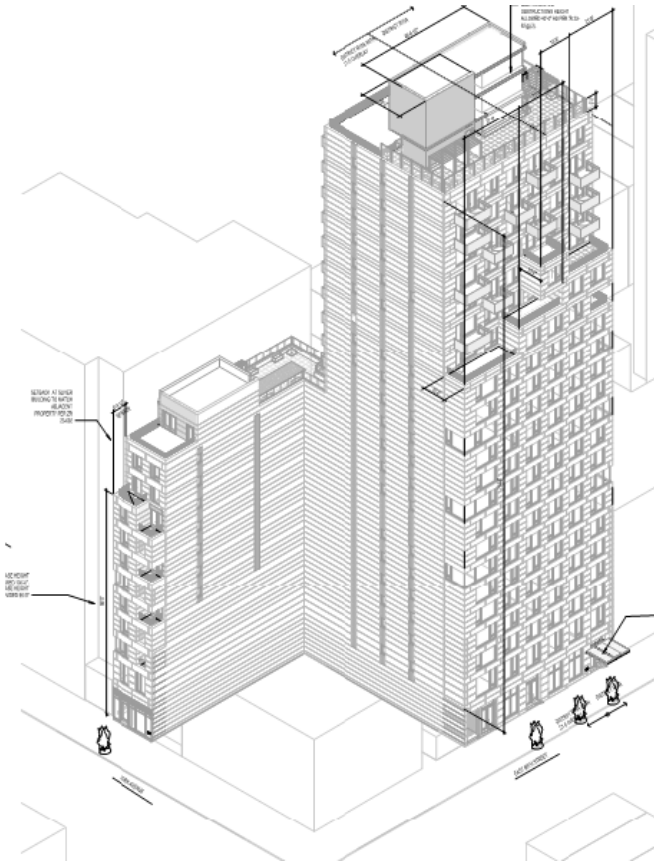


# Ventilation (211)

- Central Ventilation
  - Swegon Gold RX 35 on main roof serving apartment floors
  - Swegon Gold RX 5 on mechanical mezzanine serving retail, lobby and lower amenities
- Demand control ventilation (DCV) utilized in exercise space with CO2 sensors
- DX coil added to ERV supply to help with pre-conditioning and dehumidification

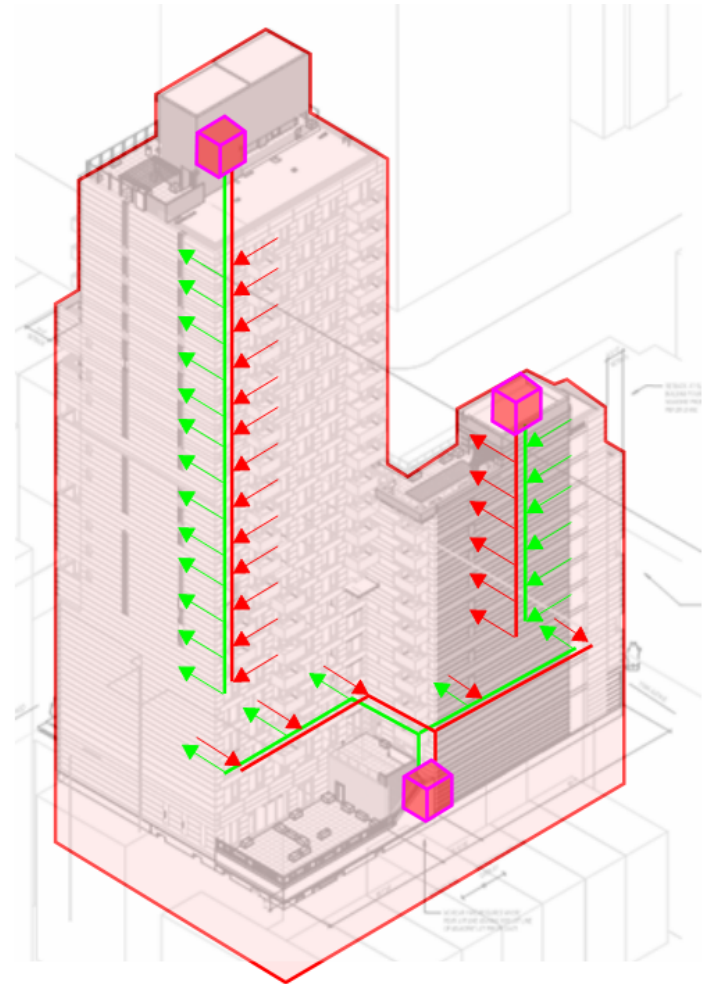


# Ventilation (511)



# Ventilation (511)

- Central Ventilation
  - Swegon Gold RX50 on main roof serving apartment spaces in main tower
  - 2x Ventacity VS1000 on roof of “sliver” building serving apartment spaces
  - Swegon Gold RX25 in cellar serving commercial space and lower amenities
  - DCV in main amenity spaces tied to occupancy sensors



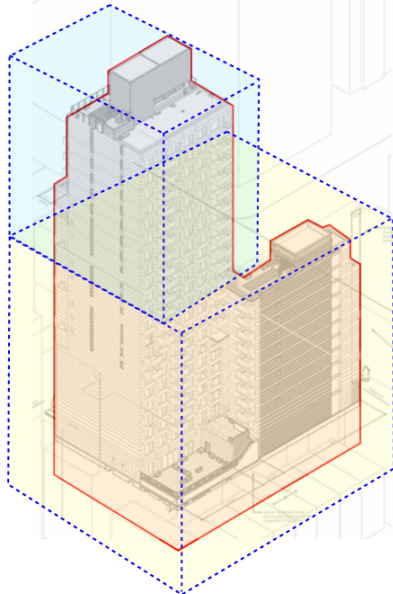
# Ventilation

511 East 86<sup>th</sup> Street

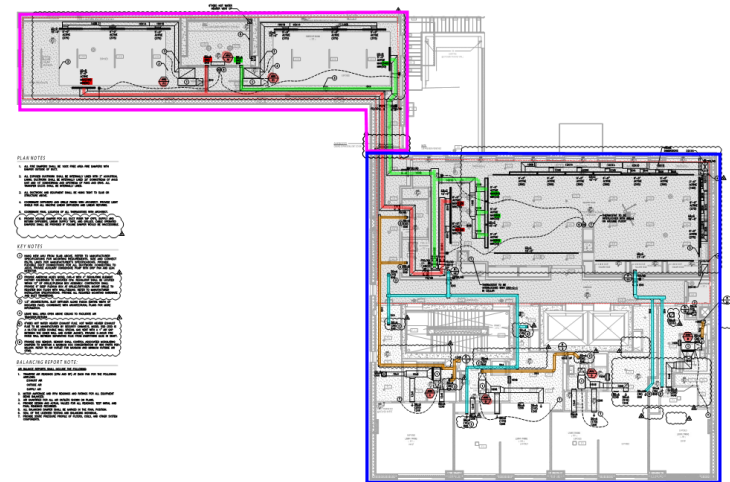
Obstacle 1: Building Form

Obstacle 2: Split TCO

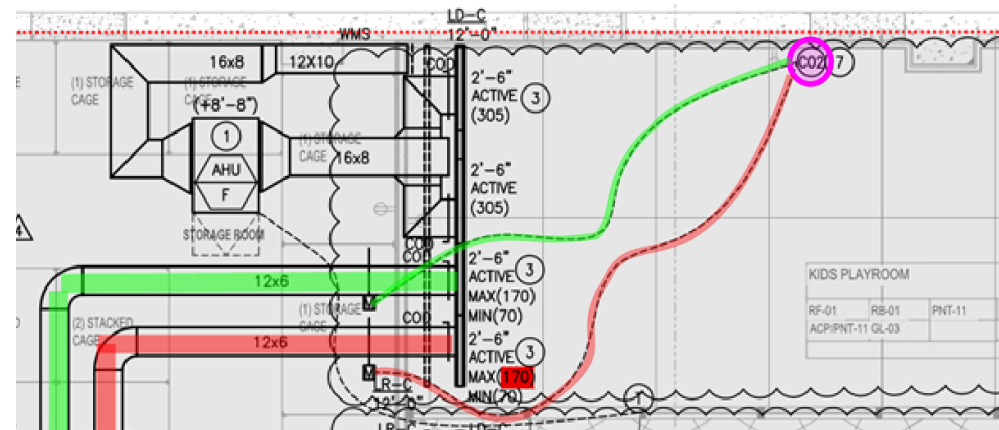
Obstacle 3: Cost of CO2 Sensors



**Obstacle 2:** Allowing one part of the building to be occupied while construction is still happening in another will make balancing the system almost impossible. This is not advised.

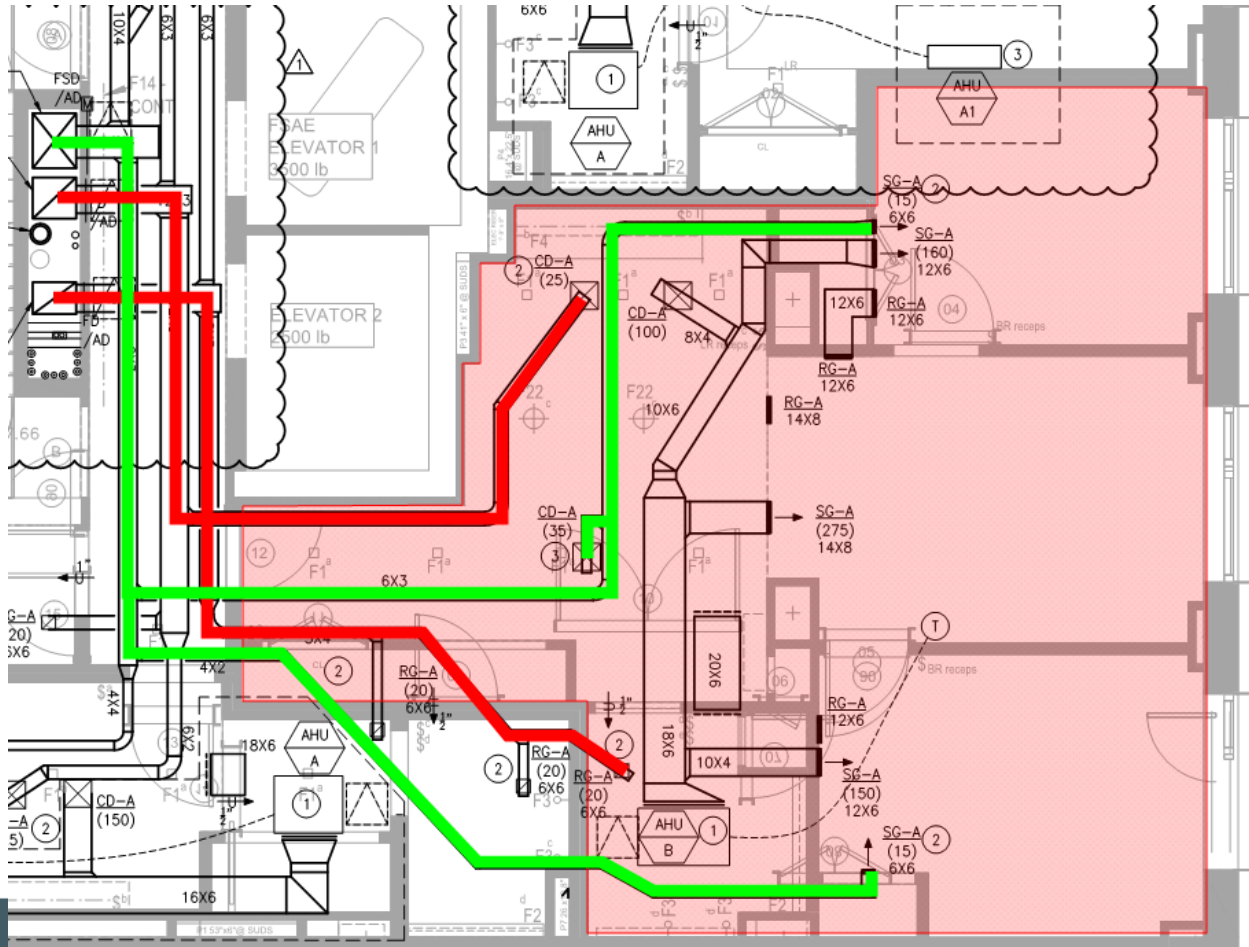


**Obstacle 1:** The building is two large masses connected by a thin corridor. This results in long duct lengths on some floors and separation of systems on others.



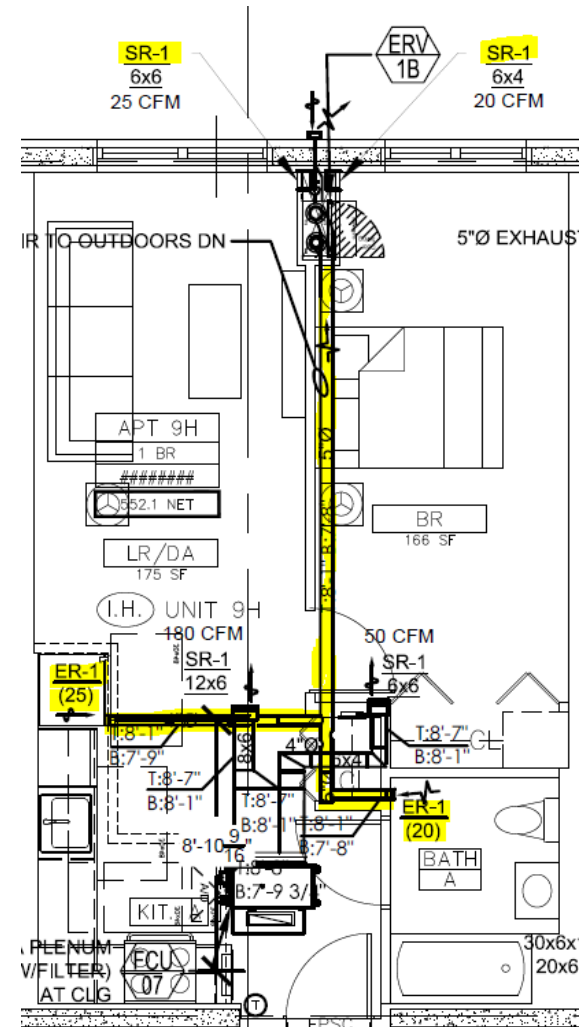
**Obstacle 3:** The cost of integrating CO2 sensors and the required controls can be significant. Consider using simple occupancy sensors when granular control is not needed.

# Ventilation Ducting Layouts Central System



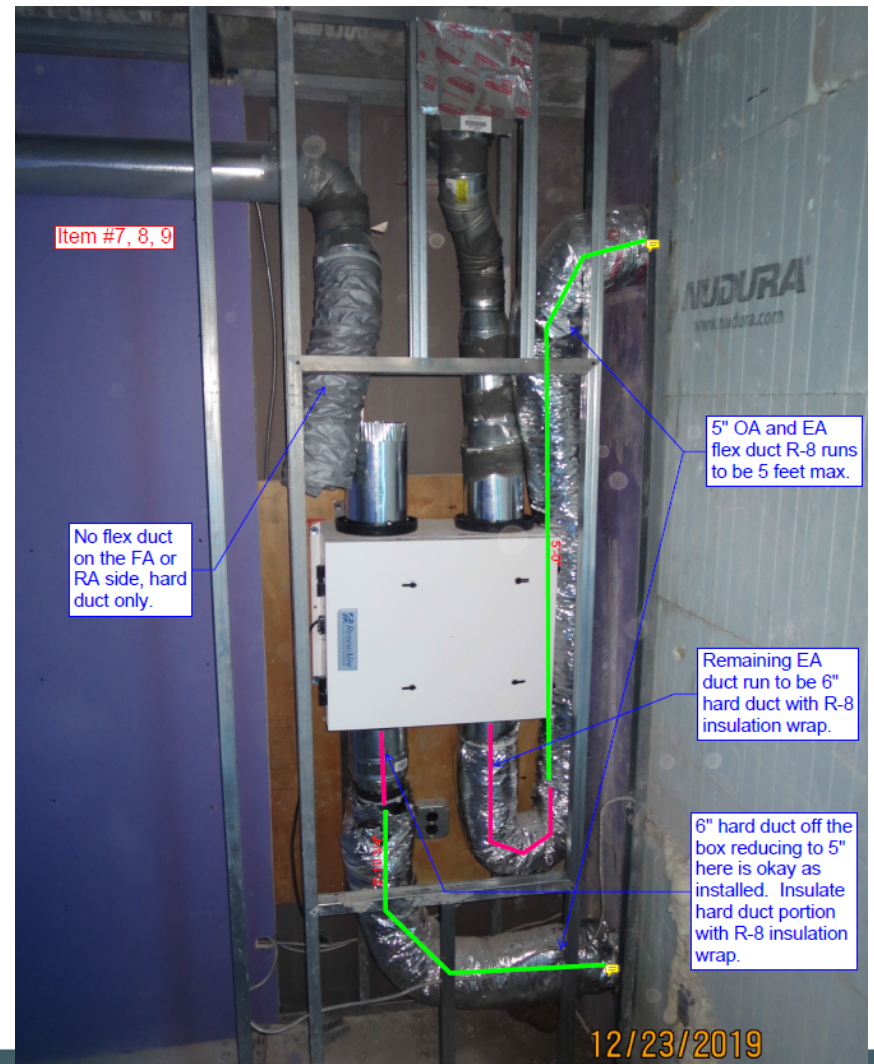
# Ventilation

- Individual Ventilation

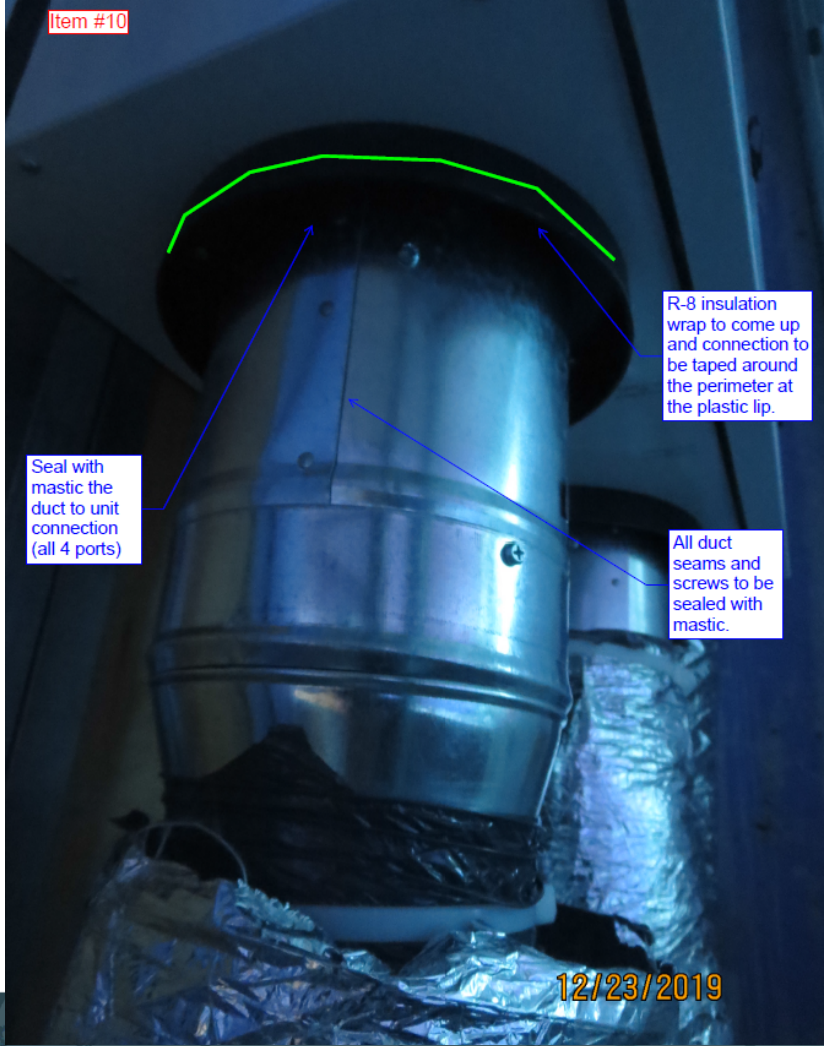


# Ventilation - Challenges

- Individual Ventilation
  - Cramped ERV closets
  - Difficulty in properly insulating and air sealing exterior wall connections
  - 2x wall penetrations per apartment
  - Future maintenance (filter changes)
- What do you see wrong in this photo?



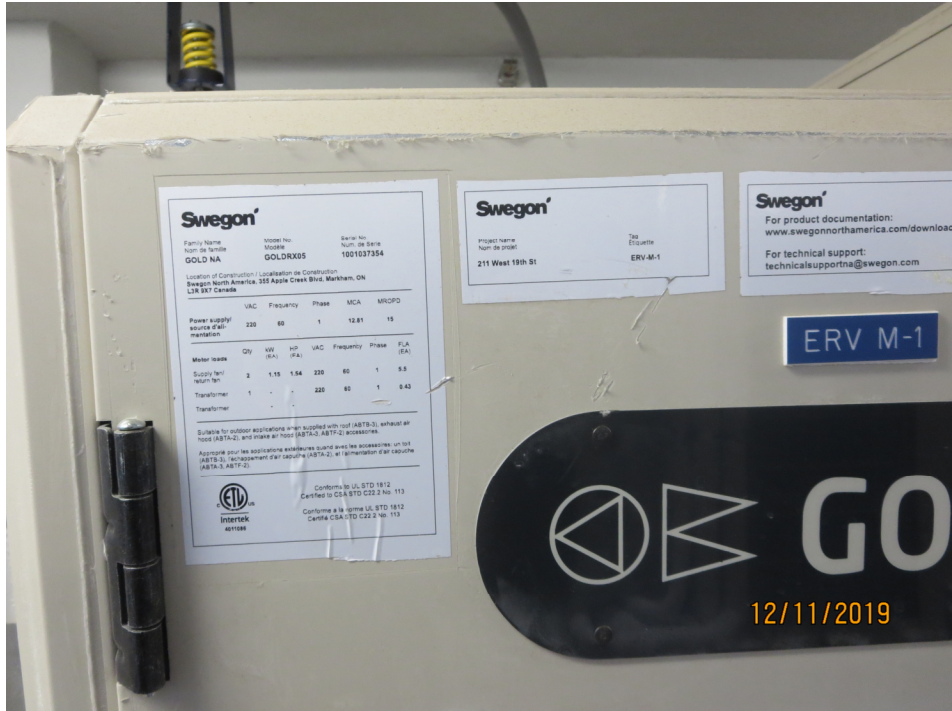
# Ventilation - Challenges



# Ventilation - Challenges



# Ventilation - Installs



# Ventilation - Installs



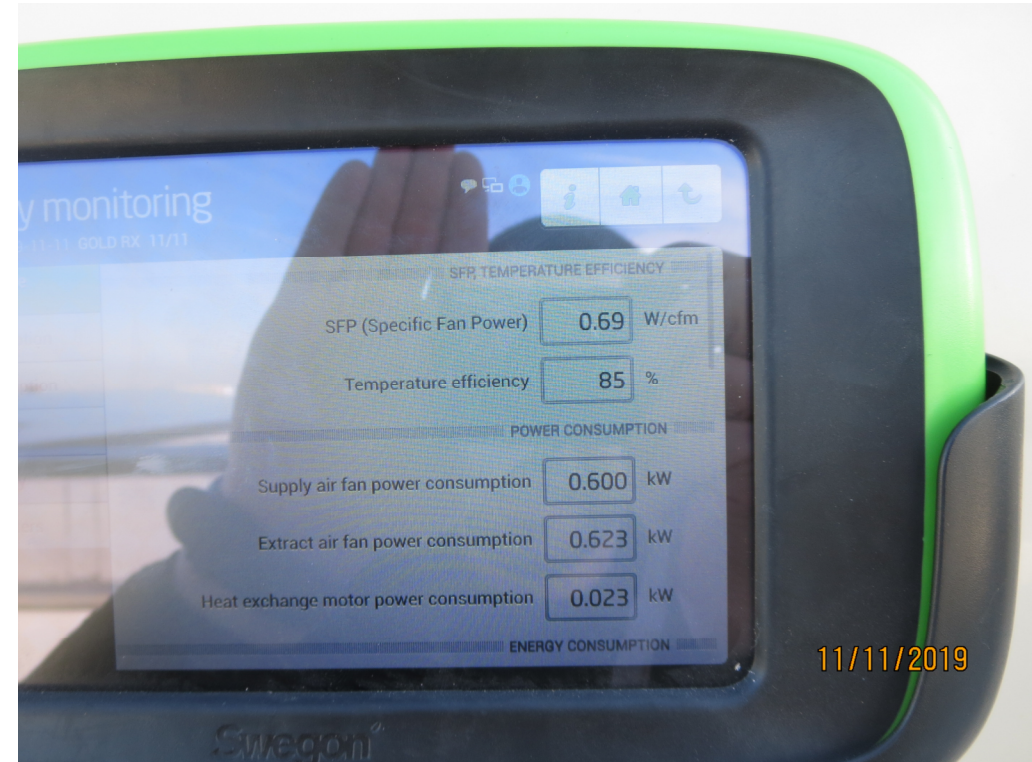
# Ventilation - Installs



# Ventilation - Installs



# Ventilation – Airflows

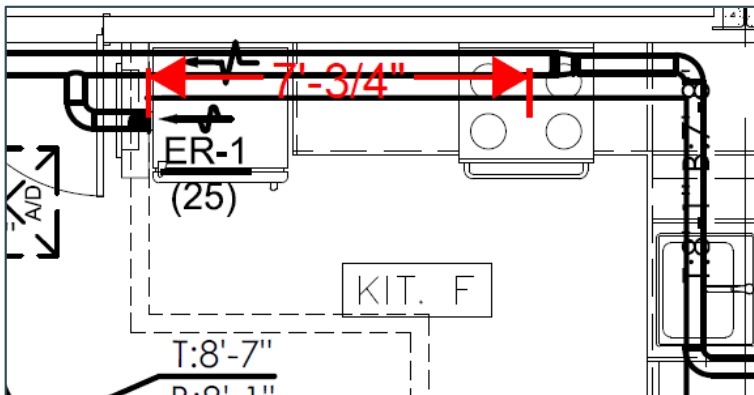


# Ventilation – Filters



# Ventilation - Filtration

- MERV13 commonly seen fore central ERVs
- MERV 3 or washable mesh at kitchen grille locations PHIUS
- Kitchen grilles 6' distance from stoves in plan view PHIUS



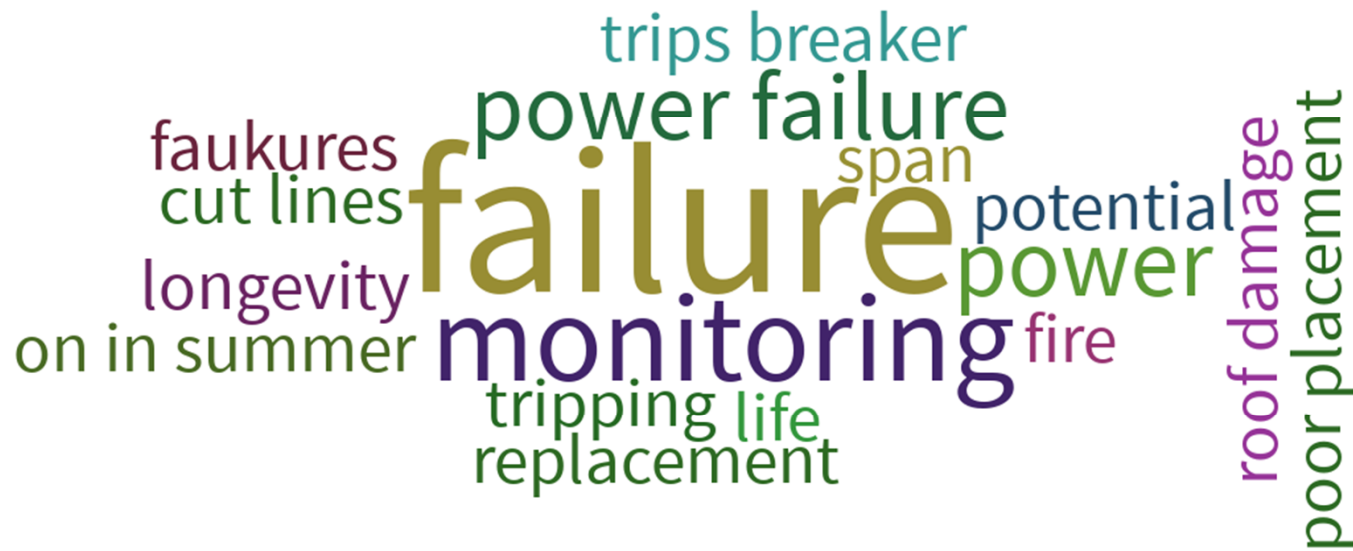
# Ventilation - Tolerances

- Total supply and exhaust are +/- 10% design values and within 10% of each other
- Air flow measurements at ERV units (traverse) in addition to all grille measurements
- Wattage of ERVs
- TAB Requirements
  - Third party (certified air balancing professional)
  - Recommend pre-meeting with TAB contractor to discuss expectations

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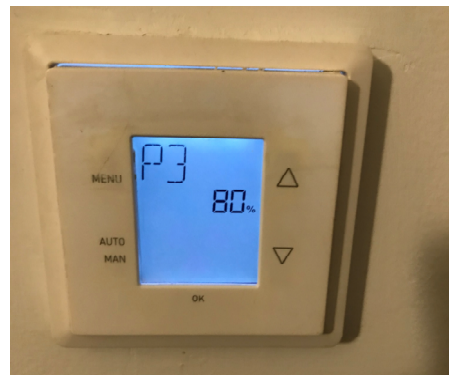
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## What are some potential issues with heat tracing systems?



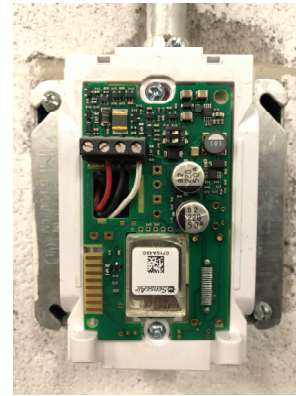
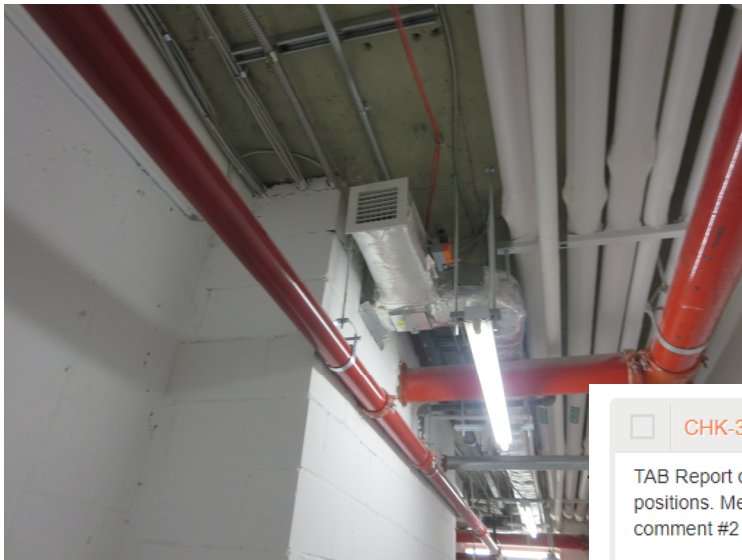
# Final Air Flow Rates & TAB

Manufacturer:		Zehnder				
Model:		COMFOAIR 200				
Location:		Apt 6C Closet				
Drawing	Area Served	Supply/ Return	Grille		CFM	
			Type	Size	Design	Actual
27	Apt 6C	ERV Supply	SWR	6x4	15	15
28	Apt 6C	ERV Supply	SWR	6x4	15	15
30	Apt 6C	ERV Supply	SWR	6x4	15	15
32	Apt 6C	KX	SWG	6x6	25	25
33	Apt 6C	TX	CG	6x6	20	20



# DCV Set Up

- Demand Controlled Ventilation (DCV) getting properly set up



**CHK-3-2** **PENDING VERIFICATION** Actions Watch

ASSIGNED TO **Mechanical Contractor**

ASSET **ERV-R-1**

DISCIPLINE **Testing and Balancing**

DRAWING **TAB Report 2019-09-27**

DUE DATE **10/29/2019**

CREATED BY **Chris Lyle**

IDENTIFIED ON **10/15/2019 9:34 AM**

View Details >

TAB Report dated 2019-09-27 does not include measurements with DCV dampers at their minimum/low positions. Measurements should be provided at both min and max positions. (See also EP Engineering comment #2 on their review)

Additionally, the actual programmed damper positions (i.e. % open) should be noted for each damper at min and max positions.

SOURCE **Checklist 3, TAB Reports Received, Line 2**

ERV-R-1

Comments 3 Files 0

Questions?



# 10 Minute Break

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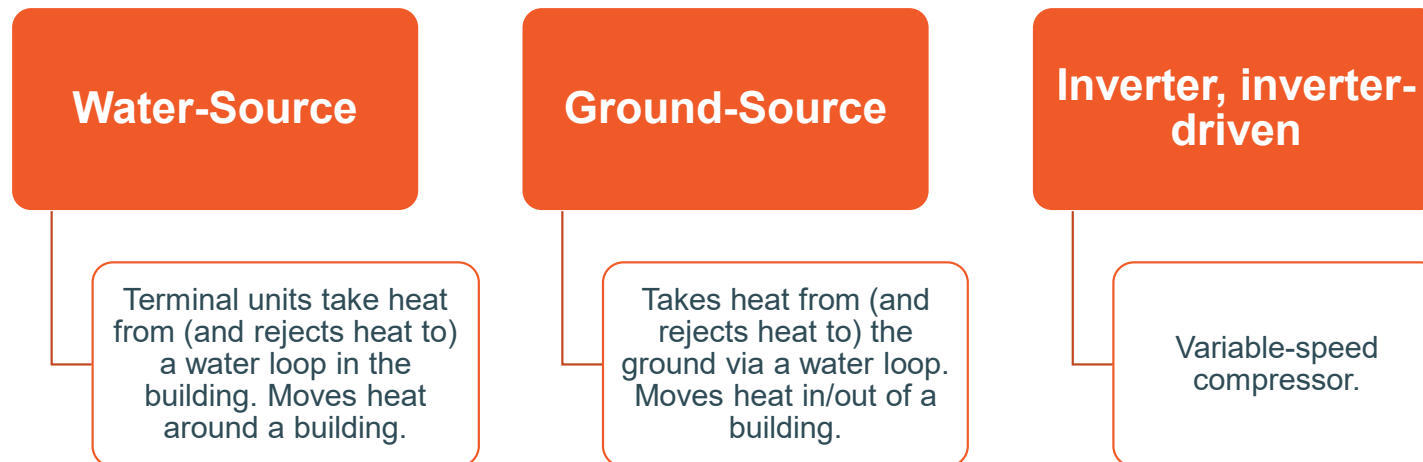
# Space Conditioning & General Duct Sealing

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# Heating & Cooling

## Air-Source

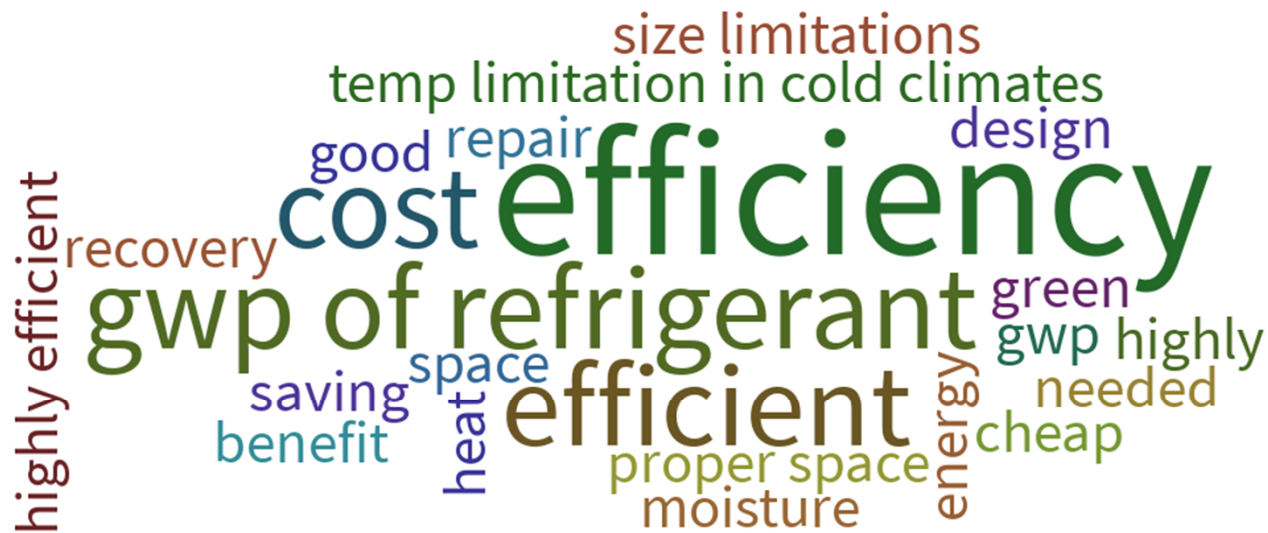
Takes heat from air, pushes it into air or water. Commonly moves heat in/out of a building.



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# What are some benefits or drawbacks of air source heat pump systems?



# Heating & Cooling

## Performance

- + Heat recovery option allows for simultaneous heating and cooling

## Design

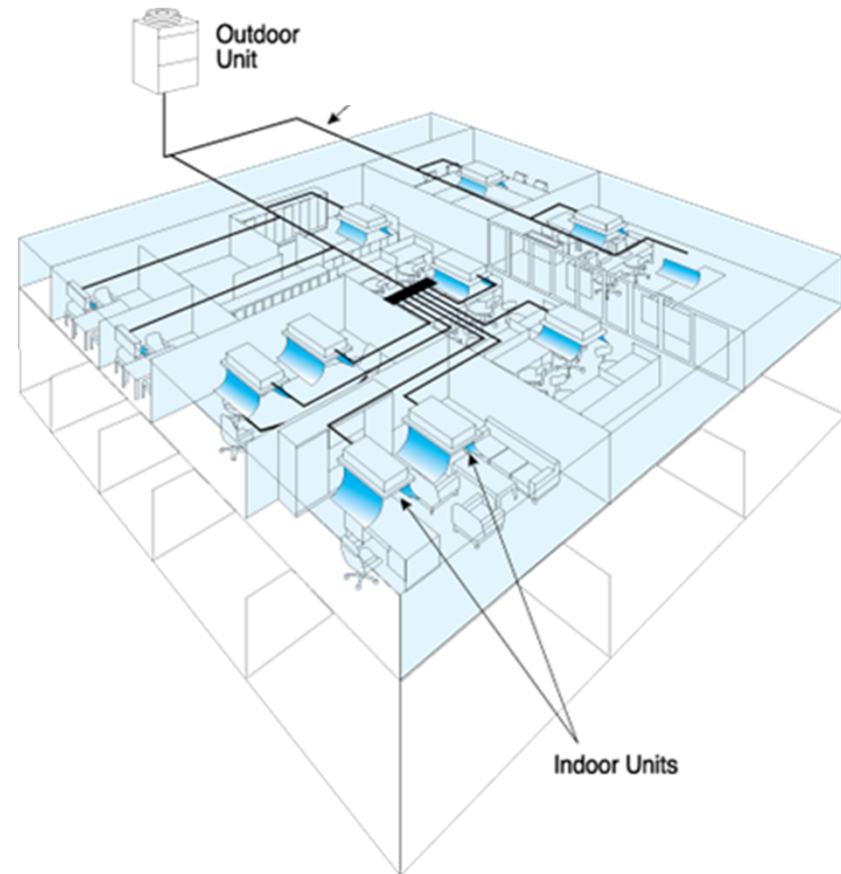
- Extra piping required

## Wall Units

- + No additional ceiling space required
- Additional power for individual unit per room one unit per room

## Ducted Units

- Requires additional ceiling space
- Required sealing of ducts



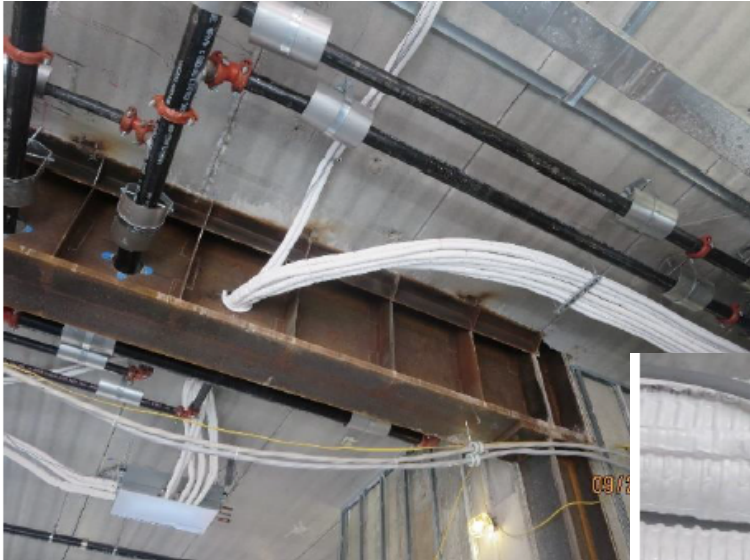
# Heating & Cooling



# Heating & Cooling



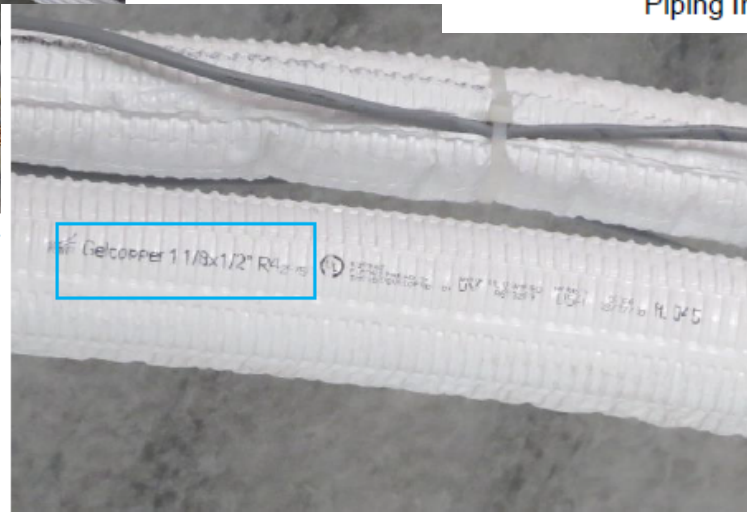
# Heating & Cooling – Preinsulated Linesets



Observed refrigerant piping insulation on site.

PIPING INSULATION	
HOT WATER PIPING	PROVIDE 1½" PIPE INSULATION FOR PIPES LESS THAN 1½". PROVIDE 2" INSULATION FOR PIPES EQUAL OR GREATER THAN 1½"
CONDENSATE DRAIN PIPING	PROVIDE ½" PIPE INSULATION FOR COPPER PIPING. NO INSULATION REQUIRED IF PVC PIPE IS USED.
REFRIGERANT PIPING	PROVIDE ½" ARMAFLEX INSULATION

Piping Insulation Schedule (M-300.01)



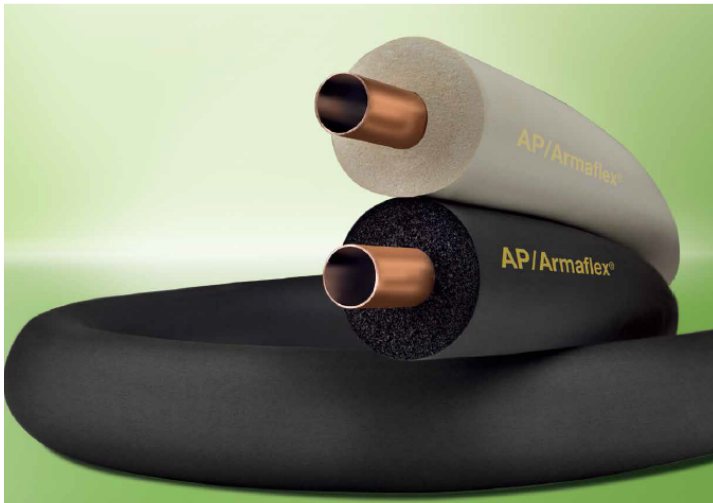
½" thickness indicated on insulation jacket

# Heating & Cooling

**AP/Armaflex®**

White and Black  
Tube Insulation

The original, fiber-free, flexible elastomeric pipe insulation for reliable protection against condensation and energy loss.



- Fiber-free, formaldehyde-free, low VOC and non-particulating formulation protects indoor air quality
- Closed-cell structure provides excellent condensation control
- Built-in vapor barrier eliminates need for additional vapor retarder
- Microban® antimicrobial product protection inhibits the growth of mold and mildew in the insulation
- 25/50 rated for use in air plenums up to 2" wall
- Available up to 2" wall and 10" ID

**armacell**



GREENGUARD Certified products are certified to GREENGUARD standards for low chemical emissions into indoor air during product usage. For more information, visit us at [us.greenguard.com](http://us.greenguard.com)

Microban antimicrobial product protection is limited to the product itself and is not designed to protect the users of these products from disease causing microorganisms, or as a substitute for normal cleaning and hygiene practices.



# Heating & Cooling

- Be careful of refrigerant leaks, installing insulation, and closing up walls.

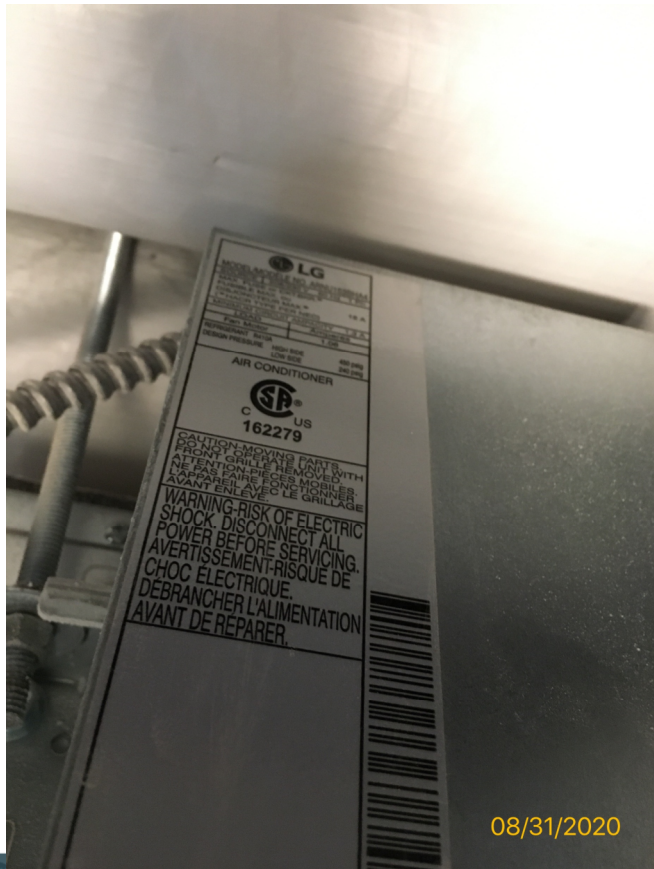


# Heating & Cooling

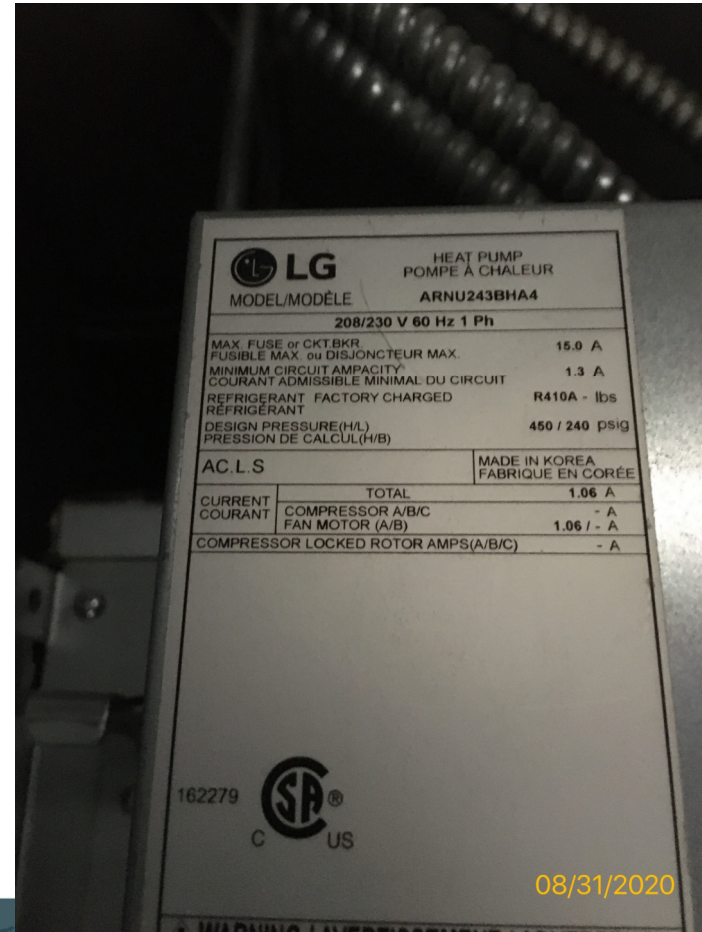
- Be careful of refrigerant leaks, installing insulation, and closing up walls.



# Heating & Cooling – Air Handlers



08/31/2020



08/31/2020

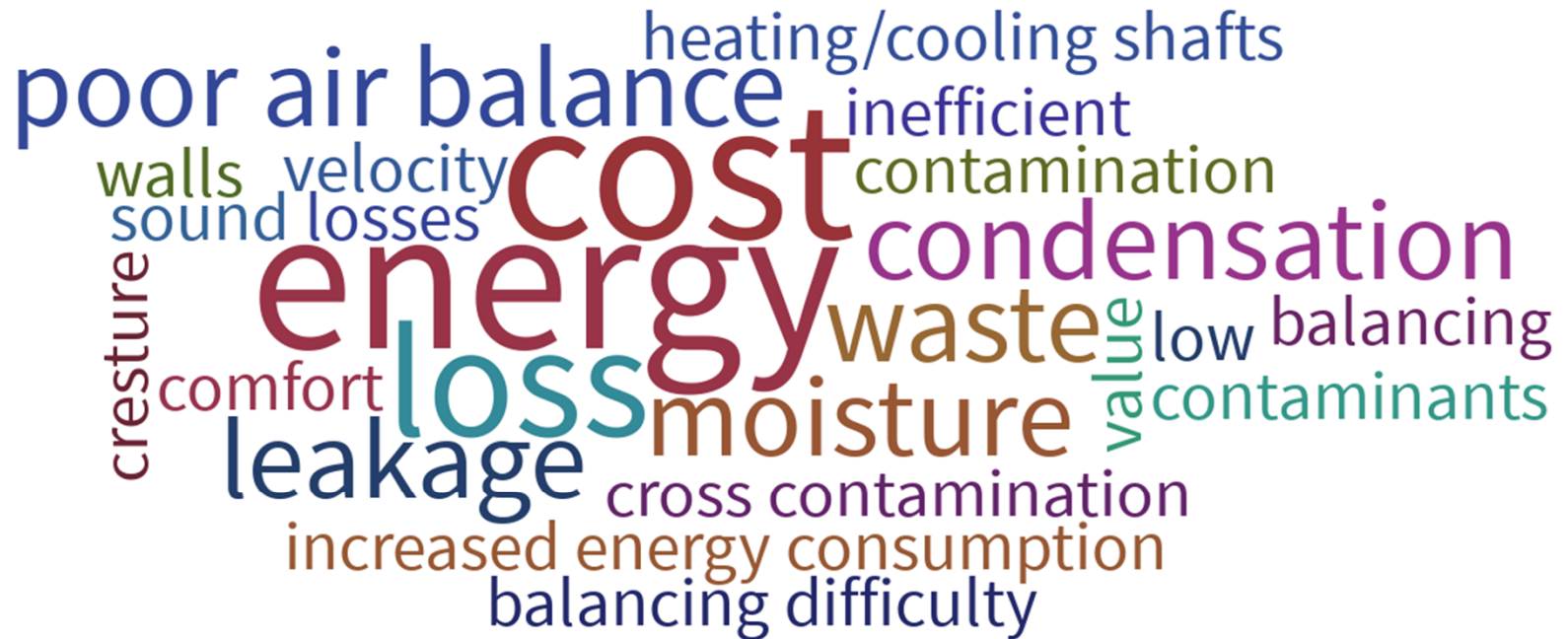
# Heating & Cooling – Duct Sealing



When poll is active, respond at [PollEv.com/swa335](https://PollEv.com/swa335)

Text **SWA335** to **22333** once to join

## What are some negative consequences of poor duct sealing?



# VRF Tags, Wiring, and Thermostats

TST-64-2 CLOSED HIGH Actions Watch

Per [REDACTED] The laundry room and trash room split system control wiring to their respective outdoor units are crossed. Please correct wiring and ensure the correct outdoor units are connected to the correct indoor units.

SOURCE Test 64, Attempt 2, Line 21

Unit is not heating or cooling?

Comments 2 Files 0

TST-61-2 CLOSED Actions Watch

Per [REDACTED] all VRF thermostats in the building are programmed by default to control to the return air temperature. All units should be controlled to the space temperature since most units do not have ducted returns, but rather plenum returns, the temperatures of which do not accurately reflect space temperatures.

Please reprogram all apartment thermostats to control to space temperature (as measured by the thermostat).

SOURCE Test 61, Attempt 1, Line 18

Space Temperature

Comments 2 Files 0

ASSIGNED TO Mechanical Contractor

ASSET VRF Indoor Unit

DISCIPLINE Mechanical

DRAWING

DUE DATE 10/10/2019

CREATED BY Chris Lyle

IDENTIFIED ON 9/26/2019 10:49 AM

View Details >



TST-10-1 CLOSED Actions Watch

The thermostat in Apt 5B (construction 4B) was reading 69 when SWA measured 63. Please calibrate sensors.

SOURCE Test 10, Attempt 1, Line 11

Space Temperature

Comments 2 Files 0

ASSIGNED TO Mechanical Contractor

ASSET AHU Apt 4B

DISCIPLINE Mechanical

DRAWING

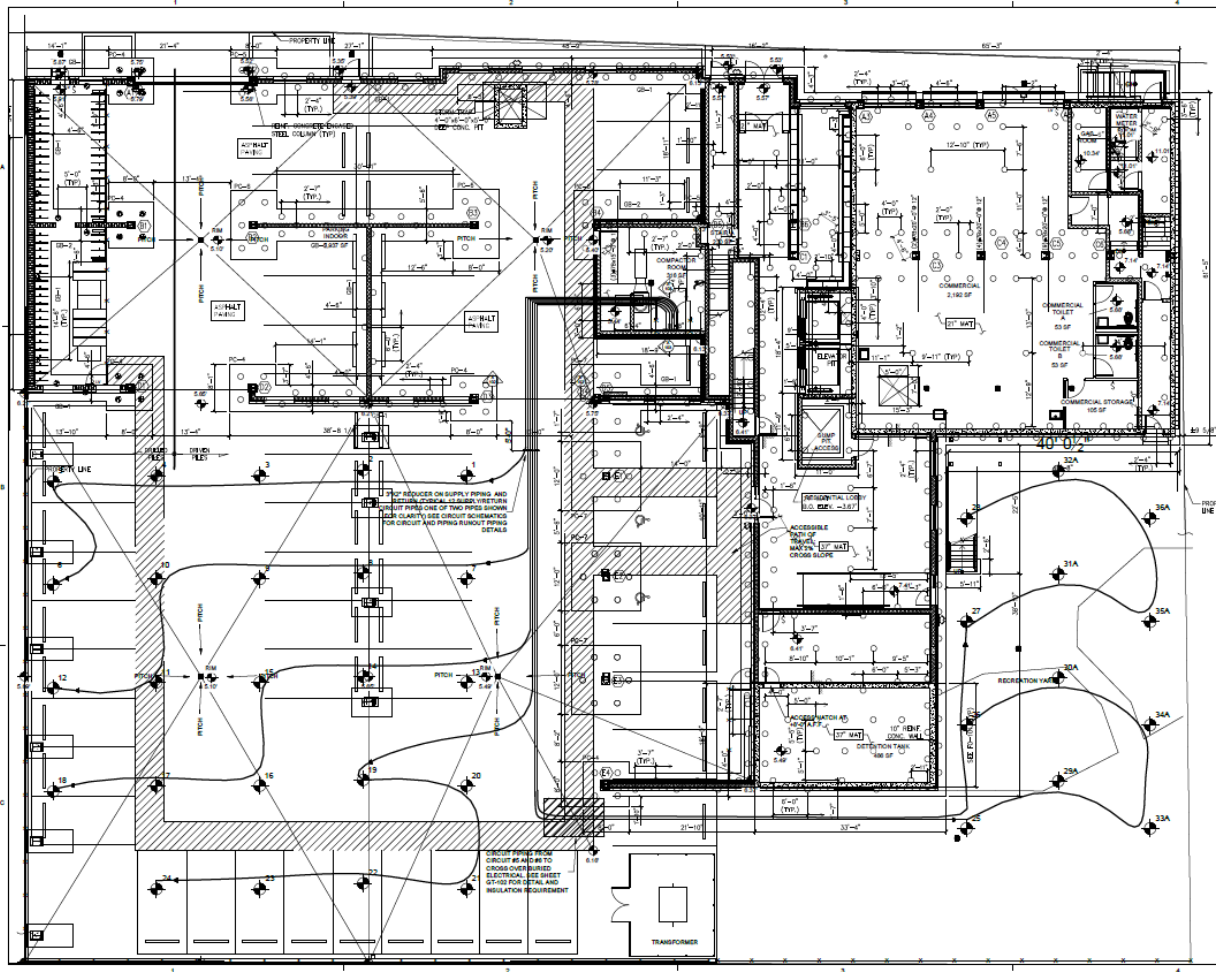
DUE DATE 11/19/2019


CREATED BY Chris Lyle

IDENTIFIED ON 11/5/2019 10:35 AM

View Details >

# Heating & Cooling - Geothermal



No.	Date	Submission
Title:		
<b>GEOTHERMAL SITE PLAN</b>		
		
© 2017 CURTIS + GINSBERG ARCHITECTS LLP Job No.: 1218		
Scale: 1:100 Drawn By: DWH Checked By: ZBF		
Sheet No.:		
1 of 4		<b>GT-100.00</b>

# Heating & Cooling - Geothermal

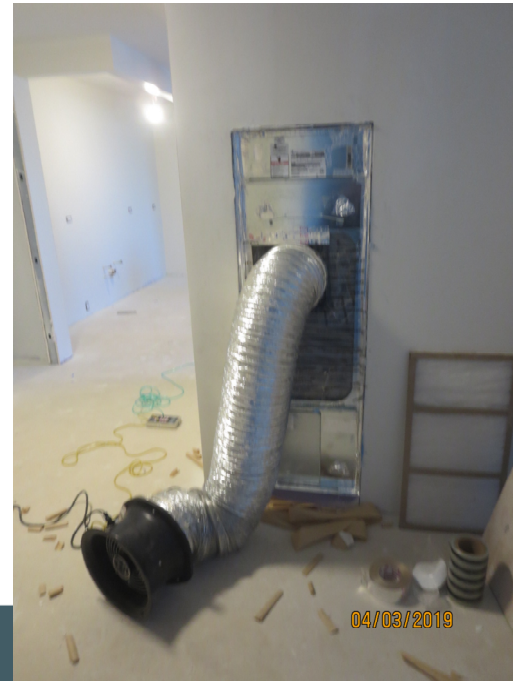


# Heating & Cooling - Geothermal



# Ductwork - Sealing

- Duct work sealing is critical for both heating/cooling and ERV system operations and achieving the desired air flows
- PHIUS requires in-unit duct testing of heating and cooling systems



# Heating & Cooling - Ductwork

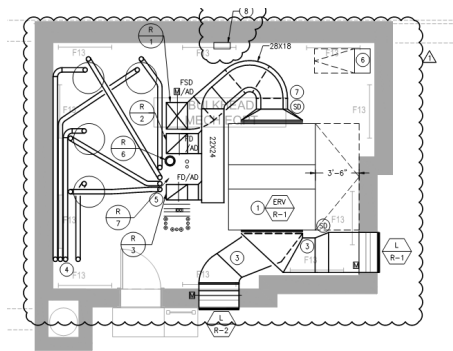
- The Kingspan KoolDuct System is an advanced and innovative pre-insulated rectangular HVAC ductwork system, which is installed in a single fix.



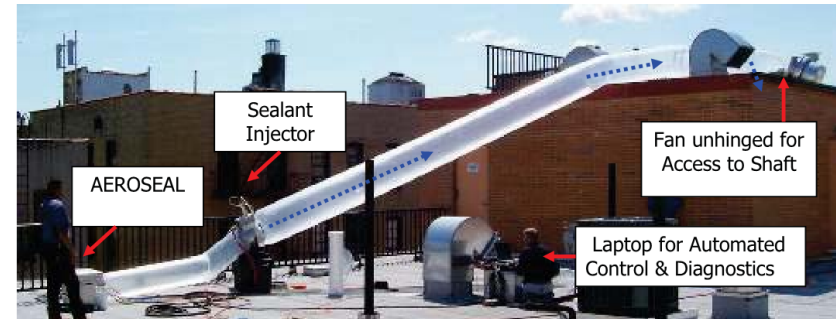
# Duct Sealing - Ventilation

211 West 29<sup>th</sup> Street

- Obstacle 1: Timing of AeroSeal
- Obstacle 2: Final balancing
- Obstacle 3: Initial design much higher than mechanical code



**Obstacle 2:** During balancing, the total CFM measured at the unit will likely be higher than the design CFM because of leakage in ductwork and higher static to overcome tight mechanical rooms. To minimize this, sharp turns in ductwork should be reduced when possible and extra fan power should be accounted for in energy models.



**Obstacle 1:** Due to the sequencing of the project, it is very difficult to schedule AeroSeal at a time when all riser and branch ductwork has been installed. Scheduling of AeroSeal should be coordinated with HVAC contractor early in construction.

TABLE 403.3—continued  
MINIMUM VENTILATION RATES

OCCUPANCY CLASSIFICATION	OCCUPANT DENSITY #/1000 FT <sup>2</sup>	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R <sub>p</sub> CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R <sub>a</sub> CFM/FT <sup>2</sup>	EXHAUST AIRFLOW RATE CFM/FT <sup>2</sup>
Private dwellings, single and multiple Garages, common for multiple units <sup>a</sup> Garages, separate for each dwelling <sup>b</sup>	—	—	—	0.75 100 cfm per car
Kitchens <sup>c</sup> Living areas <sup>c</sup>	— Based upon number of bedrooms. First bed- room, 2; each addi- tional bedroom, 1	— 0.35 ACH but not less than 15 cfm/person	—	25/100 <sup>d</sup> —
Toilet rooms and bathrooms <sup>e</sup>	—	—	—	20/50 <sup>f</sup>
<b>Public spaces</b>	—	—	0.06	—
Corridors	—	—	—	—
Elevator car	—	—	—	1.0
Shower room (per shower head) <sup>g</sup>	—	—	—	50/20 <sup>f</sup>
Smoking lounges <sup>h</sup>	70	60	—	—
Toilet rooms — public <sup>i</sup>	—	—	—	50/70 <sup>f</sup>

**Obstacle 3:** The initial ventilation design included rates in BOH and amenity spaces that were much higher than required by the IMC. This results in unnecessary fan energy use.

# Ventilation

## IF YOU REMEMBER ANYTHING, REMEMBER THIS LIST

- Ductwork must be Aerosealed in order to achieve balancing and ALL DUCTWORK SHOULD BE INSTALLED
- Constant airflow regulating (CAR) dampers must be used at all registers and must be ACCESSIBLE
- Ductwork behind registers must be CLEARLY connected to drywall
- Do not combine AHU and ERV ductwork
- Account for buffer on top of design flowrate in energy model



**CAR Damper:** CAR dampers must be used at all registers to achieve proper balancing. Make sure to use CAR dampers like the one pictured here, with a set screw to adjust the flap.

<https://eflowusa.net/product/constant-air-flow-regulators-3/>



**Well sealed ductwork to drywall:** If ductwork is not properly sealed to drywall behind registers, air will dump into ceiling or wall cavities, drastically increasing total fan power required to achieve proper balancing.

# Ventilation

Aeroseal at 511 E. 86<sup>th</sup> Street

Dates of Sealing: 2/24/20 thru 3/5/20

## Summary

Despite excessive leakage conditions, all risers at 511 E. 86<sup>th</sup> Street have now been sealed. Multiple days were spent troubleshooting large holes or disconnected sections of the ductwork.

Duct Identifier	Initial Leakage (CFM)	Final Leakage (CFM)	Reduction
TX-RR-12	862.5	21.4	97.5%
TX-RR2-12	946.9	27.6	97.1%
TX-RL12	1145.0	35.9	96.9%
TX-RL2-12	639.2	24.1	96.2%
TX-R3	998.1	33.1	96.7%
TX-R2	737.4	31.7	95.7%
TX-1	762.4	91.8	88.0%
Cellar Return	1140.4	48.3	95.8%
Cellar Supply	568.1	36.9	93.5%

## B&L Manpower Onsite Most Days

Ryan Oakey – Lead Technician

Romario Auguste – Project Technician

Raashid Weeks – Project Technician


*All staff onsite from 7 AM – 3 PM most days*

## Findings & Recommendations for Future Sealing Events

- Multiple duct termination points were found to be open to atmosphere. Ducts should be prepared in the same manner as would be for duct pressurization testing
- Multiple risers had disconnections or holes that were greater than 5/8". Aeroseal duct sealing is effective only for holes < 5/8", ductwork should be inspected prior to beginning Aeroseal services so extensive troubleshooting efforts are mitigated

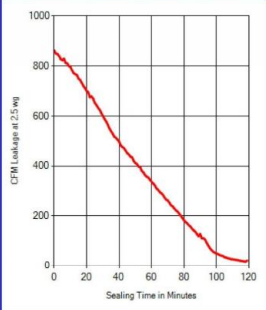
# Ventilation

AeroSeal at 511 E. 86<sup>th</sup> Street Dates of Sealing: 2/24/20 thru 3/5/20



### Certificate of Completion

**Duct Sealing Performed For:**  
511 East 86th St  
511 East 86th St  
New York, NY 10028



**Overall Sealing Results**

When we arrived,  
YOUR DUCTS HAD:  
**862.5 CFM of Leakage**, equivalent to a  
**23.6 Square Inch Hole**


After we finished,  
YOUR DUCTS HAVE:  
**21.4 CFM of Leakage**, equivalent to a  
**0.6 Square Inch Hole**

**This corresponds to a 97.5% Reduction in Duct Leakage.**

Note: Duct Leakage results are calculated in Cubic Feet per Minute (CFM) measured at a standard OPERATING PRESSURE of 2.5 wg.

AeroSeal Technician RO  
AeroSeal Case ID 3427  
Date of Seal 3/4/2020  
System Description TX-RR-12  
Seal Description Seal 1  
Hardware Gen2

**Duct Sealing Performed By:**  
B&L Testing and Balancing  
2735 Academy Street  
Brooklyn, NY 11572  
Phone: 917.359.3810




Duct Sealing From The Inside

B&L Testing and Balancing, LLC  
516.724.3630

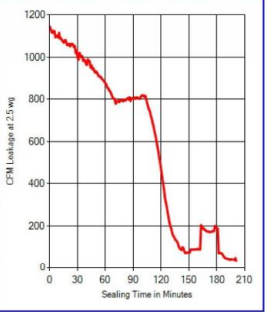
2735 Academy Street, Oceanside, NY 11572  
info@bltab.com

AeroSeal at 511 E. 86<sup>th</sup> Street Dates of Sealing: 2/24/20 thru 3/5/20



### Certificate of Completion

**Duct Sealing Performed For:**  
511 East 86th St  
511 East 86th St  
New York, NY 10028



**Overall Sealing Results**

When we arrived,  
YOUR DUCTS HAD:  
**1145.0 CFM of Leakage**, equivalent to a  
**31.4 Square Inch Hole**


After we finished,  
YOUR DUCTS HAVE:  
**35.9 CFM of Leakage**, equivalent to a  
**1.0 Square Inch Hole**

**This corresponds to a 96.9% Reduction in Duct Leakage.**

Note: Duct Leakage results are calculated in Cubic Feet per Minute (CFM) measured at a standard OPERATING PRESSURE of 2.5 wg.

AeroSeal Technician RO  
AeroSeal Case ID 3427  
Date of Seal 3/3/2020  
System Description TX-RL 12  
Seal Description Seal 1  
Hardware Gen2

**Duct Sealing Performed By:**  
B&L Testing and Balancing  
2735 Academy Street  
Brooklyn, NY 11572  
Phone: 917.359.3810



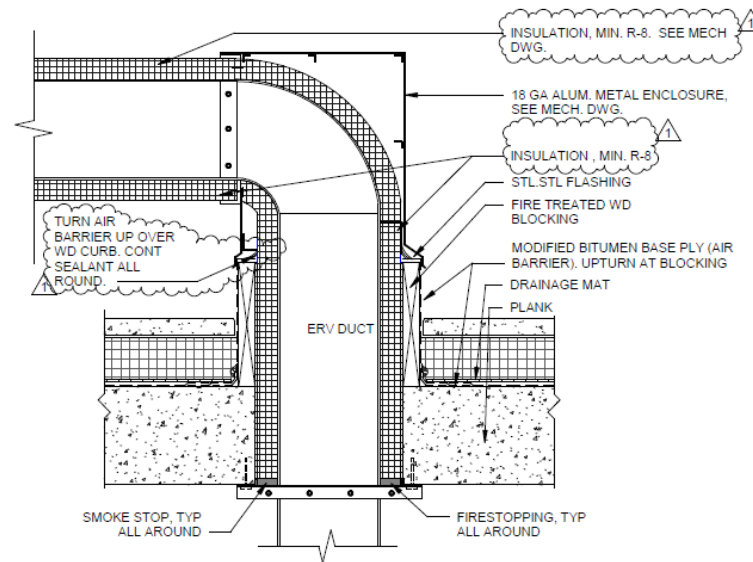
Duct Sealing From The Inside

B&L Testing and Balancing, LLC  
516.724.3630

2735 Academy Street, Oceanside, NY 11572  
info@bltab.com

# Ventilation

- Continuous R-8 insulation on all exterior ERV ducts, insulation fully sealed/vapor tight



C3 ERV PENETRATION @ ROOF  
A-332 1" = 1'-0"

# Aeroseal Too Early



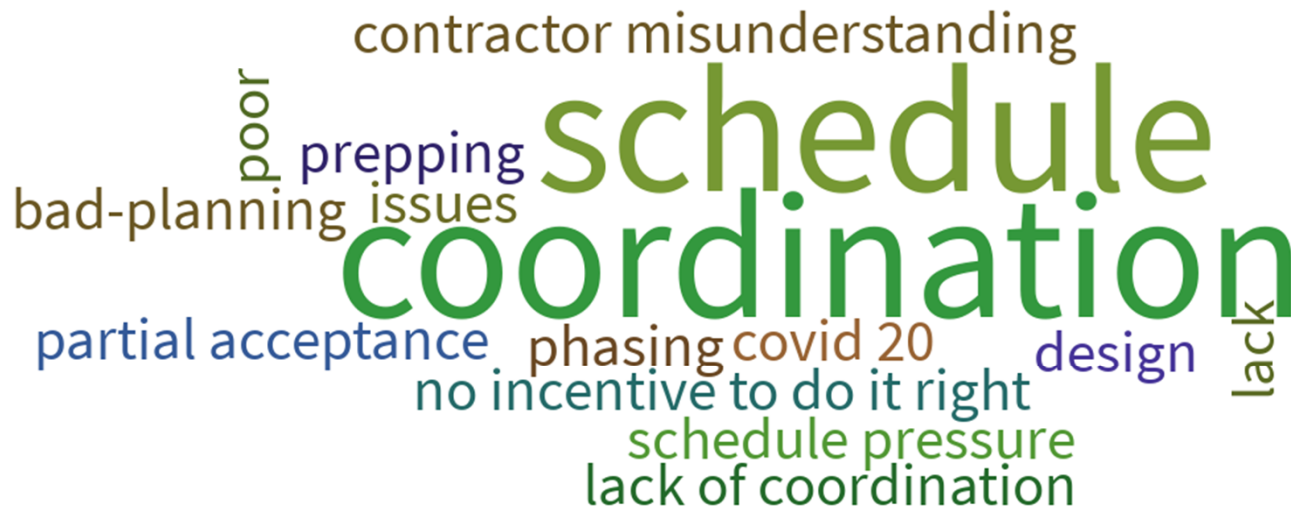
# Aeroseal Too Early



When poll is active, respond at [PollEv.com/swa335](https://PollEv.com/swa335)

Text **SWA335** to **22333** once to join

## What are some reasons why AeroSeal may not take place at the appropriate time?





# Ventilation – Dampers in Envelope

- Any / all dampers to be Class I leakage rated and fully closed for a tight seal



# Ventilation - Commissioning



Questions?



10 Minute Break

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# Plumbing

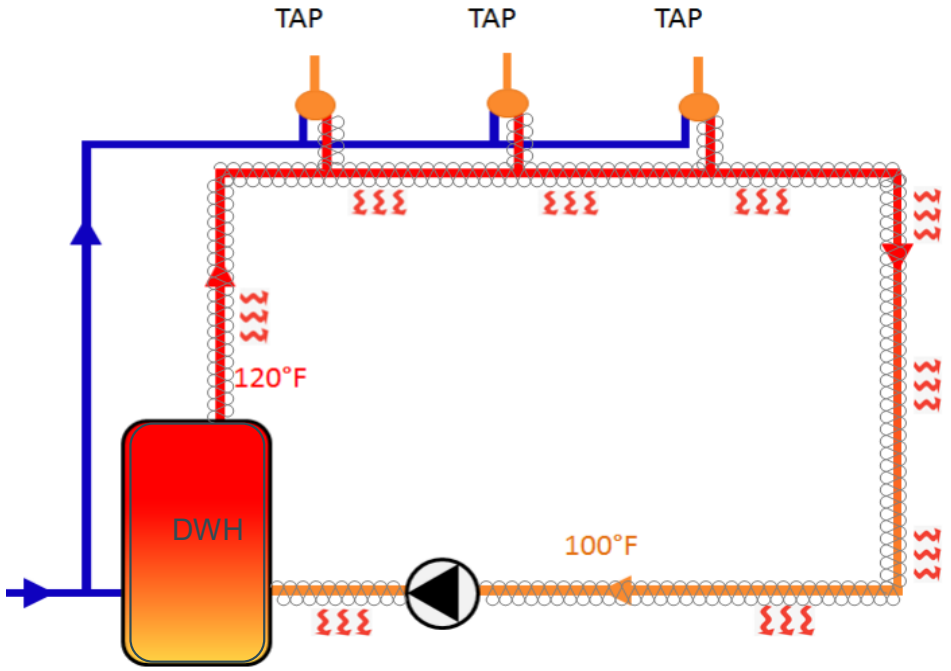
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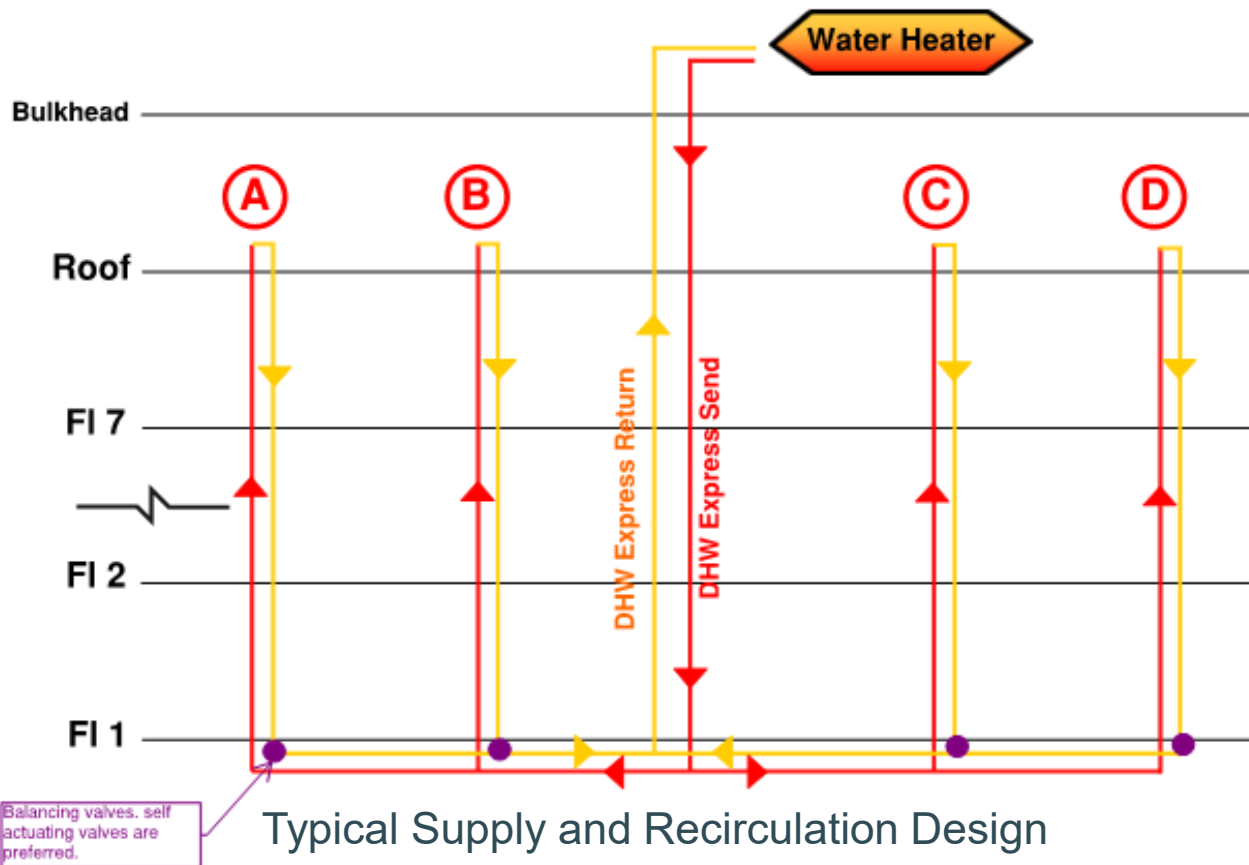
# Central Recirculation



# Central Recirculation

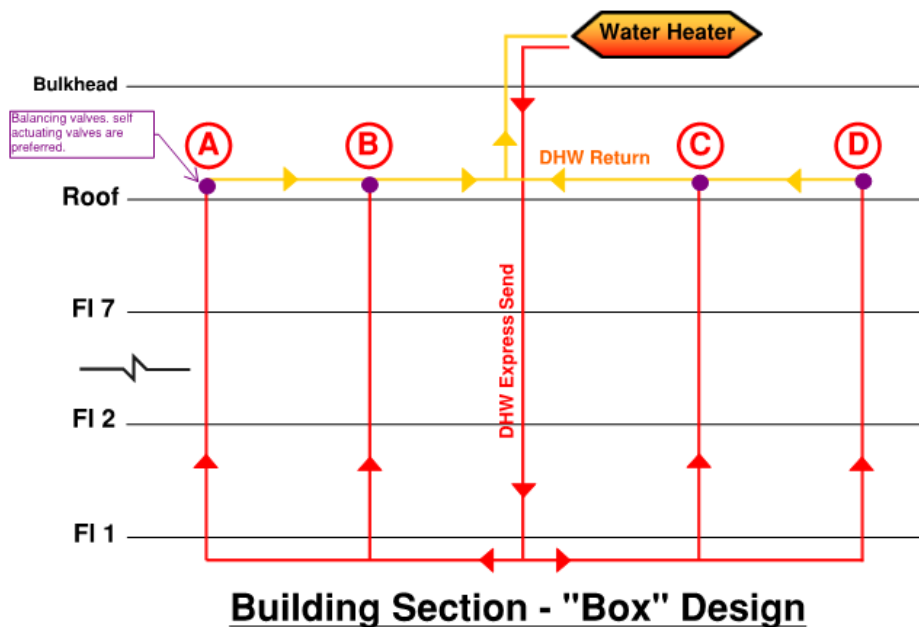
Insulation helps, but there is more we can do (design side)





# Designing Optimized Recirculation

# Design Optimization – Central Recirculation



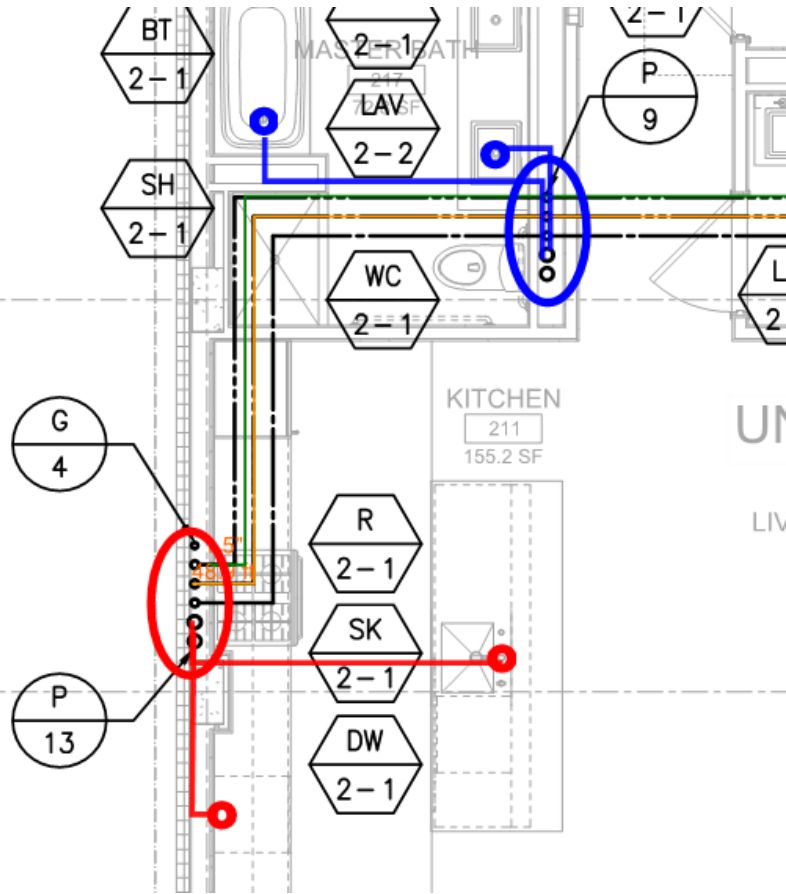
- Will reduce distribution piping by ~40%.
  - Pumping energy ↓
  - Material costs ↓
  - DHW heating costs ↓
- Balancing critical
  - Thermostatic balancing valves help
- May impact floor to floor heights

# Central Recirculation Optimization Case Study

- 37 story residential tower
- Switched from 3-pipe to box design
- Savings
  - 10,000 ft of recirc. piping
  - 18% reduction DHW heating
  - 16% reduction cooling



## Design Optimization – Central Recirculation



- Distribution losses ~ **30% of DHW heating demand**
- Reduce risers
  - Cluster plumbing locations when feasible
  - Optimize HWR loop location – reduce runouts from riser to fixtures
- Insulation
  - Code required (NYS Energy Code 1" to 1.5")

# Plumbing - DHW

- Follow P-001.00 for DHW, including crotons
- Insulation to be continuous at all hanger locations (kindorf & clevis)
- Runout piping



PLUMBING PIPING INSULATION				
MATERIAL	MANUFACTURER	SERVICE	INSULATION THICKNESS	COMMENTS
FLEXIBLE ELASTOMERIC	AEROFLOX USA INC.; AEROCEL ARMACELL LLC; AF ARMAFLEX RBX CORPORATION; INSUL-SHEET 1800; INSUL-TUBE 180	DOMESTIC HOT & RE-CIRCULATED HOTWATER	1" FOR PIPES < 1.5" 1½" FOR PIPES ≥ 1.5"	1) FLAME SPREAD RATING INDEX SHALL BE 25 OR LESS.  2) SMOKE DEVELOPED INDEX SHALL BE 50 OR LESS.  3) PIPE INSULATION SHALL NOT BE INTERRUPTED BY PIPE SUPPORTS OR PIPE SERVICE.
		DOMESTIC COLD WATER (POTABLE)	1"	
		STORMWATER & OVERFLOW	1"	
		ROOF DRAIN AND OVERFLOW DRAIN BODIES	1"	
		EXPOSED SANITARY DRAINS	1"	
MINERAL-FIBER	FIBREX INSULATIONS INC.; COREPLUS 1200. JOHNS MANVILLE; MICRO-LOK. KNAUF INSULATION; 1000 PIPE INSULATION. OWENS CORNING; FIBERGLAS PIPE INSULATION	DOMESTIC HOT & RE-CIRCULATED HOTWATER	1" FOR PIPES < 1.5" 1½" FOR PIPES ≥ 1.5"	1) FLAME SPREAD RATING INDEX SHALL BE 25 OR LESS.  2) SMOKE DEVELOPED INDEX SHALL BE 50 OR LESS.  3) PIPE INSULATION SHALL NOT BE INTERRUPTED BY PIPE SUPPORTS OR PIPE SERVICE.
		DOMESTIC COLD WATER (POTABLE)	1"	
		STORMWATER & OVERFLOW	1"	
		ROOF DRAIN AND OVERFLOW DRAIN BODIES	1"	
		EXPOSED SANITARY DRAINS	1"	
POLYOLEFIN	ARMACELL LLC; TUBOLIT NOMACO INC.; IMCOLOCK, IMCOSHEET, NOMALOCK & NOMAPLY RBX CORPORATION; THERMA-CELL	DOMESTIC HOT & RE-CIRCULATED HOTWATER	1" FOR PIPES < 1.5" 1½" FOR PIPES ≥ 1.5"	1) FLAME SPREAD RATING INDEX SHALL BE 25 OR LESS.  2) SMOKE DEVELOPED INDEX SHALL BE 50 OR LESS.  3) PIPE INSULATION SHALL NOT BE INTERRUPTED BY PIPE SUPPORTS OR PIPE SERVICE.
		DOMESTIC COLD WATER (POTABLE)	1"	
		STORMWATER & OVERFLOW	1"	
		ROOF DRAIN AND OVERFLOW DRAIN BODIES	1"	
		EXPOSED SANITARY DRAINS	1"	

# Pipe Insulation Sizes

## Pi-Piper® THE PIPE SIZER™

The Pipe Sizer Provides a Viable Solution To Measuring Pipe Sizes



The Pipe Sizer Provides a Quick Solution for Measuring Pipe Size (diameters)

- <http://www.pi-piper.com/>



1.5" diameter hot water piping observed with only 1.0" thick insulation, 9<sup>th</sup> floor



# Plumbing - DHW



When poll is active, respond at [PollEv.com/swa335](https://PollEv.com/swa335)

Text **SWA335** to **22333** once to join

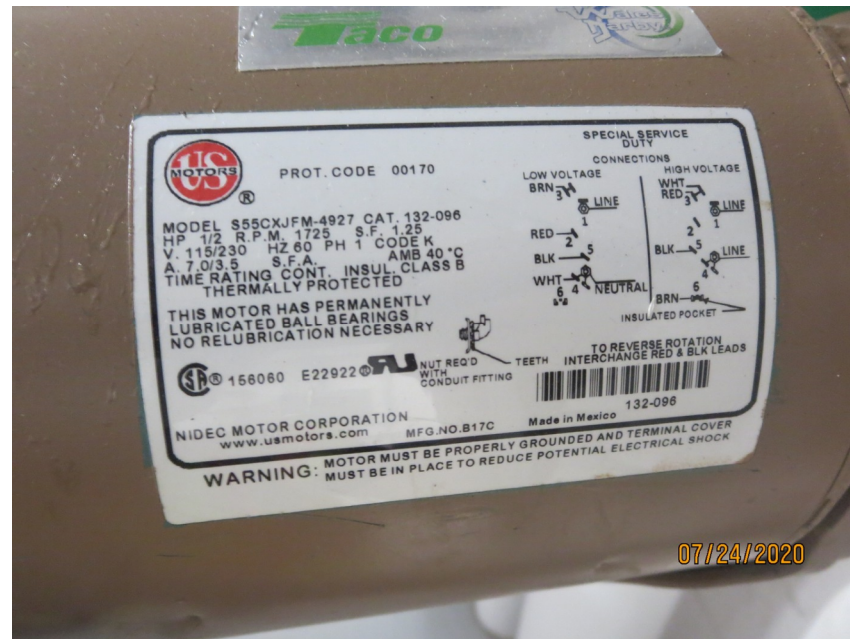
## Who checks that pipe insulation thickness is correct on site?



# Plumbing - DHW



# Plumbing - Recirc



# Plumbing – Heating Hot Water

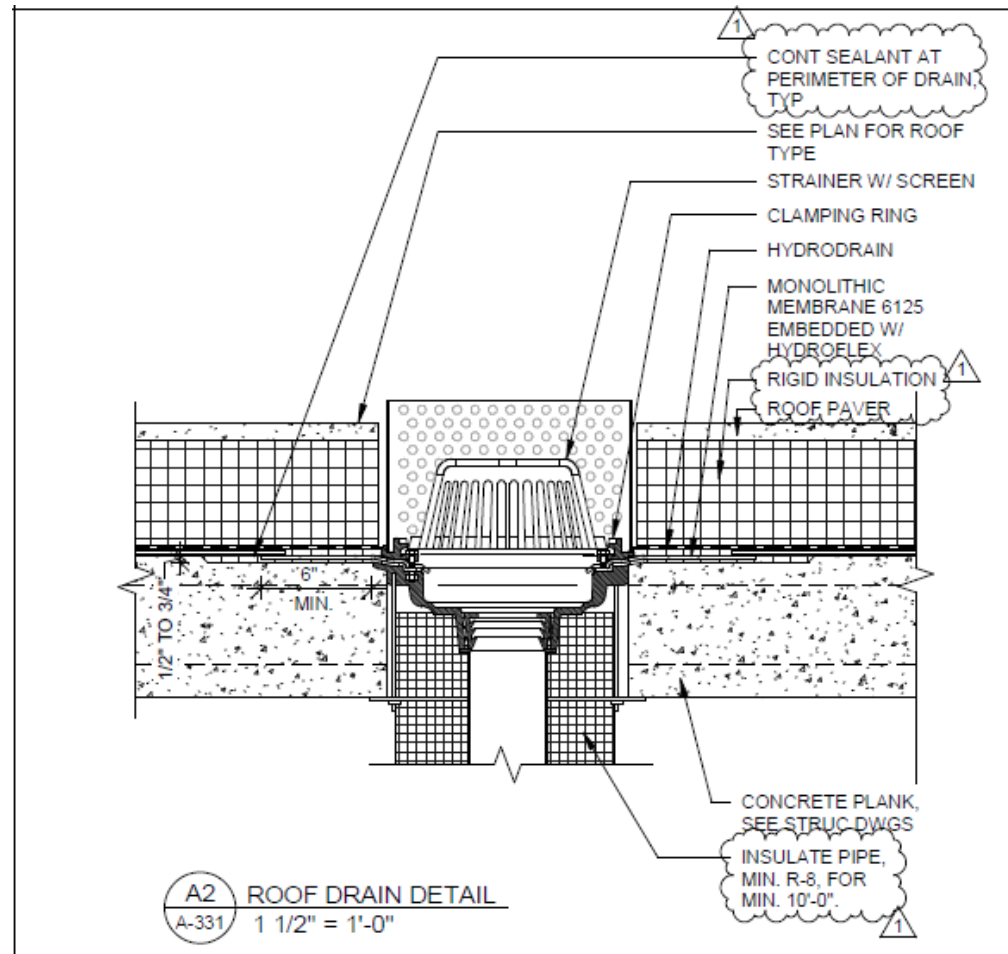


# Plumbing – Heating Hot Water



# Plumbing

- Insulate roof drains



# Plumbing - Water Flow Rates

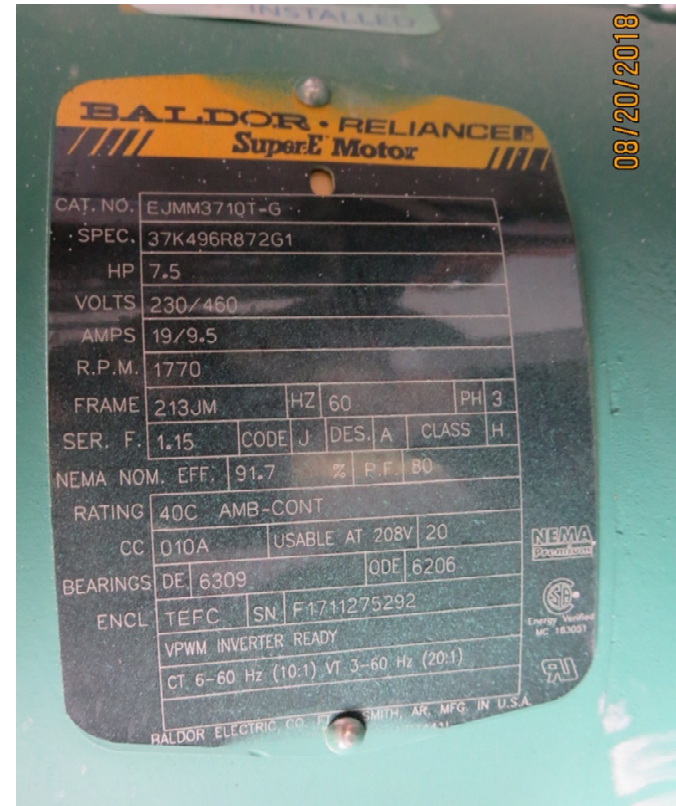
- Water flow rates (toilets, shower heads, etc.) to match submittals and be Water Sense where applicable
- Conduct pressure-loss tests and visual inspections to determine if there are any leaks. Fix any leaks found. (Enterprise Green Communities)
- Water meters installed on
  - Each toilet
  - Laundry facilities
  - The boiler makeup water
  - Outdoor water
  - Water in commercial spaces

## H2O NOTES:

1. PROVIDE H2O IT1002-0500 GATEWAY AND M54700 COORDINATOR . IT1002-0500 GATEWAY REQUIRES CAT5E DHCP INTERNET CONNECTION AND 110V POWER. M54700 COORDINATOR CONNECT VIA USB. OWNER SHALL CONTACT H2O FOR COMMISSIONING AND DATA MONITORING AGREEMENT.
2. PROVIDE M54200 WIRELESS MESH TRANSFER WITH PS1001 ABOVE THE KITCHEN REFRIGERATOR IN LOCATIONS SHOWN ON THE PLAN. COORDINATE EXACT LOCATION IN FILED.
3. PROVIDE WATER METERS WM1200C AND WM1200H WITH WIRELESS MESH TRANSFER M54230 FOR LAUNDRY DEDICATED COLD AND HOT WATER BRANCHES.

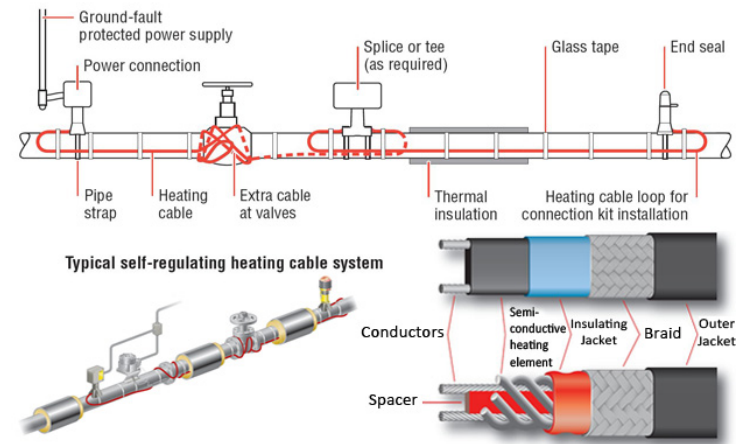
# Plumbing - Pump Motors

- NEMA Premium for pump motors 3 phase, 1hp or greater
- Double check the nameplate or with the product rep.
- <https://www.ny-engineers.com/blog/nema-premium-efficiency-motors>



# Plumbing - Heat Trace

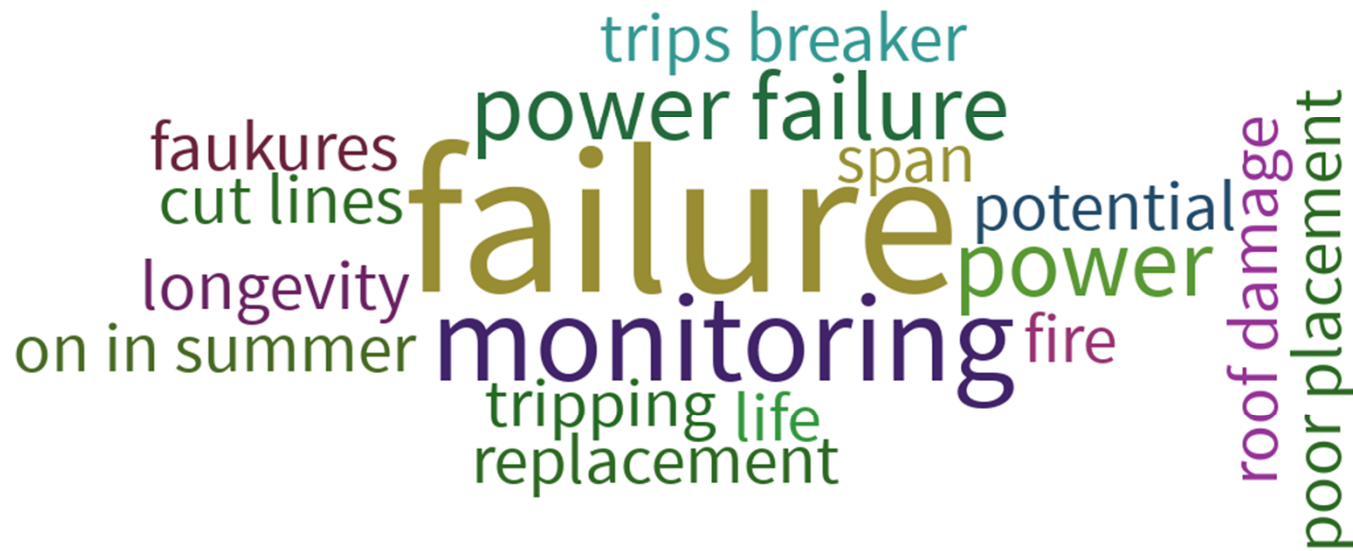
- Heat trace to be controlled by pipe wall sensing technology (instead of ambient air) and only activate when pipe temperature falls below pre-determined set point



When poll is active, respond at [PollEv.com/swa335](https://PollEv.com/swa335)

Text **SWA335** to **22333** once to join

## What are some potential issues with heat tracing systems?



Questions?



# 5 Minute Break

---

# Electrical

---

# DOE Lighting Facts Label

## Light Output/Lumens

Measures light output. The higher the number, the more light is emitted.

Reported as "Total Integrated Flux (Lumens)" on LM-79 test report.

## Watts

Measures energy required to light the product. The lower the wattage, the less energy used.

Reported as "Input Power (Watts)" on LM-79 report.

## Lumens per Watt/Efficacy

Measures efficiency. The higher the number, the more efficient the product.

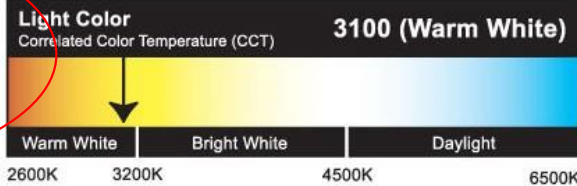
Reported as "Efficacy" on LM-79 test report.

## Lighting Facts™

LED Product

•Light Output (Lumens)	840
•Watts	9
•Lumens per Watt (Efficacy)	93

Color Accuracy	87
Color Rendering Index (CRI)	



Visit [www.lighting-facts.com](http://www.lighting-facts.com) for the *Label Reference Guide*.

All results are according to IESNA LM-79-2008: *Approved Method for the Electrical and Photometric Testing of Solid-State Lighting*.

## Color Rendering Index (CRI)

Measures color accuracy.

Color rendition is the effect of the lamp's light spectrum on the color appearance of objects.

## Correlated Color Temperature (CCT)

Measures light color.

"Cool" colors have higher Kelvin temperatures (3600–5500 K); "warm" colors have lower color temperatures (2700–3500 K).

## IESNA LM-79-2008

Industry standardized test procedure that measures performance qualities of LED luminaires and integral lamps. It allows for a true comparison of luminaires regardless of the light source.

# Light Fixtures

- Light fixture make/model/wattage matches submittals and the energy model
- Keep empty boxes of LED fixtures, as many fixtures don't have clear labeling on the fixture itself



# Light Fixtures



# Light Fixtures - BOH



# Light Fixtures – Verification



# Light Fixtures

- Be careful on decorative lighting



# Exterior Lighting



# Lighting Controls - General

- Interior and exterior controls on the electrical plans

LIGHTING CONTROL LEGEND	
AREA	CONTROL DESCRIPTION
CORRIDOR	CEILING MOUNTED AUTOMATIC OCCUPANCY SENSOR (AUNTOMATICALLY TURN OFF LIGHTS WITHIN 20 MINUTES)
LAUNDRY, BIKE STORAGE & RETAIL SPACE COMMON BATHROOMS	VACANCY SENSOR MANUAL ON/AUTO OFF (AUNTOMATICALLY TURN OFF LIGHTS WITHIN 20 MINUTES)
EXTERIOR LIGHTING	PHOTOCELL TO TURN LIGHTS ON & TIME CLOCK TO TURN LIGHTS OFF
GARAGE	ASTRONOMICAL TIME CLOCK TO TURN LIGHTS ON & OFF
AREAS WITHIN 15' OF WINDOWS (LOBBY)	DAY LIGHT ZONE SENSOR





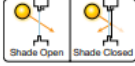

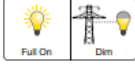


#### NOTES:

1. ALL FIXTURES IN DWELLING UNITS ARE HIGH EFFICACY FIXTURES.
2. EACH DWELLING UNIT IS SEPARATELY METERED THROUGH CON-EDISON. METER BANKS ARE LOCATED IN THE ELECTRICAL ROOM.
3. EACH SPACE INCLUDING INDIVIDUAL DWELLING UNITS ARE INDEPENDENTLY CONTROLLED VIA SWITCH OR OCCUPANCY SENSOR.
4. EXIT SIGNS WILL BE NOT MORE THEN 5 WATTS LED TYPE.
5. ELEVATOR CABS LIGHTING SYSTEM CONTROL SHALL BE PROVIDED BY ELEVATOR CONTRACTOR PER NYC ECC 2016 C405.9.1 REQUIREMENTS.

# Lighting Controls - General

## Energy-saving lighting control strategies

- [http://www.lutron.com/TechnicalDocumentLibrary/3672623\\_2013\\_ASHRAE.pdf](http://www.lutron.com/TechnicalDocumentLibrary/3672623_2013_ASHRAE.pdf)


Strategy	Potential savings
 <p><b>High-end trim/tuning</b> sets the maximum light level based on customer requirements in each space.*</p>	10–30% Lighting
 <p><b>Occupancy/vacancy sensing</b> turns lights on when occupants are in a space and off when they vacate the space.*</p>	20–60% Lighting
 <p><b>Daylight harvesting</b> dims electric lights when daylight is available to light the space.*</p>	25–60% Lighting
 <p><b>Personal dimming control</b> gives occupants the ability to set the light level.*</p>	10–20% Lighting
 <p><b>Controllable window shading</b> moves shades to reduce glare and solar heat gain.*</p>	10–20% Cooling
 <p><b>Scheduling</b> provides scheduled changes in light levels based on the time of day.*</p>	10–20% Lighting
 <p><b>Demand response</b> automatically reduces lighting loads during peak electricity usage times.*</p>	30–50% During peak period
 <p><b>Plug load control</b> automatically turns off loads after occupants leave a space.*</p>	15–50% of Controlled loads
 <p><b>HVAC integration</b> controls heating, ventilation, and air conditioning systems through a contact closure.*</p>	5–15% HVAC

\*Go to [lutron.com/references](http://lutron.com/references) for more information

# Lighting Controls - General

Codes can sometimes be complicated and difficult to navigate. This commercial application guide provides examples of how Lutron products can be used to meet or exceed code requirements. This guide focuses on Vive and Vive compatible solutions, but our other control systems offer similar features.

## Lutron Product Capabilities: Commercial Applications



	Local Solutions			Panel Solutions	
	Wallbox	Vive	Vive with wireless hub*	Energi Savr Node	Quantum
	Occupancy sensing	●	●	●	●
Multi-level lighting control	●	●	●	●	●
Daylight harvesting		●	●	●	●
Receptacle control		●	●	●	●
Timeclock			●	●**	●
Demand response			●†	●†	●
Energy monitoring			●		●
BACnet integration			●		●

Strategies for code/standards compliance

# Occupancy Sensors

- Three technology types
  - Infrared
  - Ultrasonic
  - Dual technology
- Occupancy Sensor (auto on - auto off)
- Vacancy Sensor (manual on - auto off)
- Work well with proper selection and positioning
- Make sure they are rated for the connected wattage of fixtures (“load capacity”)



## Bilevel Lighting



- Operates at lower light output under unoccupied conditions
- Occupancy sensor triggers full light level when motion detected
- Allows for code minimum lighting in rarely-occupied spaces, with safer lighting when in use

# Lighting Controls – Location

- Ceiling mounted vs wall mounted & obstructions and sensing spread



FALSE-ON	The sensor inaccurately detects occupancy, which can waste energy. Example: sensor in private office detects motion outside in hall.	Mitigate by selecting appropriate sensor technology, restricting coverage area, reducing sensitivity and/or specifying manual-ON operation.
FALSE-OFF	The sensor inaccurately detects vacancy, which can be disruptive to user activity while causing irritation. Example: students motionless for longer period of time while taking a test.	Mitigate by selecting appropriate sensor technology, providing good coverage, ensuring sensor can detect users wherever they are in space, and by increasing sensitivity.

When poll is active, respond at [PollEv.com/swa335](https://PollEv.com/swa335)

Text **SWA335** to **22333** once to join

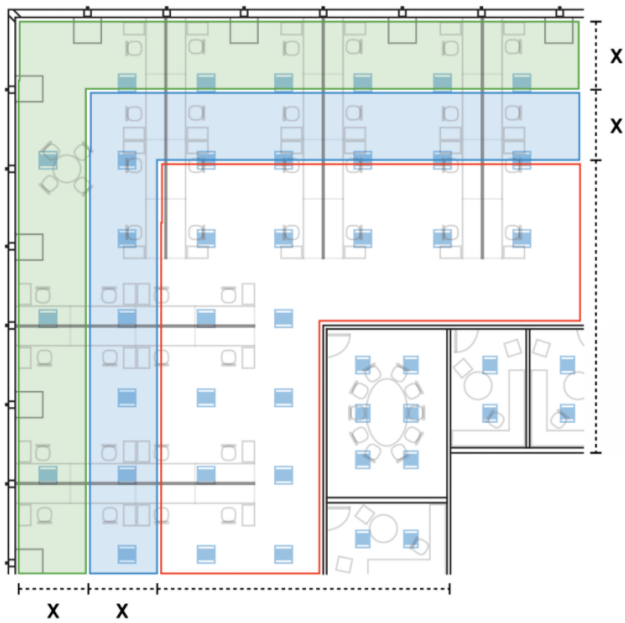
## What issues have you seen with occupancy or vacancy sensors?

A word cloud of responses to the poll question. The words are arranged in various sizes and orientations, with some appearing vertically on the left side. The most prominent words include 'improper placement', 'pollution', 'flux capacitor fails', 'commissioning high', 'mechanical', 'failure', 'sensitivity', 'poor placement', 'light pollution', 'installed', 'setup', 'operating', 'user resentment', 'blocked', 'movement', 'lack', 'ceilings', 'sensitivity', 'shut toilets', 'consistency', 'sensitivities', 'soon', 'light', 'systems', 'working occupant complaints', 'light', 'bathrooms', 'overridden', and 'correctly'.

improper placement  
pollution  
working occupant complaints  
flux capacitor fails  
commissioning high  
mechanical  
failure  
sensitivity  
poor placement  
light pollution  
installed  
setup  
operating  
user resentment  
blocked  
movement  
lack  
ceilings  
sensitivity  
shut toilets  
consistency  
sensitivities  
soon  
light  
systems  
bathrooms  
overridden  
correctly

# Lighting Controls – Daylight Zones

- Dimming controls
- Daylight zones



# Elevators

**10.4.3 Elevators.** Elevator systems shall comply with the requirements of this section.

**10.4.3.1 Lighting.** For the luminaires in each elevator cab, not including signals and displays, the sum of the lumens divided by the sum of the watts (as described in Section 9.1.4) shall be no less than 35 lm/W.

**10.4.3.2 Ventilation Power Limitation.** Cab ventilation fans for elevators without air conditioning shall not consume over 0.33 W/cfm at maximum speed.

**10.4.3.3 Standby Mode.** When stopped and unoccupied with doors closed for over 15 minutes, cab interior lighting and ventilation shall be de-energized until required for operation.

# Cold Water Booster Pump

- Very high horsepower
- Often variable frequency drive (VFD)
- Sized for redundancy

PUMPS SCHEDULE							
DESIGNATION		SERVICE	MANUFACTURE/MODEL	G.P.M./CFH	MAX. CFH	MAX. T.D.H./P.S.I.	H.P. (EA)
PP-1	TRIPLEX DOMESTIC BOOSTER PUMP	DOMESTIC WATER SYSTEM	SYNCROFLO	125	-	365'	25
PP-2			MODEL 250TRKB158VFD-GAF	125		365'	25
PP-3			RKB40/12LV/4 (4-STAGES)	125		365'	25



# Metering



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## What are your final thoughts and takeaways from the presentation today?



# Questions & Final Discussion



# Join Us for More Trainings!

- **Module 8.3** - QA/QC Techniques for Ensuring Success
- **Module 8.4** - Field Training & Mock-Ups

Register here: <https://www.newpaltz.edu/sustainability/view-programs-and-progress/zero-net-carbon-training/workshop-schedule-registration--details/>

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# Resources

- <https://www.swinter.com/party-walls/multifamily-passive-house-ventilation-design-part-1-unitized-or-centralized-hrv-erv/>
- [www.lightingfacts.com](http://www.lightingfacts.com)
- [http://www.lutron.com/TechnicalDocumentLibrary/3672623\\_2013\\_ASHRA\\_E.pdf](http://www.lutron.com/TechnicalDocumentLibrary/3672623_2013_ASHRA_E.pdf)