We will be starting soon!

Thanks for joining us

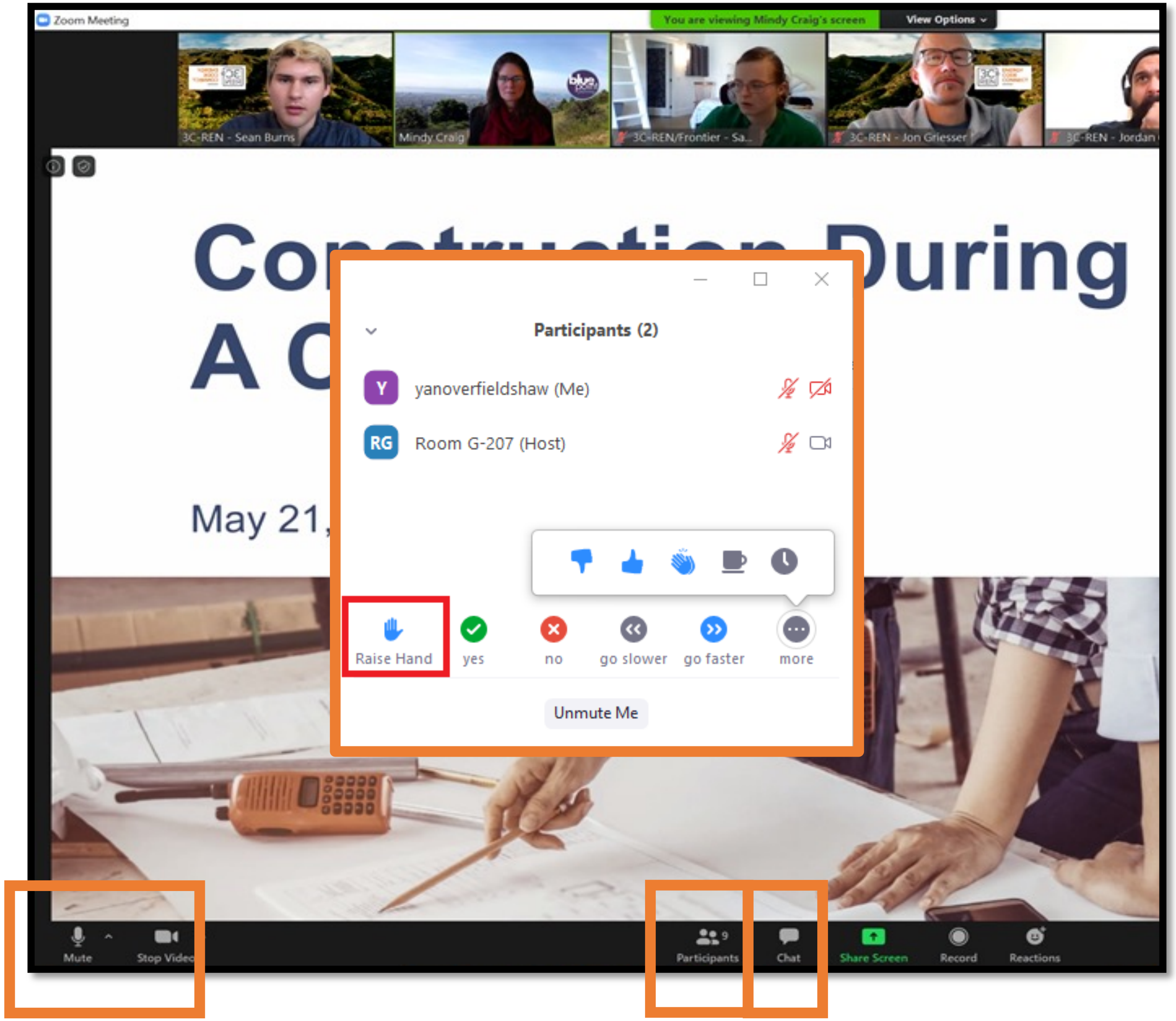
HRVs and ERVs for Passive House Applications

Albert Rooks – Small Planet Supply

October 25th, 2022

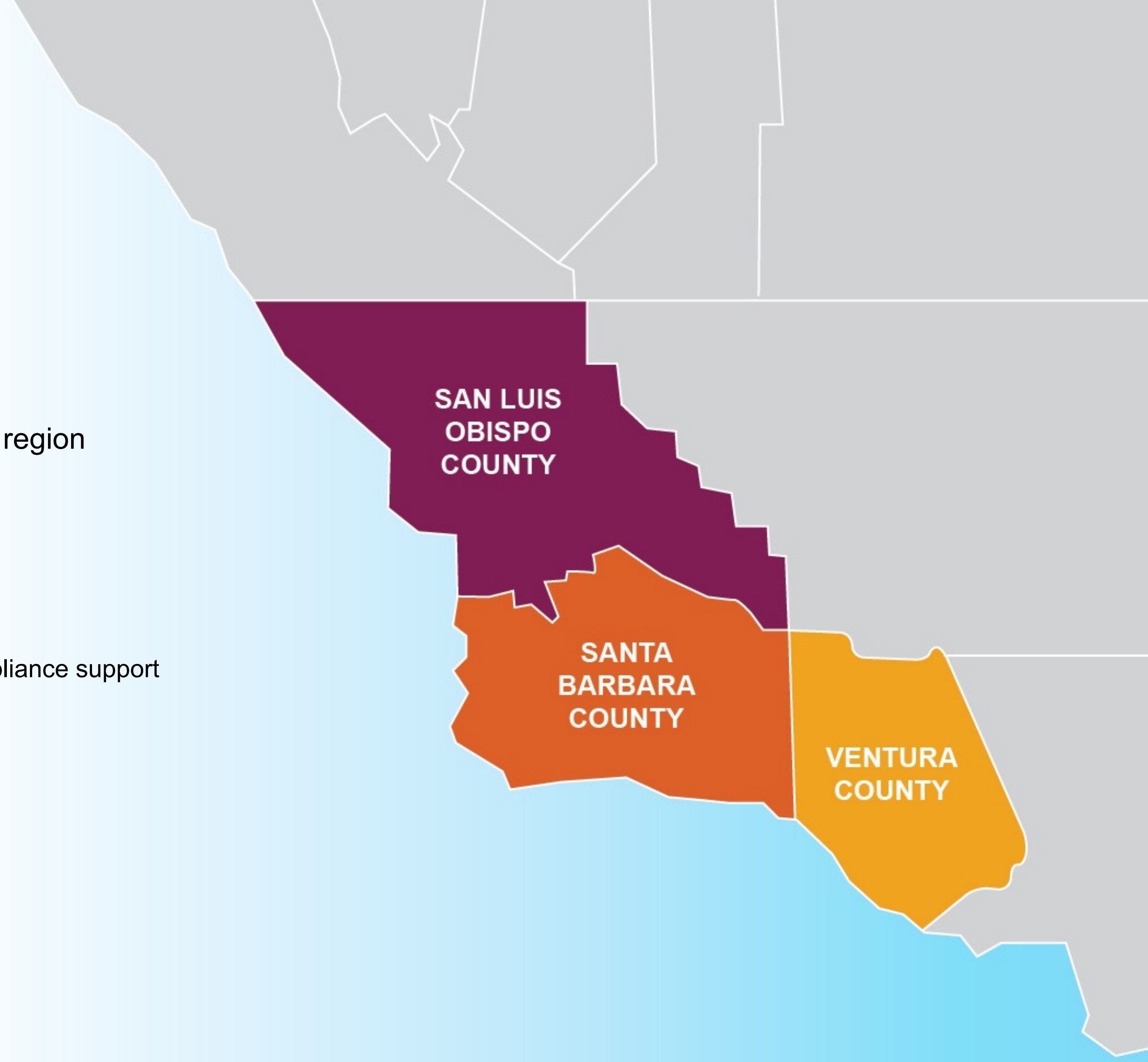
Zoom Orientation

- Please be sure your full name is displayed
- Please mute upon joining
- Use "Chat“ box to share questions or comments
- Under "Participant" select "Raise Hand"
to share a question or comment verbally
- The session may be recorded and posted to 3C-REN's on-demand page. Feel free to ask questions via the chat and keep video off if you want to remain anonymous in the recording.



3C-REN: Tri-County Regional Energy Network

- Three counties working together to improve energy efficiency in the region
- Services for –
  - **Building Professionals:** industry events, training, and energy code compliance support
  - **Households:** free and discounted home upgrades
- Funded by ratepayer dollars that 3C-REN returns to the region



3C-REN ENERGY CODE CONNECT

3C-REN BUILDING PERFORMANCE TRAINING

3C-REN HOME ENERGY SAVINGS

3C-REN ENERGY CODE CONNECT

- Serves all building professionals
- Three services –
  - **Energy Code Coach**
  - **Training and Support**
  - **Regional Forums**
- Makes the Energy Code easy to follow

Energy Code Coach:
3c-ren.org/codes
805.220.9991

Event Registration:
3c-ren.org/events

3C-REN BUILDING PERFORMANCE TRAINING

- Serves current and prospective building professionals
- Expert instruction:
    - **Technical skills**
    - **Soft skills**
- Helps workers to thrive in an evolving industry

Event Registration:
3c-ren.org/events

3C-REN HOME ENERGY SAVINGS

Multifamily (5+ units)

- No cost technical assistance
- Rebates up to $750/apartment plus additional rebates for specialty measures like heat pumps

Single Family (up to 4 units)

- Sign up to participate!
- Get paid for the metered energy savings of your customers

Enrollment:
3C-REN.org/contractor-participation

3C-REN
Staff Online

Instructor Introduction

Albert Rooks

- •CEO: Small Planet Supply
- •Workshop leader teaching airtightness & ventilation USA (2010)
- •Workshop leader for British Columbia Canada energy code, air tightness, & ventilation (2016)
- •Passive House Instructor British Columbia Institute of Technology

A little bit about you:

Are you a:

- **Builder:** (Contractors, plumbers, electricians and other building trades)
- **Designer: (**Architects, engineers and other design professionals)
- **Real Estate:** (Realtors, appraisers, inspectors and other real estate professionals)
- **Emerging Professional:** (Student or young professional)
- **Other**

Where are you from?

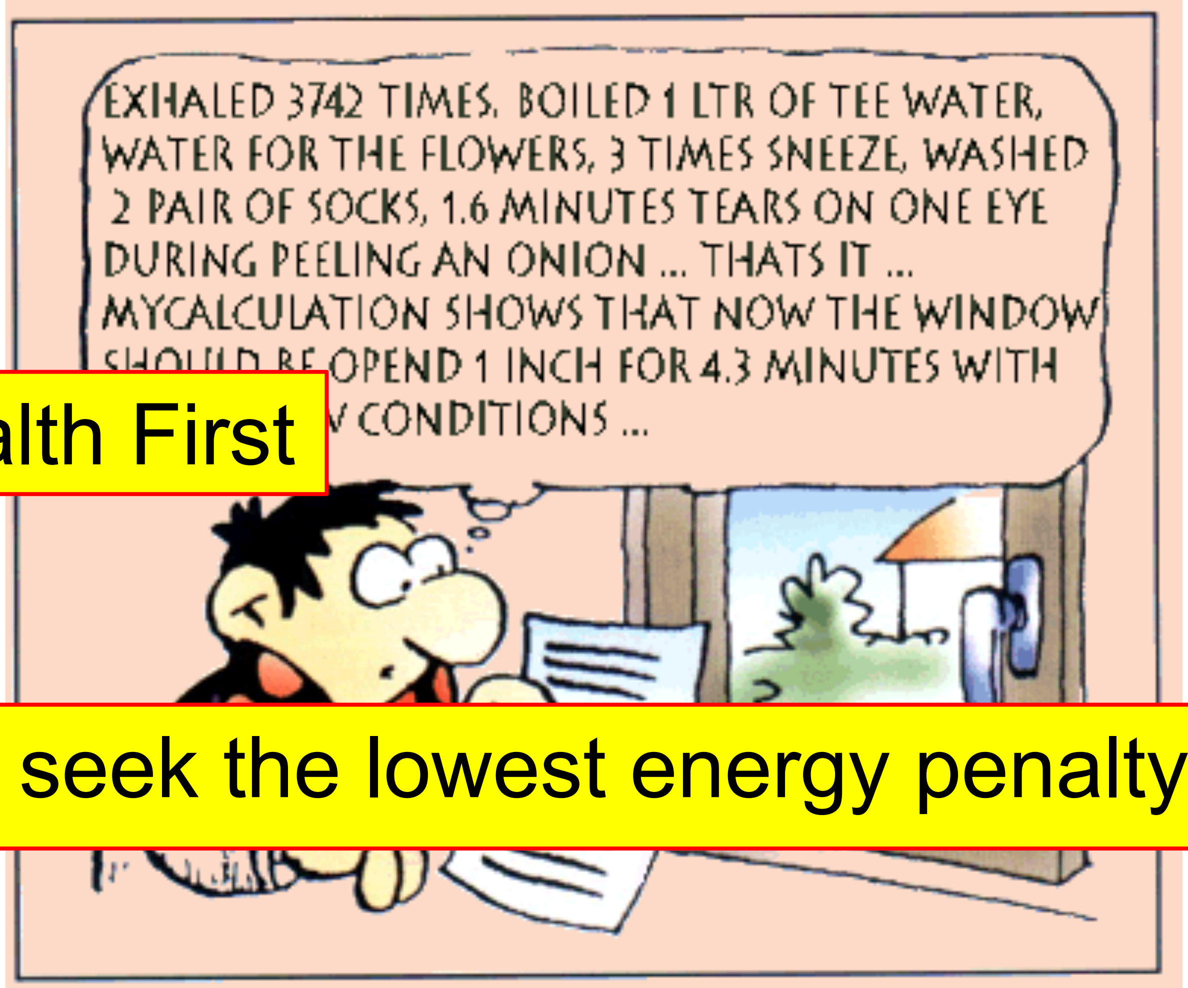
- **Central California**
- **Elsewhere in California**
- **United States**
- **Canada**
- **Other**

How familiar are you with Passive House?

- Heard of it but haven't participated in a project
- Built or designed a Passive House project
- Work exclusively in designing or building Passive House projects

Passive House Ventilation Goals

Passive House Ventilation



Comfort & Health First

Then seek the lowest energy penalty

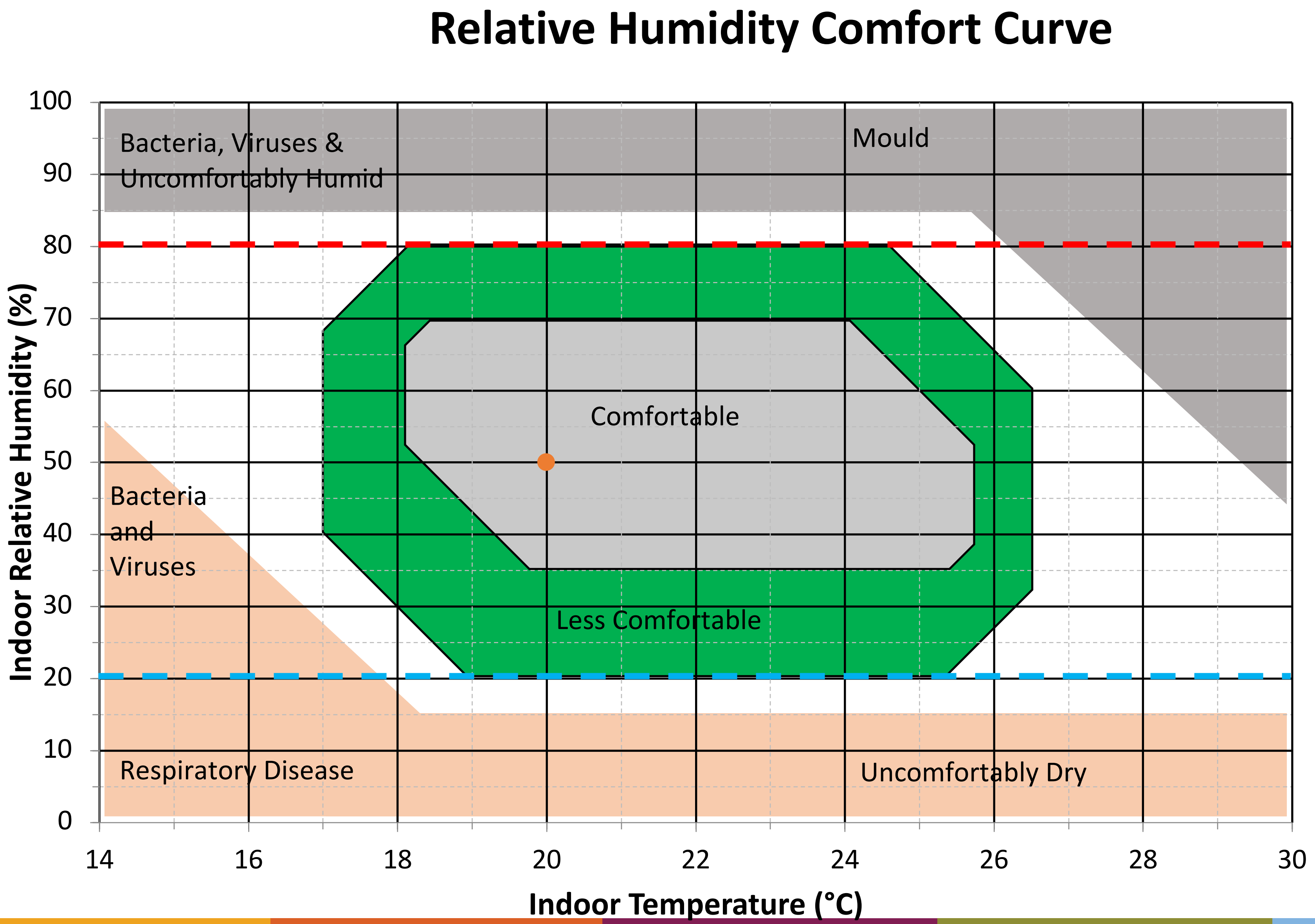
wikipedia.org/wiki/Communaute_metropolitaine_de_Quebec

Why Ventilate?

- **Bring in fresh air:**
  - Dilutes pollutants
    - CO_2, water vapor, VOCs
  - Can help to improve humidity (in humid or dry climates)

- **Mechanical ventilation systems can:**
  - Filter the air
  - Temper the air in heating & cooling seasons
  - Provide humidification and dehumidification
  - Take advantage of heat recovery between the outgoing exhaust air and incoming fresh air

Relative Humidity Comfort Curve



Comfortable Indoor Humidity Levels

- While various sources cite varying upper and lower limits, a relative humidity below approx. 30% can cause dryness of the skin and mucous membranes, possibly increasing the risk of infection, as well as dry out wood floors and furniture.

- High humidity levels, 70 – 80 % and up, foster mold growth, dust mites, and is generally uncomfortable especially at high temperatures.

- **The target range for relative humidity indoors is thus 35 – 60 % RH.**

Passive House Ventilation Design Guidelines & Requirements

Ventilation Equipment: HRV and ERV

The HRV / ERV (heat/energy recovery ventilator) is the lungs of the Passive House ventilation system.

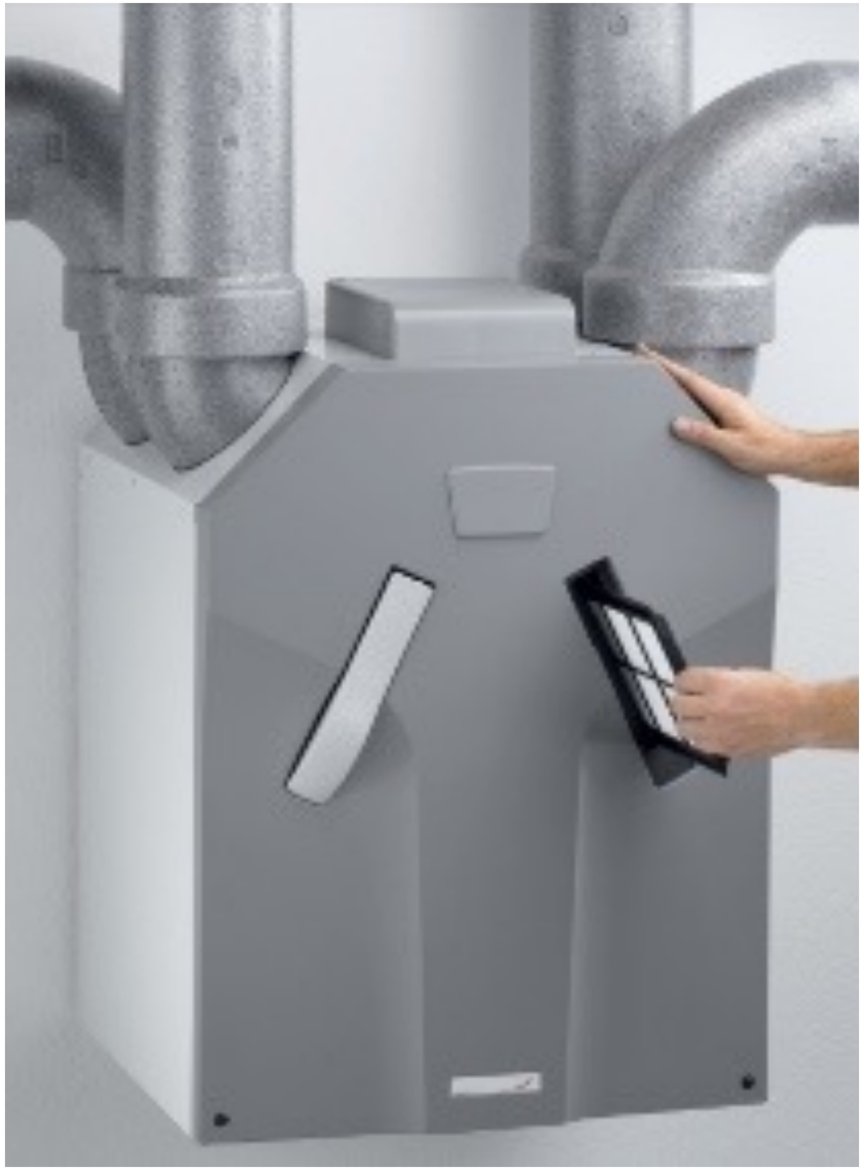
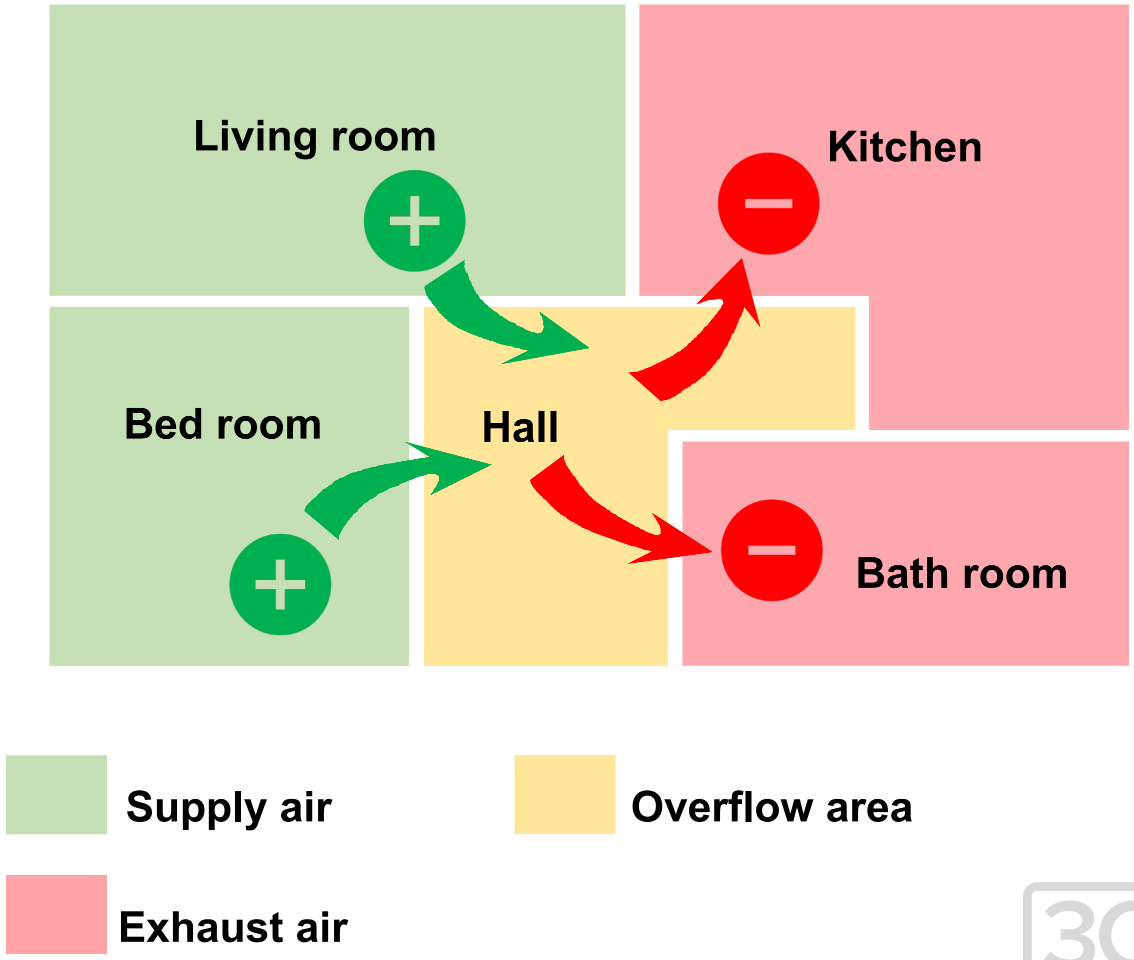


Photo: Zehnder

Balanced with Distribution

- The air goes where we design it to go.
- Bedrooms, living rooms, studies, get a steady flow of fresh air.
- Kitchens, baths, laundry and mudrooms get a steady flow of exhaust.



Determining Air Flow Rates

- **Note: local building codes and laws must always take precedence over Passive House design.**

- For the most part the methods that follow will produce a result roughly similar to many other methods, but cannot be substituted unless explicitly authorized by your local governing body.

Determining Ventilation Capacity

- Passive House uses **3 methods** to calculate the Ventilation Rate, then takes the highest of the 3 for the **Design Ventilation Rate**:

1. **MIN. TOTAL SUPPLY** @ 100% fan speed:
   - 30 m^3/h per person (18 CFM)
2. **MIN. TOTAL EXTRACT** @ 100% fan speed:
   - Each WC, Storage, Laundry, etc: 20 m^3/h (12CFM)
   - Each Full Bath: 40 m^3/h (24CFM)
   - Each Kitchen: 60 m^3/h (36 CFM)
3. **MIN. AIR CHANGE RATE** @ 77% fan speed:
   - 0.3 ACH*

'Boost' speed

'Normal' speed

** = 0.39 ACH @ 100% fan speed*

Determining Ventilation Rates: Equations

1. **MIN. TOTAL SUPPLY:**

   Flow Rate = number of people × 30 m^3/h (18CFM)

- **2. MIN. TOTAL EXTRACT:**

  Flow Rate = (Kitchens × 60 m^3/h) + (Bathrooms × 40 m^3/h)

  + (Laundry/Half-Baths/etc. × 20 m^3/h)

- (36 CFM, 24 CFM, 12 CFM)

- **3. MIN. AIR-CHANGE-RATE:**

- Flow Rate = (0.3 ACH × V_v) ÷ 0.77

V_v = the "ventilated volume" of the building = TFA x 2.5 m

Divide by 0.77 to adjust 0.3 ach at average flow rate to full speed to compare to the other calculations

Determining Ventilation Rates: Example

For an apartment for 3 people, 100 m^2 TFA, 1 kitchen, 1 full bathroom, 1 WC:

- **1. MIN. TOTAL SUPPLY:**

  3 people $\times$ 30 m^3/h = 90 m^3/h

- **2. MIN. TOTAL EXTRACT:**

  1 $\times$ 60 m^3/h (kitchen) + 1 $\times$ 40 m^3/h (bathroom)

- + 1 $\times$ 20 m^3/h (WC) = 120 m^3/h

  Required maximum capacity

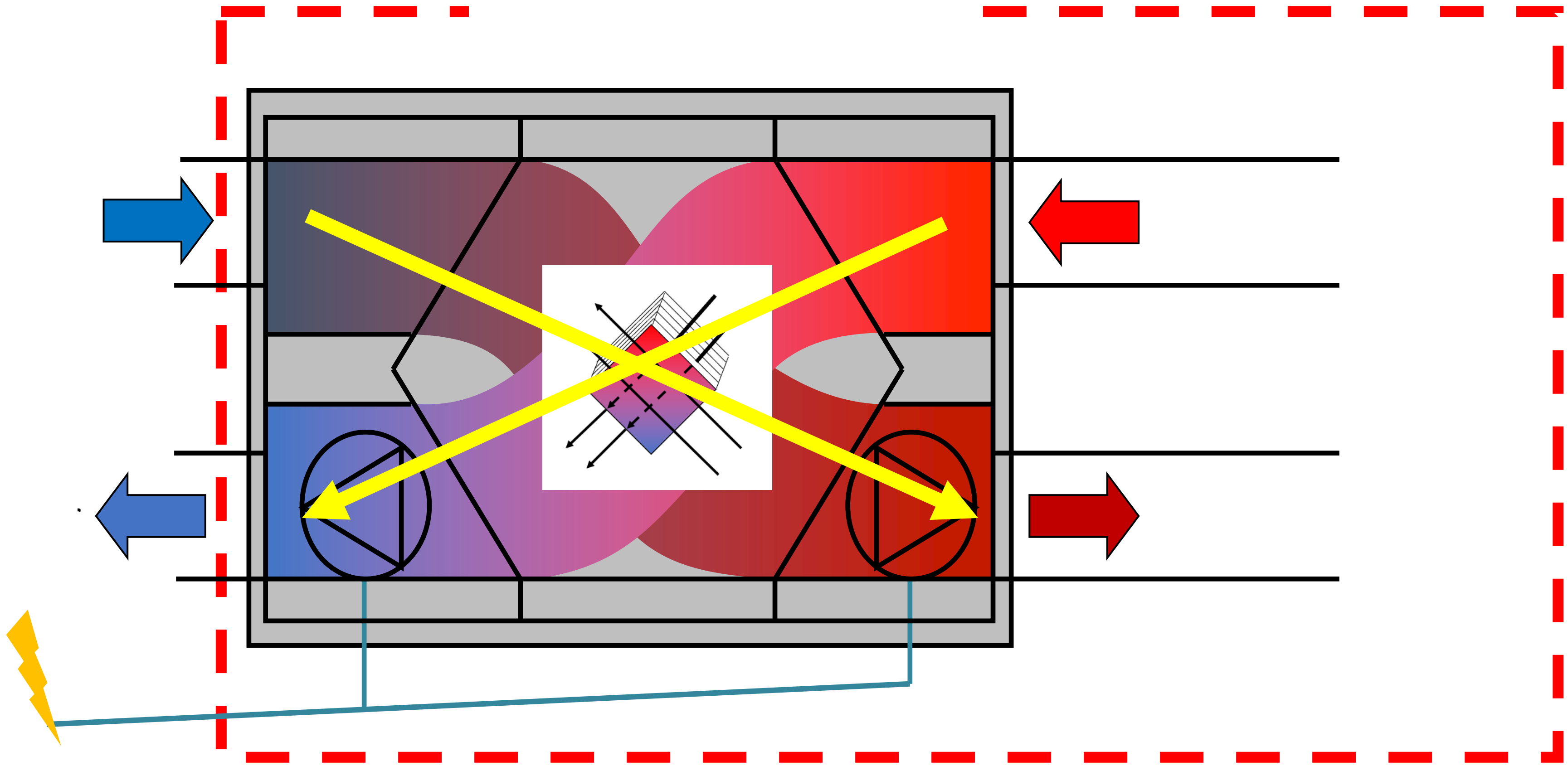
- (36+24+12 = 72 CFM)

- **3. MIN. AIR-CHANGE-RATE:**

- $0.3\ h^{-1} \times (90\ m^2 \times 2.5\ m) \div 0.77 = 87.7\ m^3/h$ (52 CFM)

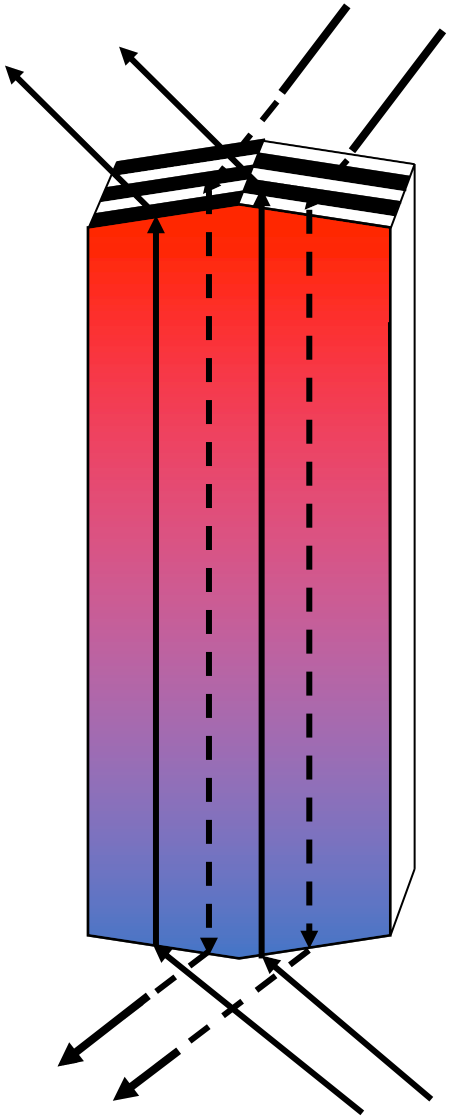
Recovery Effectiveness - Heat

How Does Heat Recovery Work?

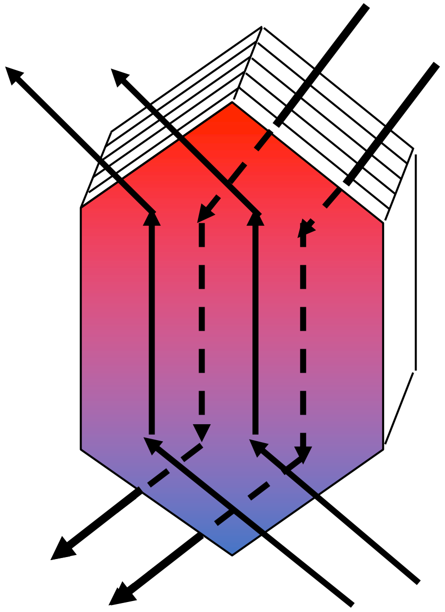


Types of heat exchange cores

Core size has an influence on heat recovery efficiency- be wary of small cores that claim high efficiencies

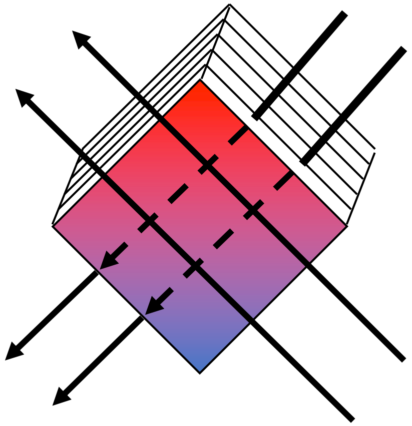


Counter flow 70 -95 %



Cross-counter flow

70 - 85 %

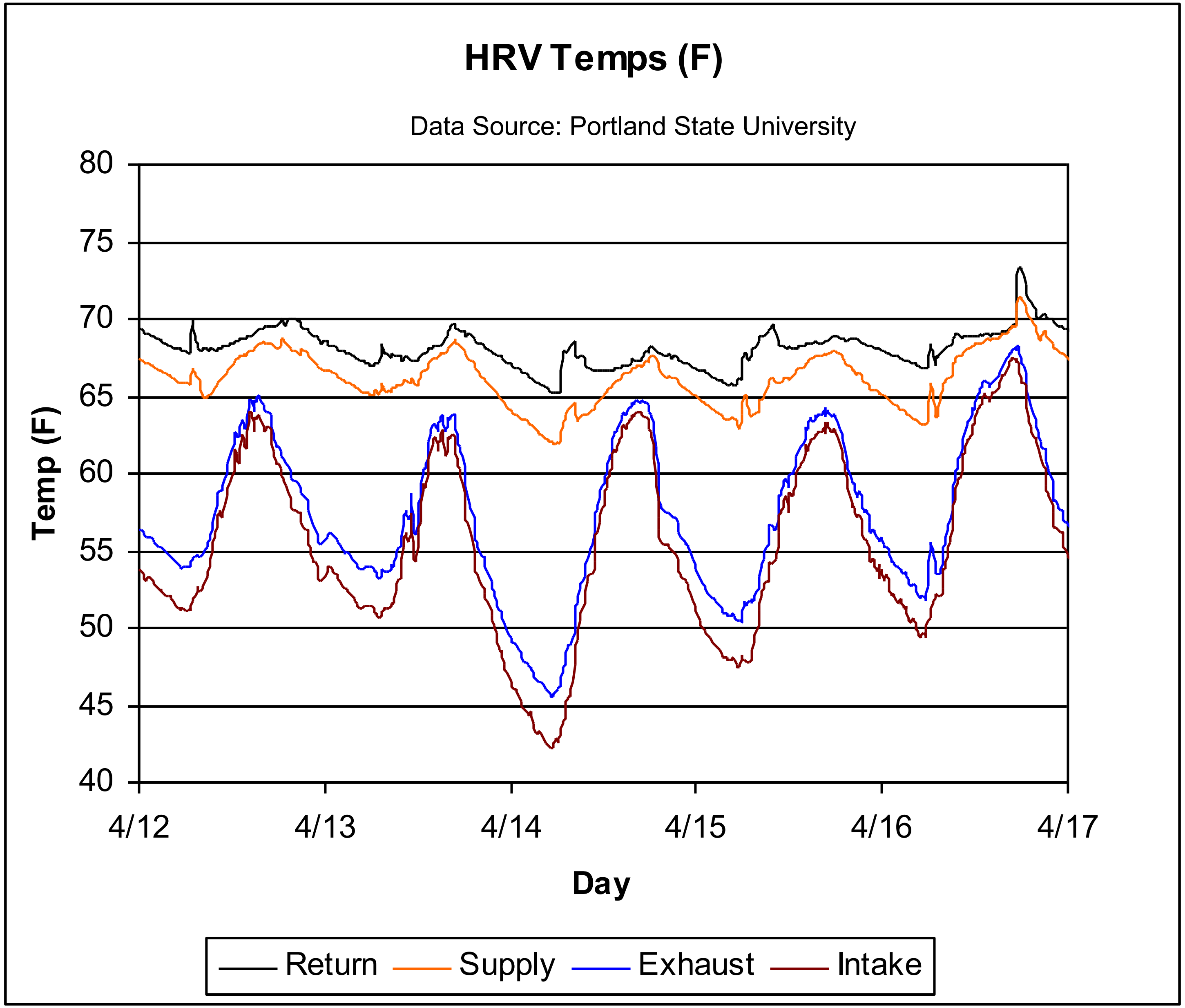


Cross flow

40 - 60 %

Use Heat Recovery to Reduce the Energy Impact

- April 2014
- New Home in Vancouver WA
- Well Insulated, Airtight.
- Heating System Not Turned on Yet.
- HRV 90% Effectiveness



Recovery Effectiveness - Moisture & Humidity

Controlling Moisture with Ventilation

In order to determine indoor humidity, we need to know the humidity that’s coming in with the fresh air, and add the humidity being generated inside.

Internal Humidity Sources

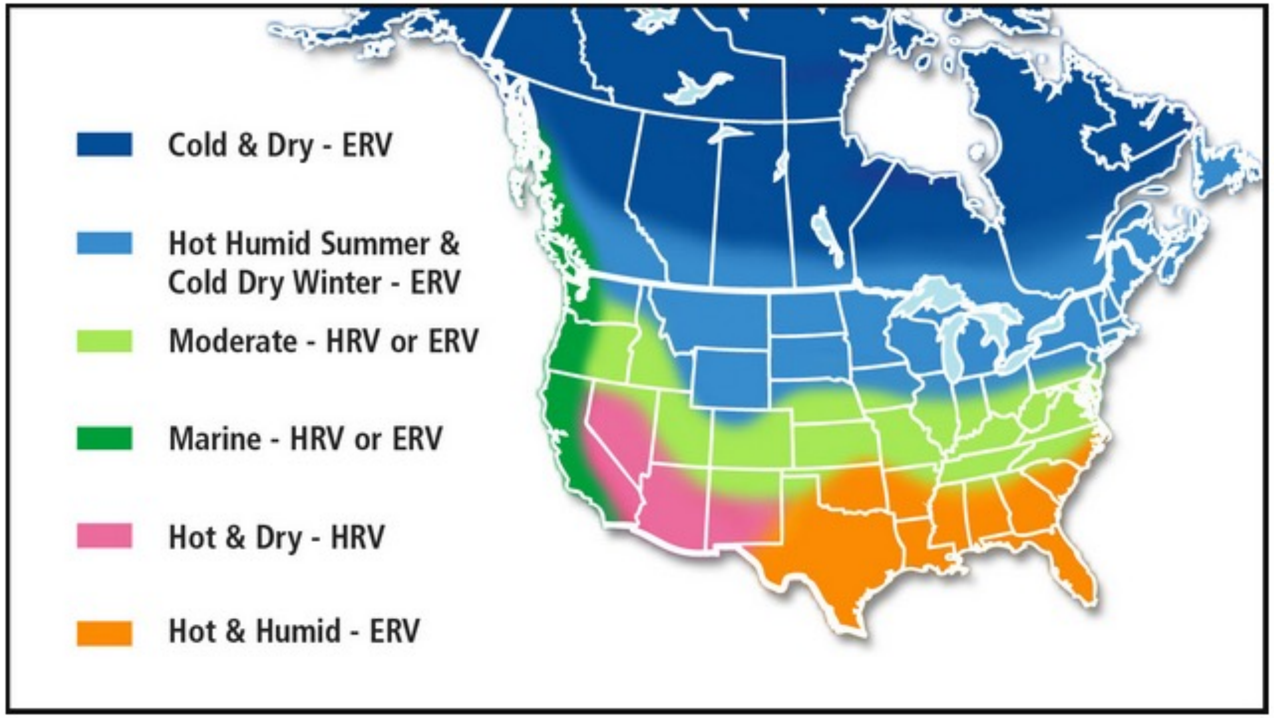
Sample calculation of mean humidity levels accumulated in an apartment with 4 residents

Humidity accumulation				
	Amount per week!	mean humidity accumulation:		Humidity production per h
Potted plants	5.0	5	g/Watering plants	25.0
Medium-sized rubber tree	1.0	15	g/Watering plants	15.0
Drying clothes 4.5kg, not inside the apartment	0.0	3200	g/Cloth drying	0.0
Bath	2.0	1100	g/Bath	13.0
Shower	14.0	1600	g/shower	133.0
Quick meal (cooking)	7.0	70	g/Cooking	3.0
Extensive meal	7.0	200	g/Cooking	8.0
Dishwasher	5.0	200	g/Dish washer	6.0
Washing machine	0.0	300	g/Washing	0.0
Sleeping human being (Assumption 8 hours)	4.0	50	g/Day	67.0
Human being awake (Assumption 6 hours)	3.0	80	g/Day	60.0
Steam air humidifier	0.0	1	l/d	0.0
Total humidity load			g/h	330.0

Source: PHI

Where to Use HRV or ERV?

- Climate conditions (temperature and humidity) have a significar influence on HR\ / ERV selection

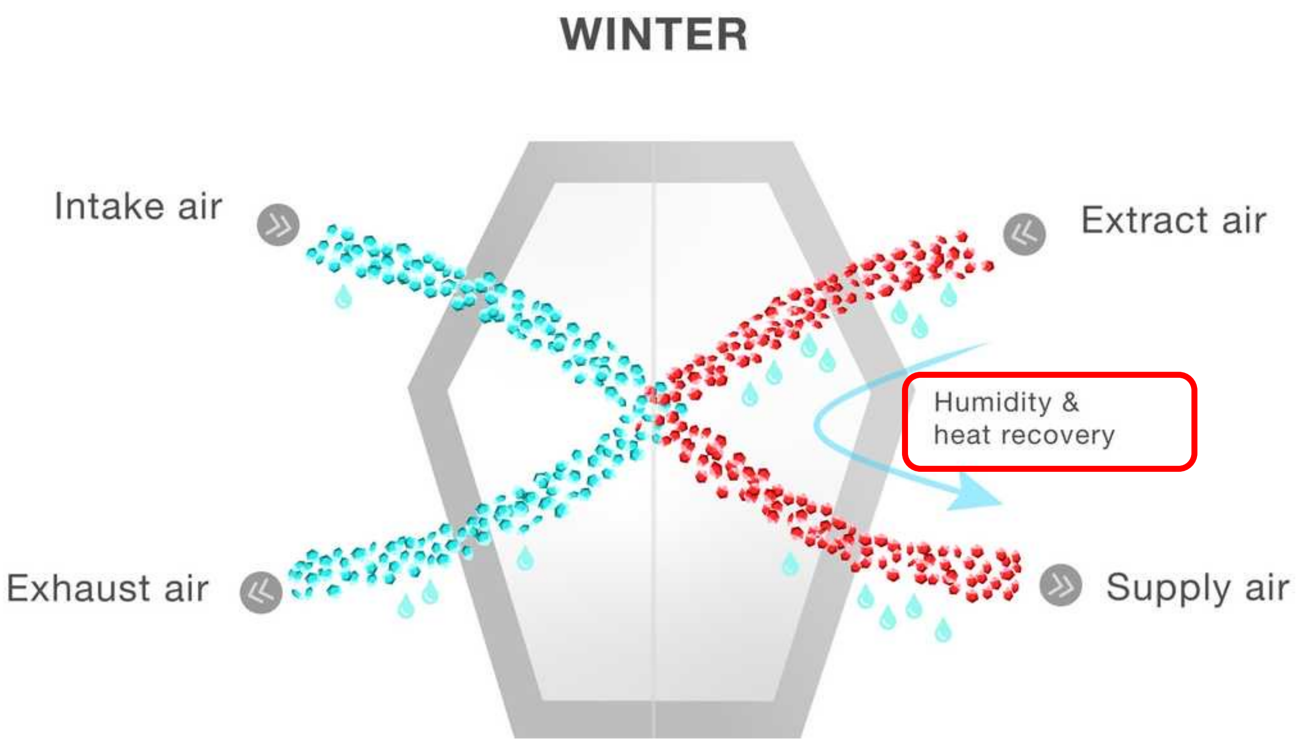


Benefits of using an ERV in a cold climate:

- Indoor humidity partially transferred to dry fresh air
- Lower frost point, requiring less pre-heating
- Reduced condensate, possibly eliminating need for condensate drain (not recommended!)

Source CoreLife.ca

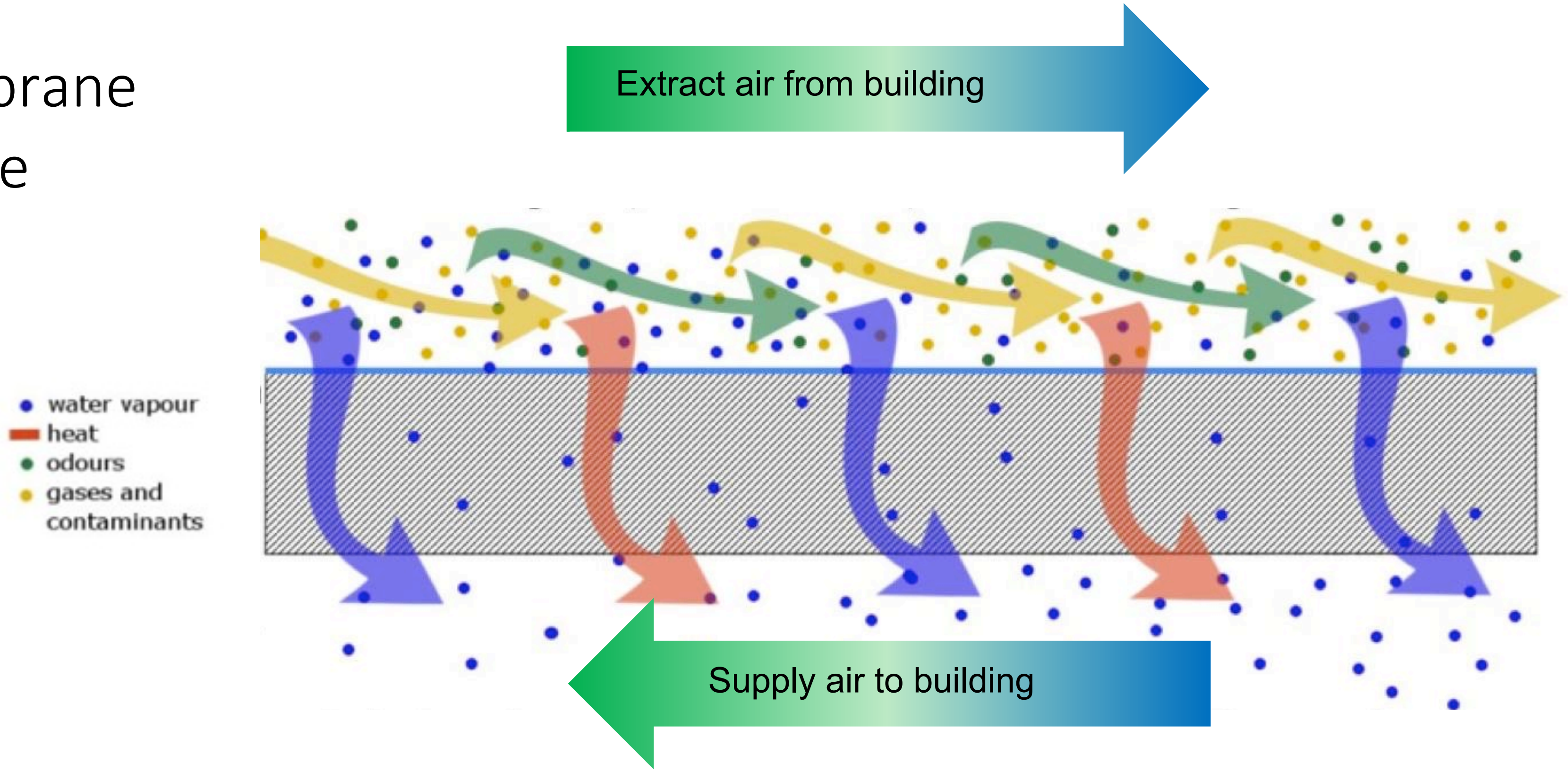
What is Enthalpy Recovery?



Source: Zehnder America

How Does Enthalpy Recovery Work?

ERVs - Membrane with Selective Transfer

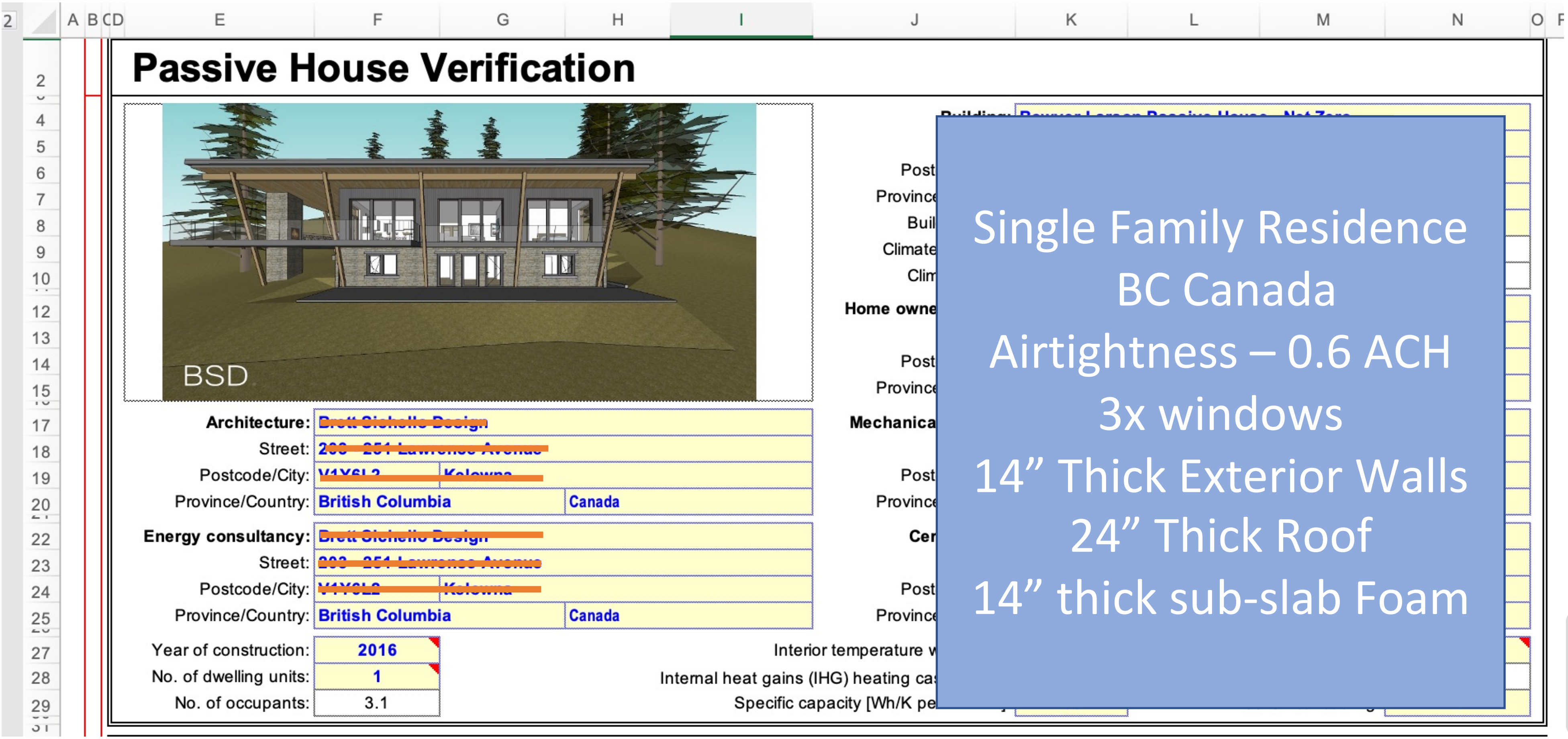


- Only transfer of heat and water vapour through the membrane
- No transfer of gases, contaminants or odours

Source: CoreLife

How HRV and ERV Effectiveness Impacts the Building Load

Ventilation Effectiveness in PHPP



Single Family Residence
BC Canada
Airtightness – 0.6 ACH
3x windows
14" Thick Exterior Walls
24" Thick Roof
14" thick sub-slab Foam

Effectiveness - Aldes - 76%

Location of ventilation unit: 1-Inside thermal envelope

Ventilation unit selection	Heat recovery efficiency Unit η_{WRG}	Energy recovery η_{ERV}	Specific efficiency [Wh/m³]	Application [m³/h]	Frost power input
Go to ventilation units list 1-Sorting: LIKE LIST					
0780vs03-ALDES Aéraulique - Dee Fly Cube 300	0.77	0.00	0.43	90 - 231	yes

Conductivity outdoor air duct	Y	W/(mK)	0.354
Length of outdoor air duct		m	1
Conductivity exhaust air duct	Y	W/(mK)	0.354
Length of exhaust air duct		m	1
Temperature of mechanical services room		°C	
(Enter only if the central unit is outside of the thermal envelope)			

Implementation of frost protection	2-Elec.
Limit temperature [°C]	-15
Useful energy [kWh/a]	0
Room temperature (°C)	20
Avg. ambient temp. heat. period (°C)	3.1
Avg. ground temp (°C)	9.3

Effective heat recovery efficiency $\eta_{HR,eff}$ **76.2%**

Effective heat recovery efficiency subsoil heat exchanger

SHX efficiency	η^*_{SHX}	100%
Heat recovery efficiency SHX	η_{SHX}	36%

Secondary calculation
Ψ-value supply or outdoor air duct

Nominal width:	150	mm
Insulation thick	50	mm
Reflective coating?	x	Yes
		No
Thermal conductivity	0.037	W/(mK)
Nominal air flow rate	176	m³/h
Δϑ	17	K
Exterior duct diameter	0.150	m
Exterior diameter	0.250	m
α–Interior	12.72	W/(m²K)
α-Surface	2.75	W/(m²K)
Ψ–value	**0.354**	**W/(mK)**
Surface temperature difference	2.764	K

Secondary calculation
Ψ-value extract or exhaust air duct

Nominal width:	150	mm
Insulation thickness	50	mm
Reflective coating?	x	yes
		no
Thermal conductivity	0.037	W/(mK)
Nominal air flow rate	176	m³/h
Δϑ	17	K
Exterior duct diameter	0.150	m
Exterior diameter	0.250	m
α–Interior	12.72	W/(m²K)
α-Surface	2.75	W/(m²K)
Ψ–value	**0.354**	**W/(mK)**
Surface temperature difference	2.764	K

Effectiveness - Aldes - 76%

Too High !!

Province/Country:	British Columbia	Canada	Province/Country:		
Year of construction:	2016	Interior temperature winter [°C]:	20.0	Interior temp. summer [°C]:	25.0
No. of dwelling units:	1	Internal heat gains (IHG) heating case [W/m²]:	2.3	IHG cooling case [W/m²]:	2.3
No. of occupants:	3.1	Specific capacity [Wh/K per m² TFA]:	60	Mechanical cooling:	x

Specific building characteristics with reference to the treated floor area

The PHPP has not been filled completely; it is not valid as verification

						Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	234.8					
Space heating	Heating demand	kWh/(m²a)	15.7	≤		15	-	no
	Heating load	W/m²	11.8	≤		-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	1	≤		15	15	yes
	Cooling load	W/m²	0	≤		-	10	
	Frequency of overheating (> 25 °C)	%	-	≤		-		-
	Frequency excessively high humidity (> 12 g/kg)	%	0	≤		10		yes
Airtightness	Pressurization test result n_{50}	1/h	0.6	≤		0.6		yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	86	≤		-		-
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	37.2	≤		45	37	yes
	Generation of renewable energy	kWh/(m²a)	62	≥		60	48	

[2] Empty field: Data missing; '-': No requirement

confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

Passive House Plus? no

Task: First name: Surname: Signature:

Effectiveness – Zehnder ComfoAir 350 - 83%

Increase effectiveness to 83%

Location of ventilation unit: 1-Inside thermal envelope

Ventilation unit selection	Heat recovery efficiency Unit η_{WRG}	Energy recovery η_{ERV}	Specific efficiency [Wh/m³]	Application [m³/h]	Frost power input
Go to ventilation units list 1-Sorting: LIKE LIST					
01ud-Zehnder - ComfoAir350, ComfoD350, WHR930	0.84	0.00	0.29	71 - 293	yes

Conductivity outdoor air duct	Y	W/(mK)	0.354
Length of outdoor air duct		m	1
Conductivity exhaust air duct	Y	W/(mK)	0.354
Length of exhaust air duct		m	1
Temperature of mechanical services room		°C	
(Enter only if the central unit is outside of the thermal envelope)			

Implementation of frost protection	2-Elec.
Limit temperature [°C]	-15
Useful energy [kWh/a]	0
Room temperature (°C)	20
Avg. ambient temp. heat. period (°C)	3.1
Avg. ground temp (°C)	9.3

Effective heat recovery efficiency $\eta_{HR,eff}$ **83.1%**

Effective heat recovery efficiency subsoil heat exchanger

SHX efficiency	η^*_{SHX}	100%
Heat recovery efficiency SHX	η_{SHX}	36%

Secondary calculation
Ψ-value supply or outdoor air duct

Nominal width:	150	mm
Insulation thick	50	mm
Reflective coating?	x	Yes
		No
Thermal conductivity	0.037	W/(mK)
Nominal air flow rate	176	m³/h
Δϑ	17	K
Exterior duct diameter	0.150	m
Exterior diameter	0.250	m
α–Interior	12.72	W/(m²K)
α-Surface	2.75	W/(m²K)
Ψ–value	**0.354**	**W/(mK)**
Surface temperature difference	2.764	K

Secondary calculation
Ψ-value extract or exhaust air duct

Nominal width:	150	mm
Insulation thickness	50	mm
Reflective coating?	x	yes
		no
Thermal conductivity	0.037	W/(mK)
Nominal air flow rate	176	m³/h
Δϑ	17	K
Exterior duct diameter	0.150	m
Exterior diameter	0.250	m
α–Interior	12.72	W/(m²K)
α-Surface	2.75	W/(m²K)
Ψ–value	**0.354**	**W/(mK)**
Surface temperature difference	2.764	K

Effectiveness – Zehnder ComfoAir 350 - 83%

Passes Heat Load Requirement

Province/Country:	British Columbia	Canada	
Year of construction:	2016	Interior temperature winter [°C]:	20.0
No. of dwelling units:	1	Internal heat gains (IHG) heating case [W/m²]:	2.3
No. of occupants:	3.1	Specific capacity [Wh/K per m² TFA]:	60

Province/Country:		
Interior temp. summer [°C]:	25.0	
IHG cooling case [W/m²]:	2.3	Occupa
Mechanical cooling:	x	2

Specific building characteristics with reference to the treated floor area — **The PHPP has not been filled completely; it is not valid as verification**

					Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	234.8				
Space heating	Heating demand	kWh/(m²a)	15.0	≤	15	-	yes
	Heating load	W/m²	11.7	≤	-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	1	≤	15	15	yes
	Cooling load	W/m²	0	≤	-	10	
	Frequency of overheating (> 25 °C)	%	-	≤	-		-
	Frequency excessively high humidity (> 12 g/kg)	%	0	≤	10		yes
Airtightness	Pressurization test result n_{50}	1/h	0.6	≤	0.6		yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	81	≤	-		-
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	35.3	≤	45	35	yes
	Generation of renewable energy	kWh/(m²a)	62	≥	60	45	

1-PE-fa

(Selecte

[2] Empty field: Data missing; '-': No requirement

I confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

Passive House Plus? yes

Task: First name: Surname: Signature:

Building

Class

Effectiveness - Novus 300 - 92%

Increase effectiveness to 92%

entilation unit selection	Go to ventilation units list 1-Sorting: LIKE LIST	Heat recovery efficiency Unit η_{WRG}	Energy recovery η_{ERV}	Specific efficiency [Wh/m³]	Application [m³/h]	Frost power input
	0302vs03-PAUL - novus 300	0.93	0.00	0.24	121 - 231	yes

Conductivity outdoor air duct	Y	W/(mK)	0.354
Length of outdoor air duct		m	1
Conductivity exhaust air duct	Y	W/(mK)	0.354
Length of exhaust air duct		m	1
Temperature of mechanical services room		°C	
(Enter only if the central unit is outside of the thermal envelope)			

Implementation of frost protection	2-Elec.
Limit temperature [°C]	-15
Useful energy [kWh/a]	0
Room temperature (°C)	20
Avg. ambient temp. heat. period (°C)	3.1
Avg. ground temp (°C)	9.3

ffective heat recovery efficiency $\eta_{HR,eff}$ **92.0%**

ffective heat recovery efficiency subsoil heat exchanger

SHX efficiency	η^*_{SHX}	100%
Heat recovery efficiency SHX	η_{SHX}	36%

Secondary calculation
Ψ-value supply or outdoor air duct

Nominal width:	150	mm
Insulation thick	50	mm
Reflective coating?	x	Yes
		No
Thermal conductivity	0.037	W/(mK)
Nominal air flow rate	176	m³/h
Δϑ	17	K
Exterior duct diameter	0.150	m
Exterior diameter	0.250	m
α–Interior	12.72	W/(m²K)
α-Surface	2.75	W/(m²K)
Ψ–value	**0.354**	**W/(mK)**
Surface temperature difference	2.764	K

Secondary calculation
Ψ-value extract or exhaust air duct

Nominal width:	150	mm
Insulation thickness	50	mm
Reflective coating?	x	yes
		no
Thermal conductivity	0.037	W/(mK)
Nominal air flow rate	176	m³/h
Δϑ	17	K
Exterior duct diameter	0.150	m
Exterior diameter	0.250	m
α–Interior	12.72	W/(m²K)
α-Surface	2.75	W/(m²K)
Ψ–value	**0.354**	**W/(mK)**
Surface temperature difference	2.764	K

Effectiveness - Novus 300 - 92%

Heat Load Reduction
From 83% = 6%
From 76% = 11%

Province/Country: British Columbia | Canada | Province/Country:

Year of construction: 2016 | Interior temperature winter [°C]: 20.0 | Interior temp. summer [°C]: 25.0

No. of dwelling units: 1 | Internal heat gains (IHG) heating case [W/m²]: 2.3 | IHG cooling case [W/m²]: 2.3

No. of occupants: 3.1 | Specific capacity [Wh/K per m² TFA]: 60 | Mechanical cooling: x

Specific building characteristics with reference to the treated floor area

The PHPP has not been filled completely; it is not valid as verification

			Value		Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	234.8				
Space heating	Heating demand	kWh/(m²a)	14.0	≤	15	-	yes
	Heating load	W/m²	11.4	≤	-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	1	≤	15	15	yes
	Cooling load	W/m²	0	≤	-	10	
	Frequency of overheating (> 25 °C)	%	-	≤	-		-
	Frequency excessively high humidity (> 12 g/kg)	%	0	≤	10		yes
Airtightness	Pressurization test result n_{50}	1/h	0.6	≤	0.6		yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	78	≤	-		-
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	33.8	≤	45	34	yes
	Generation of renewable energy	kWh/(m²a)	62	≥	60	43	

[2] Empty field: Data missing; '-': No requirement

I confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

Passive House Plus? yes

Task: First name: Surname: Signature:

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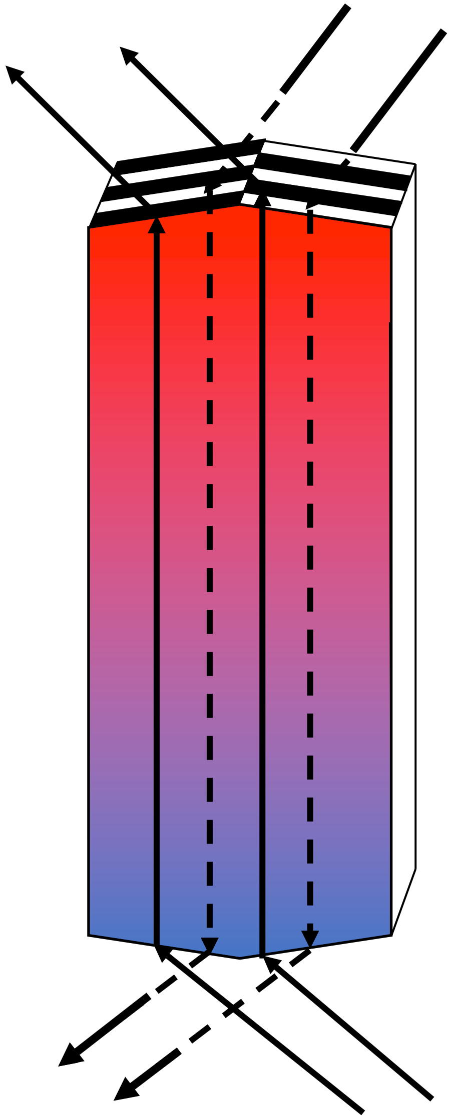
Recovery Effectiveness – PHI Certification

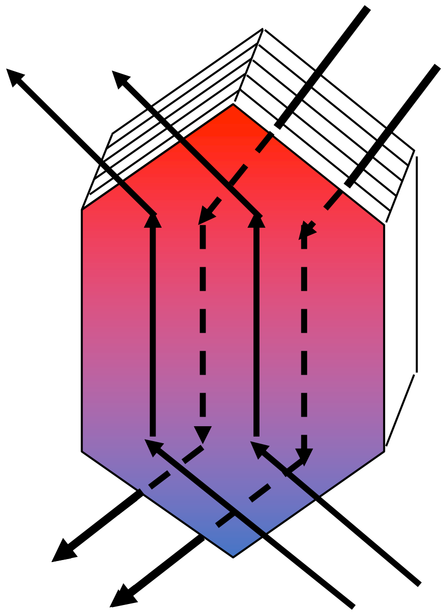
Types of heat exchange cores

Note:
Core size has an influence on heat recovery efficiency- be wary of small cores that claim high efficiencies



Counter flow

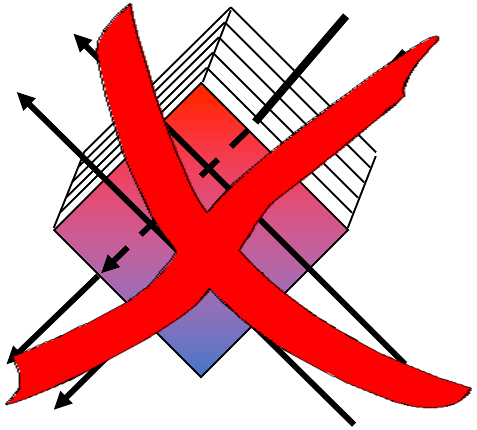
70 -95 %



Cross-counter flow

70 - 85 %

not suitable for Passive Houses

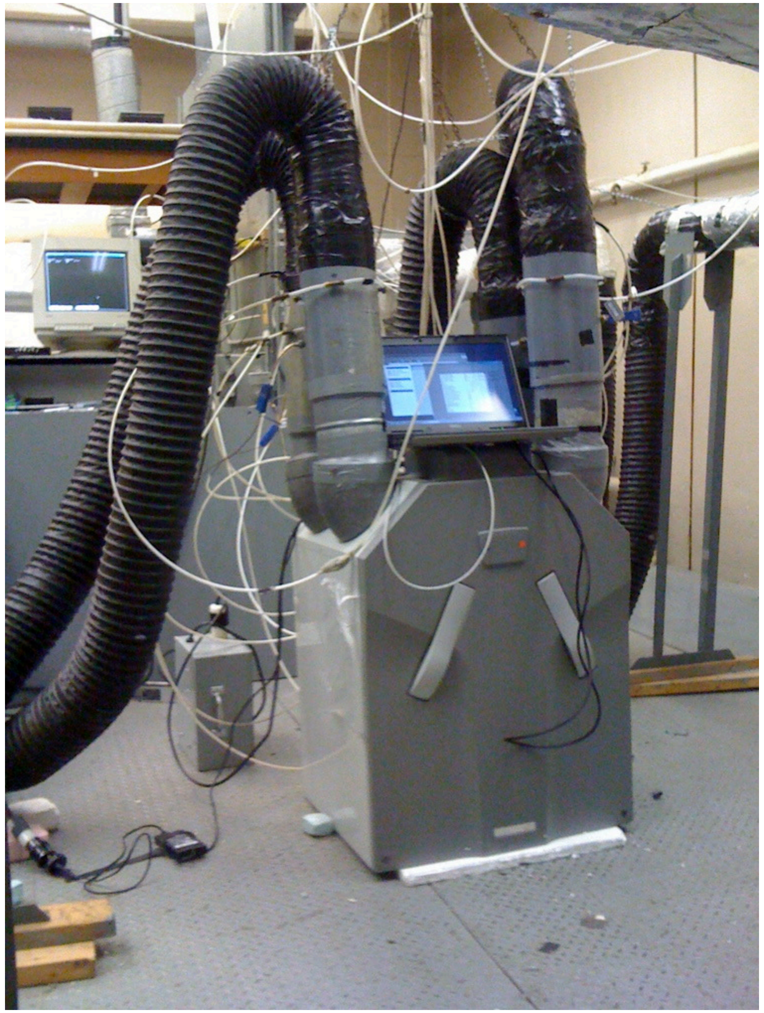


Cross flow

40 - 60 %

Certification Criteria for Ventilation Units (1)

- Determine upper and lower limits of operational **range – at least 3 controllable levels** must be possible (set-back (54%), normal (77%) and boost (100%))
- **Airtightness** testing (external and internal leakage) based on at least 4 testing pressures between 50 Pa and 300 Pa. Leakages ≤ 3% at mid-flow range.
- **Heat recovery efficiency** according to PHI method, tested at 100 Pa, ≥75% at outdoor temperatures of between - 15^{O}C and + 10^{O}C.
- **Constant flow rate** fans, imbalance <10%.



Source: Zehnder

Certification Criteria for Ventilation Units (2)

- **Electrical consumption** for all fans and controls at upper limit of operational range ≤ 0.45 W/(m^3/h) (with frost protection disabled)

- **Sound emission** at upper limit of operational range (≤ 35dB(A) in installation room) including recommendation for silencers to achieve ≤ 25dB(A) in living areas and ≤ 30dB(A) in extract rooms

- **Frost protection for heat exchanger** – must guarantee continued operation. Pre-heater must switch in at - $3^{O}C$ or less (tested for 12 hours at - $15^{O}C$)

2 Different Thermal Efficiency Calculations!

PHI's Method

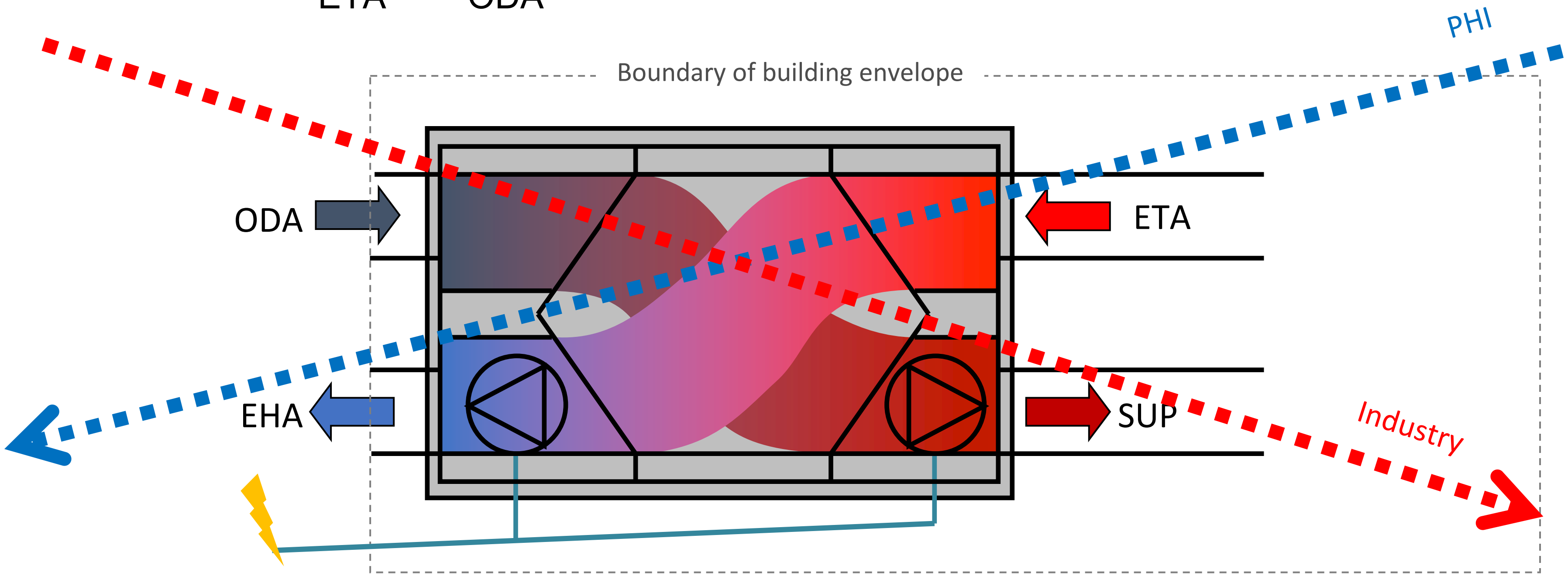
Measures drop-off between extract air and exhaust air

$$= \frac{\left(t_{ETA} - t_{EHA} \right) + \frac{P_{el}}{V \cdot c_{air}}}{t_{ETA} - t_{ODA}}$$

Industry Method

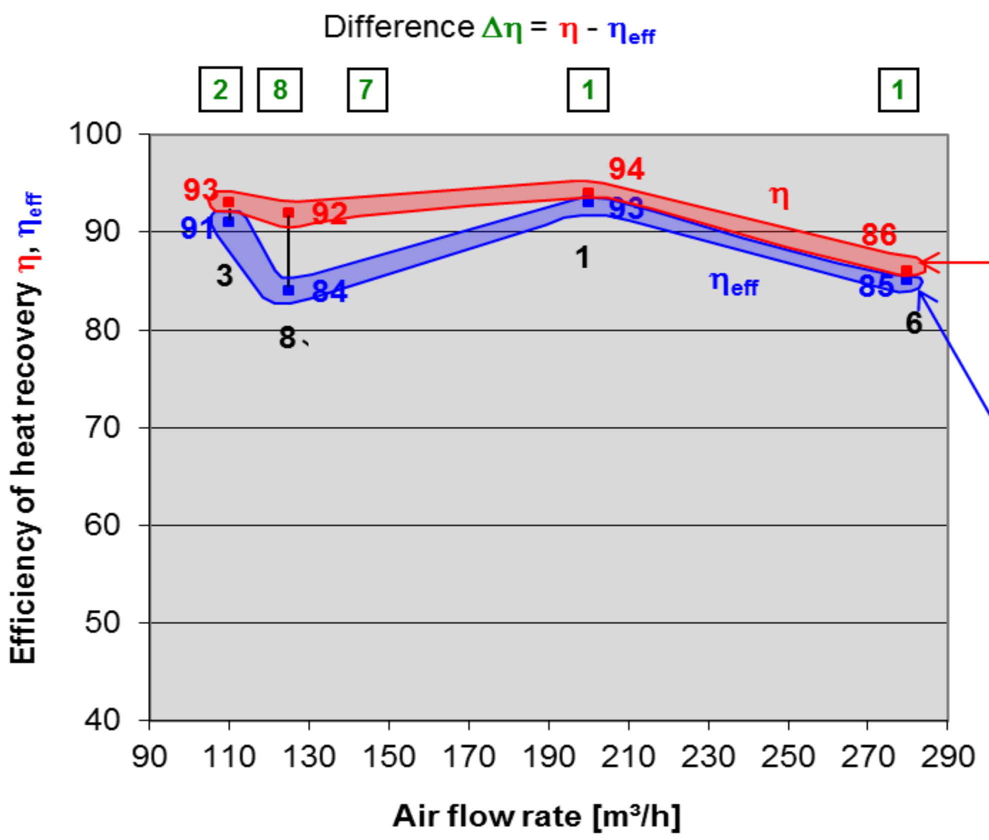
Measures uplift between outdoor air and supply air

$$= \frac{t_{SUP} - t_{ODA}}{t_{ETA} - t_{ODA}}$$



If E/HRV is poorly insulated and leaky, industry method will appear to perform better due to raised SUP temperatures

‘Very Good’ E/HRVs: Different Methods, Similar Results

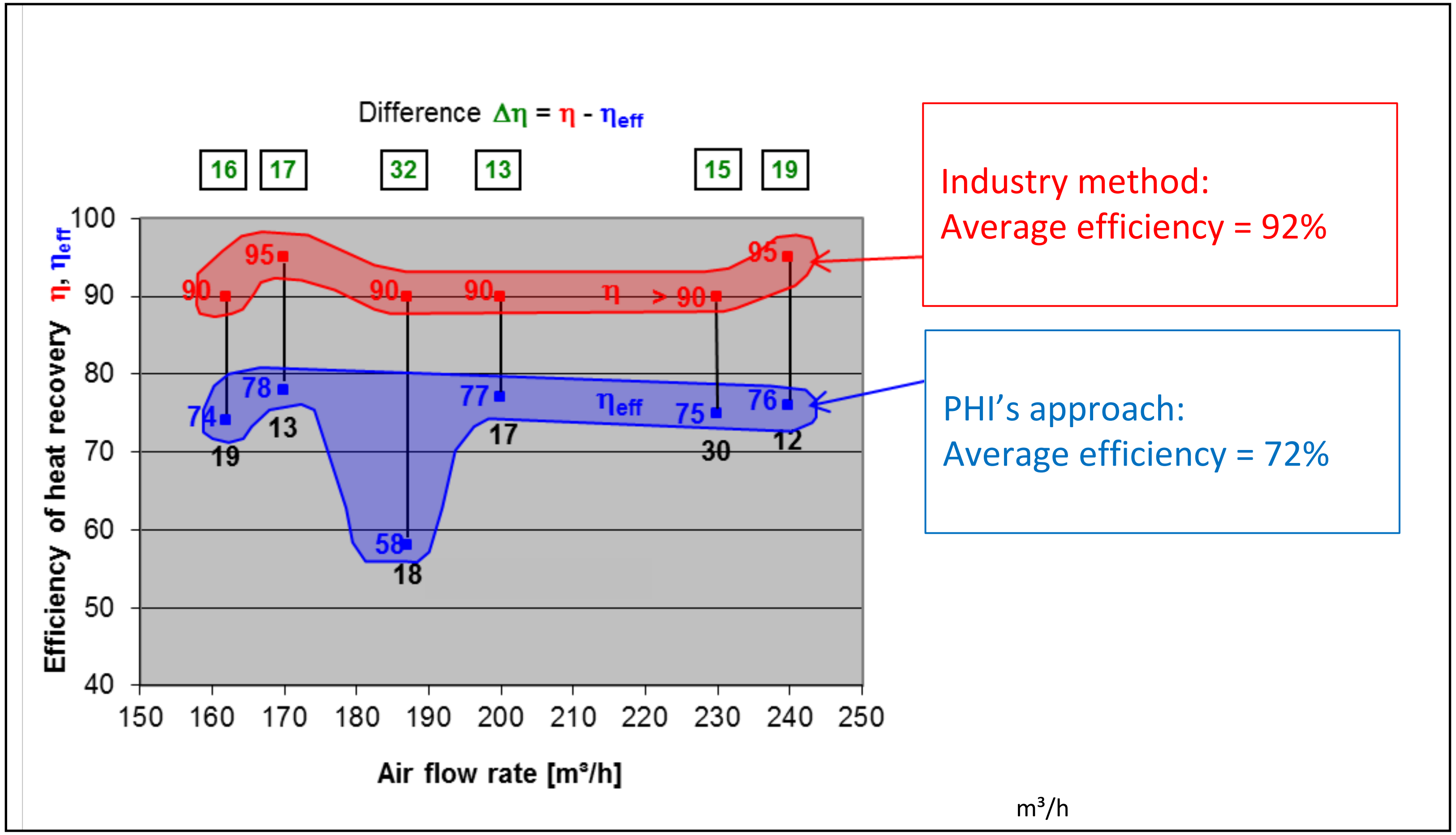


Industry method:
Average efficiency = 91%

PHI’s approach:
Average efficiency = 88%

Source: Zehnder

'Moderate' E/HRVs: Different Methods, Different Results



Remember: minimum 75% efficiency required for Passive House!

Source: Zehnder

Certified Mechanical Ventilation Equipment

- Database of PHI certified HRV / ERVs found here:
- http://database.passivehouse.com/en/components/

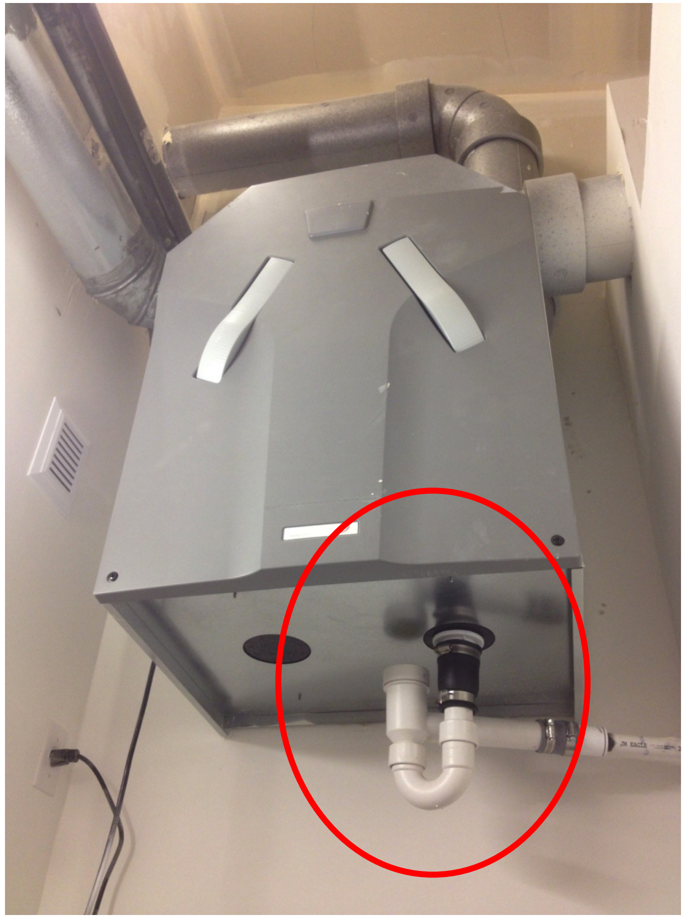
- **Grouped according to following 3 types:**
- Small: Capacity $< 600m^3$/hour
- Large: Capacity $> 600m^3$/hour
- Compact heat pumps

Unit Placement & Exterior Runs

Separating Supply and Exhaust Ducts

- Important to separate ducts to avoid cross-contamination between supply and extract
- Locating on the roof hides the ducts from ground level
- Ensure easy access is possible for periodic checking

Correctly Locating the H/ERV



- ERV located adjacent to exterior wall ensuring minimal length of cold air ducts
- Positioned at comfortable height for changing filters
- HRV's need condensate connection

Duct Insulation

Cold* Air Duct Insulation:

- If the H/ERV is inside the thermal enclosure (thus these ducts are surrounded by warm air), 2”- 4” is required, and it must have a vapor-tight facing to prevent interior moisture from getting to the duct surface and condensing.

- These ducts should be as short as possible – so locate the H/ERV near the enclosure!

**in winter*


Flow tested exterior runs to verify that long run and increase in 90's did not constrict flow

3C-REN

E/HRV Filtration

- H/ERVs must have filters, for two reasons:

1. The heat exchange core must be protected from dust, from both the outdoors and indoors
2. To provide cleaner air for the occupants (pollen).

- Therefore there are filters on the intake air side of the E/HRV core as well as the extract air side.:

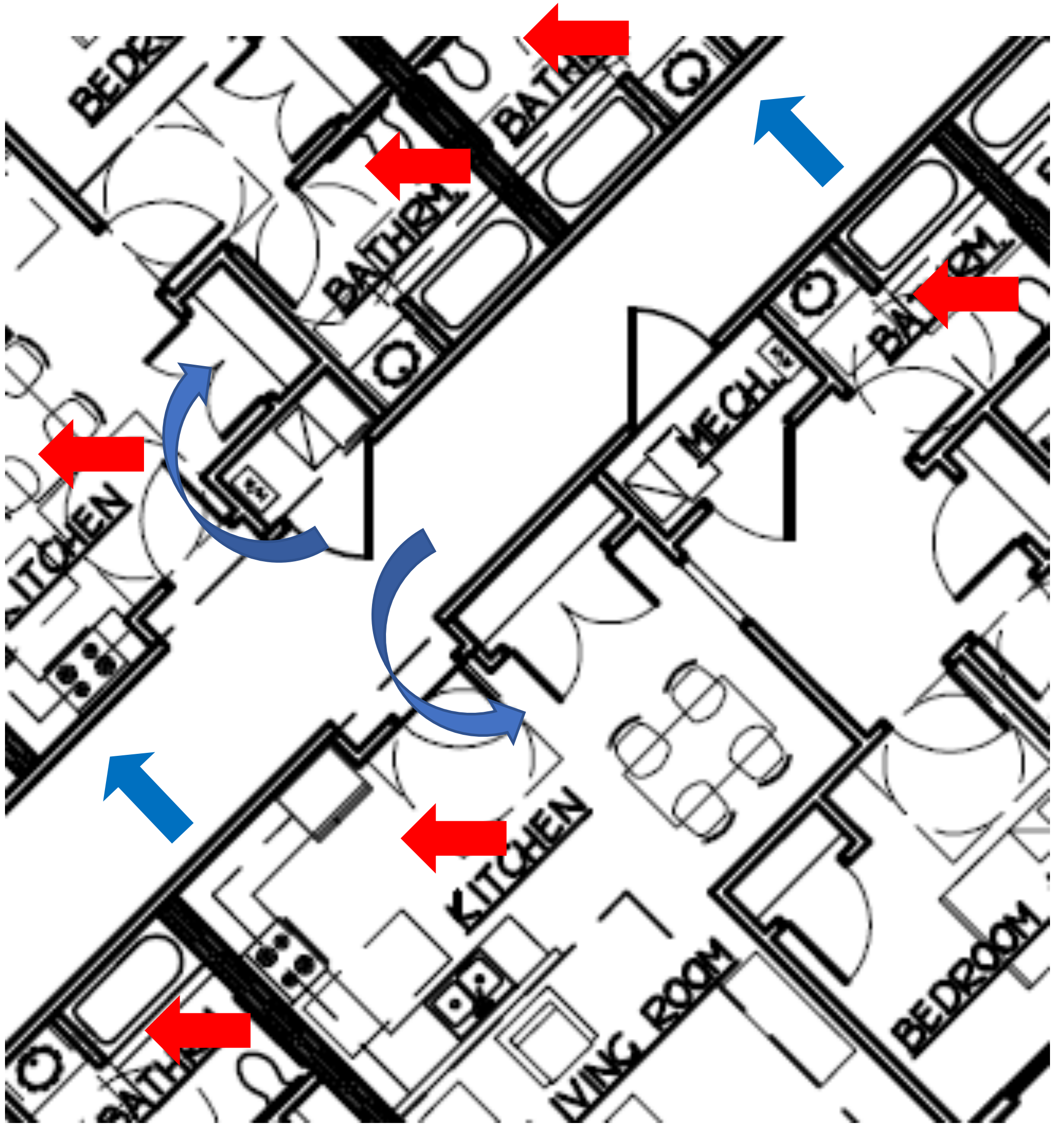
- **Outdoor intake:** F7 / F8 / F9 (MERV 13 to 15) (protects heat exchange core, as well as occupants from pollen etc)

- **Extract return:** G4 (MERV 6) (only needed to protect heat exchange core)

Photo: Baukraft Engineering

Distribution Design – Interior

Traditional Multifamily System



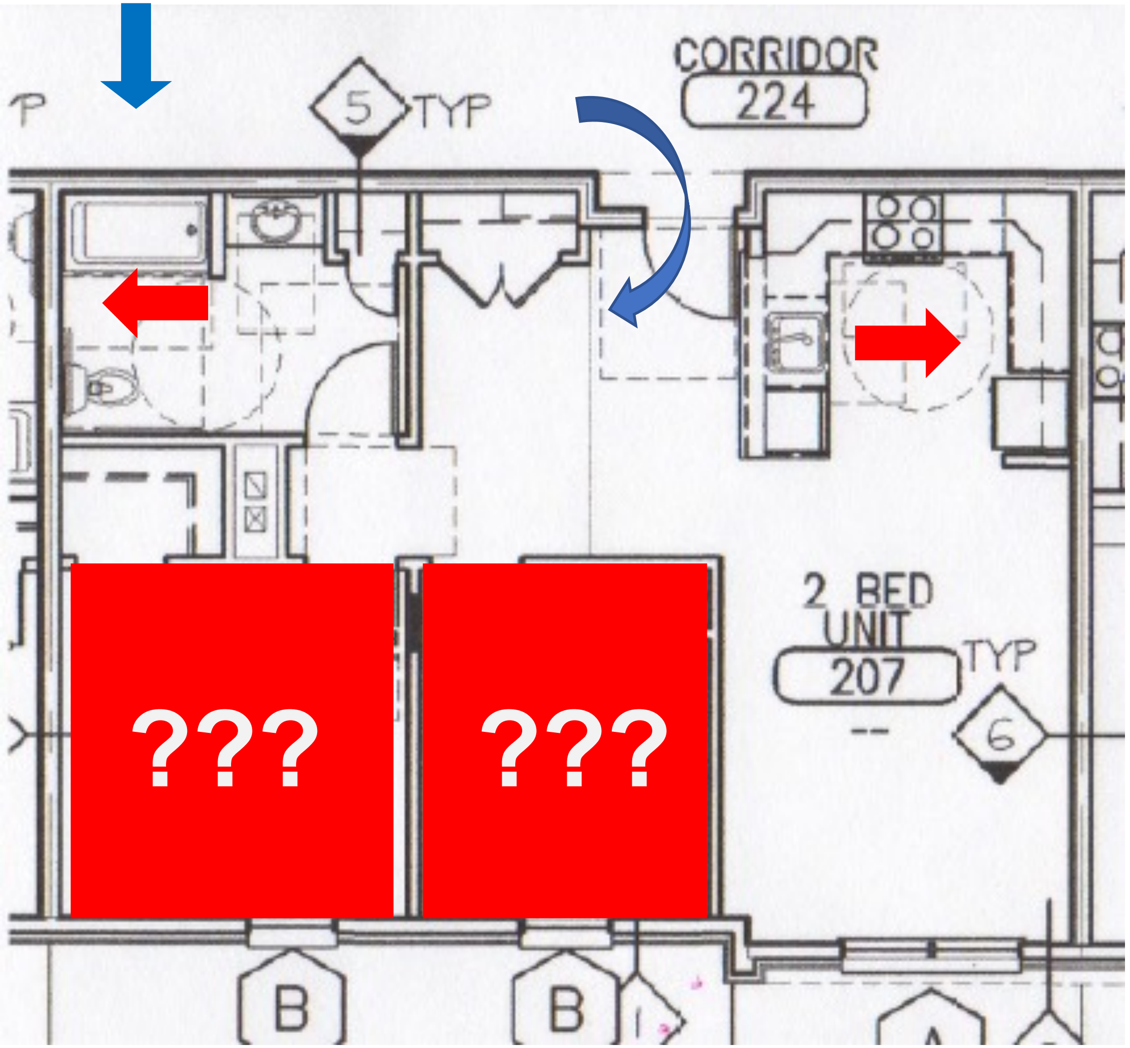
Exhaust Air Locations

- Bathrooms
- Kitchen

Supply Air Locations

- Corridors

Traditional Multifamily System



Exhaust Air Locations

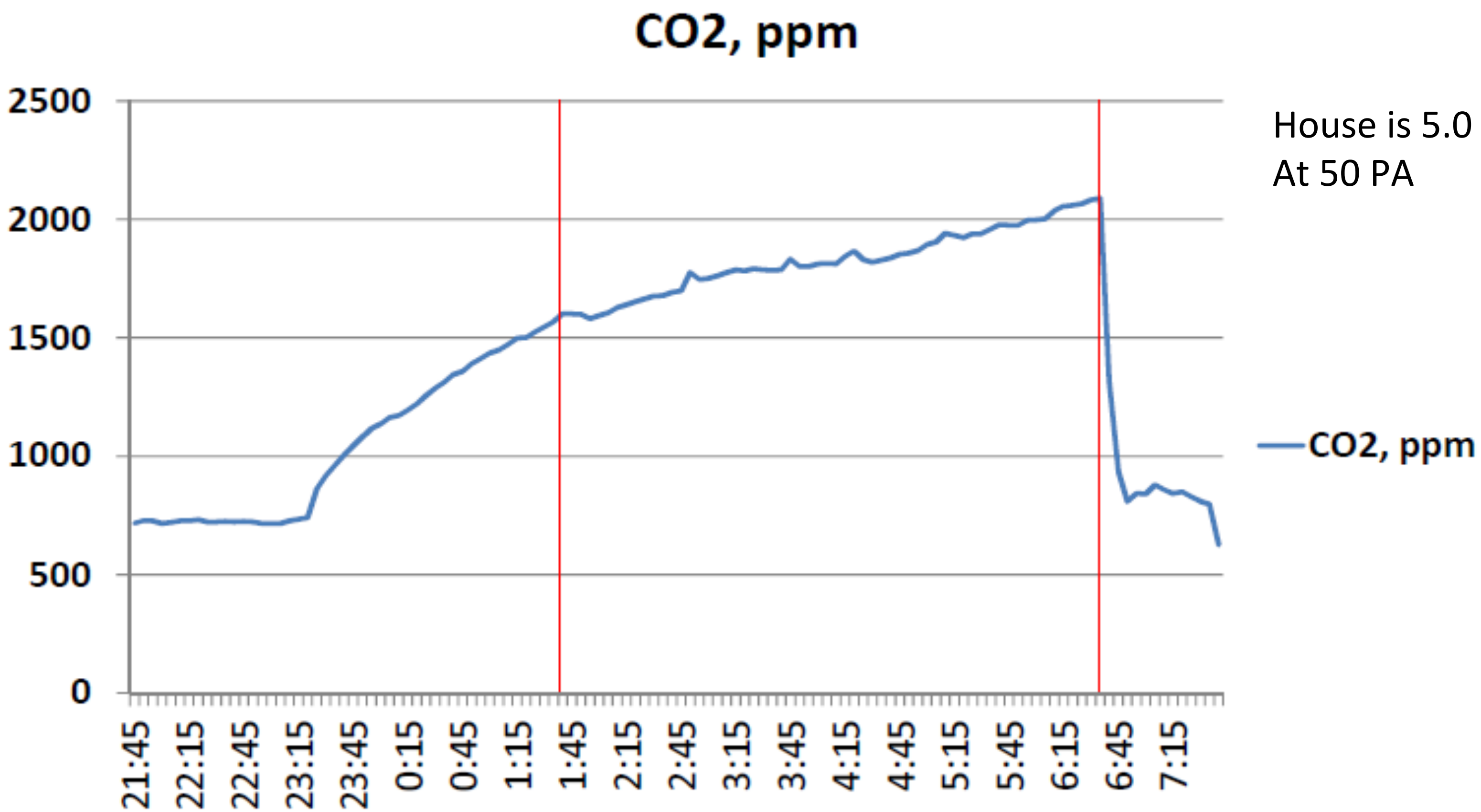
- Bathrooms
- Kitchen

Supply Air Locations

- Corridors

What's the ACH
in the Bedrooms?

Unventilated Bedrooms Get Stale

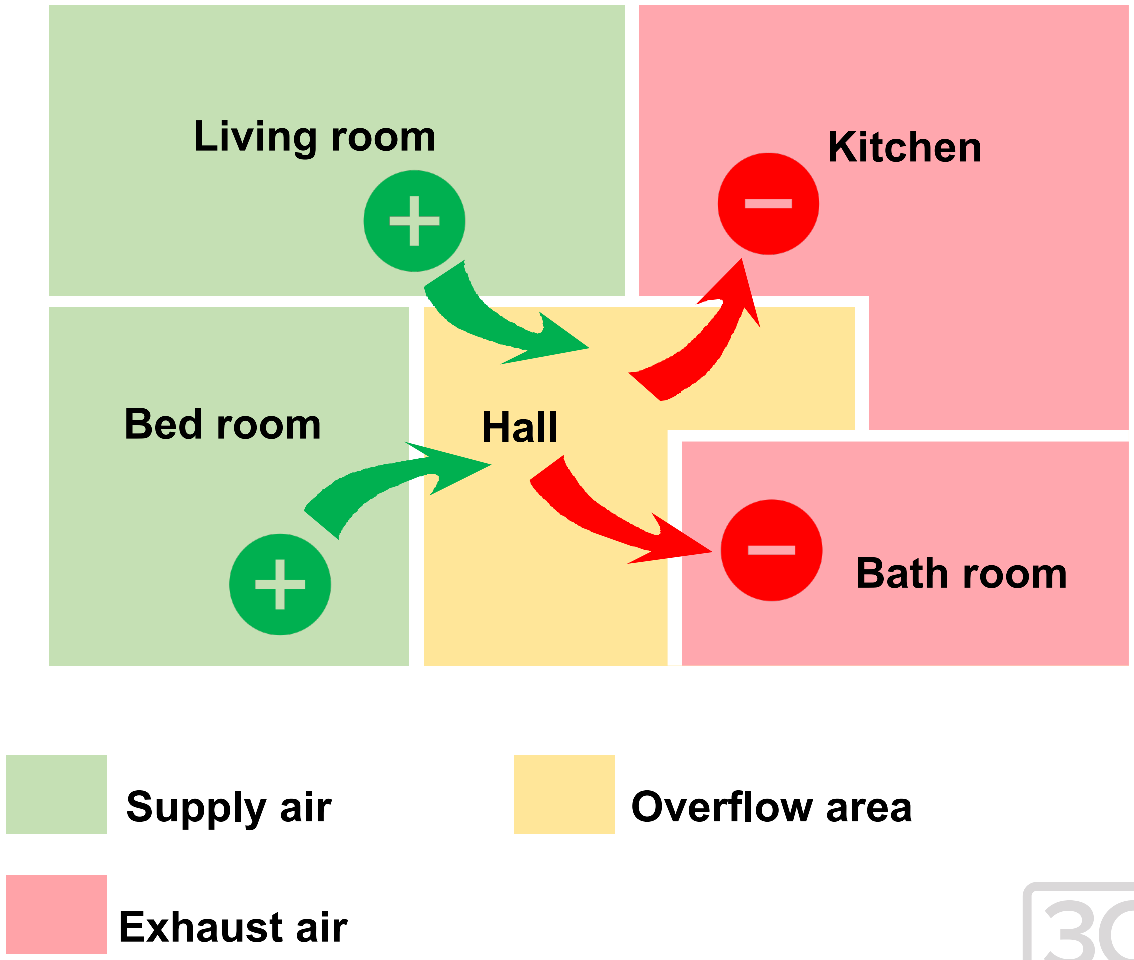


House is 5.0 ACH
At 50 PA

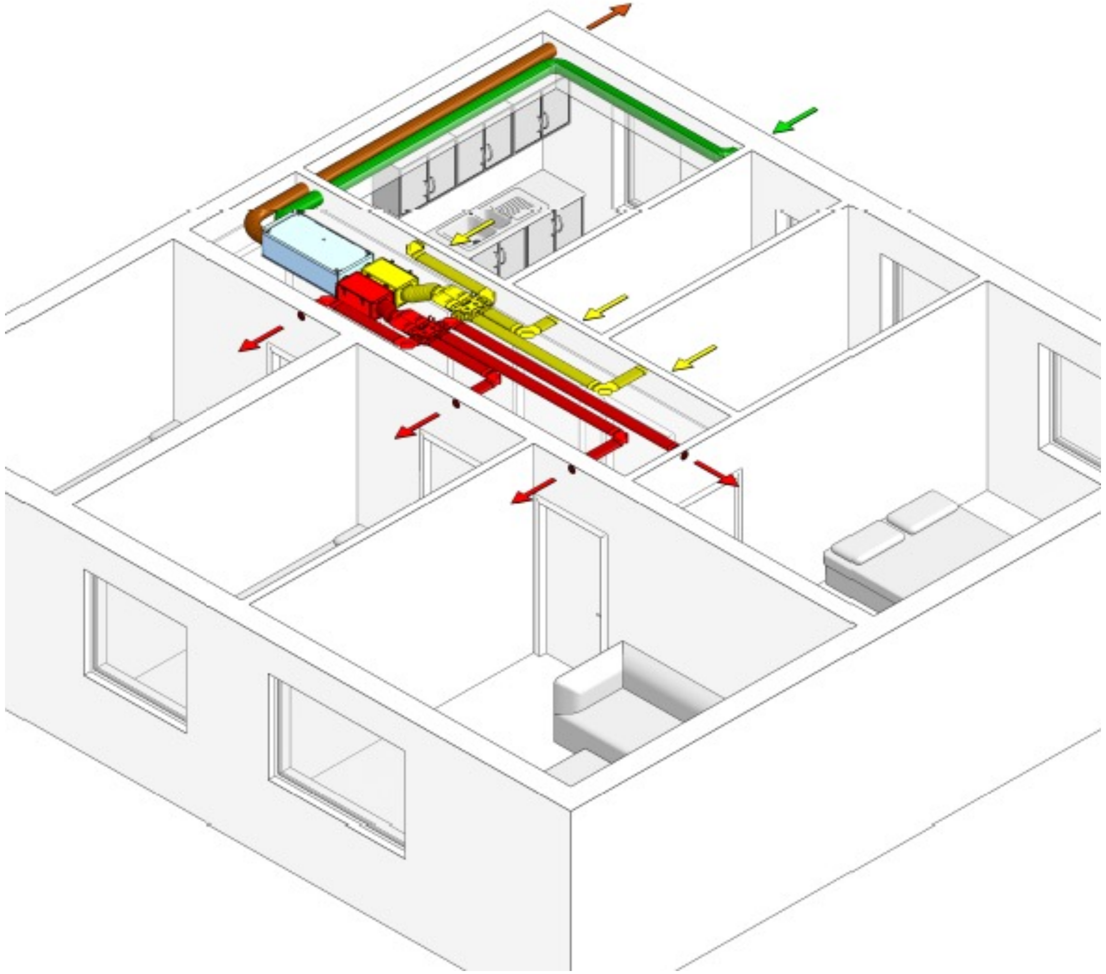
- Bedroom occupied at 11:15 pm with door closed
- Exhaust fan turned on at 1:30 am at 88 CFM (ASHRAE 62.2 Rate for house is 62 CFM
- Exhaust fan off at 6:00 am
- Door open at 6:30 am

Balanced with Distribution

- The air goes where we design it to go.
- Bedrooms, living rooms, studies, get a steady flow of fresh air.
- Kitchens, baths, laundry and mudrooms get a steady flow of exhaust.



Example Apartment for Ventilation



1,200 SF TFA
8.2 FT Ceilings
3 bedrooms
2 Bathrooms

Passive House Airflow

Airflows required for a certifying Passive House project

30 m^3/h (18 CFM) Per Person at 100% fan speed
0.30 Air Changes per Hour (ACH) of TFA

Kitchen exhaust:	60 m^3/h	(35 cfm) continuous
Bathroom exhaust:	40 m^3/h	(24 cfm) continuous
Toilet room exhaust:	20 m^3/h	(12 cfm) continuous
Laundry room exhaust:	20 m^3/h	(12 cfm) continuous

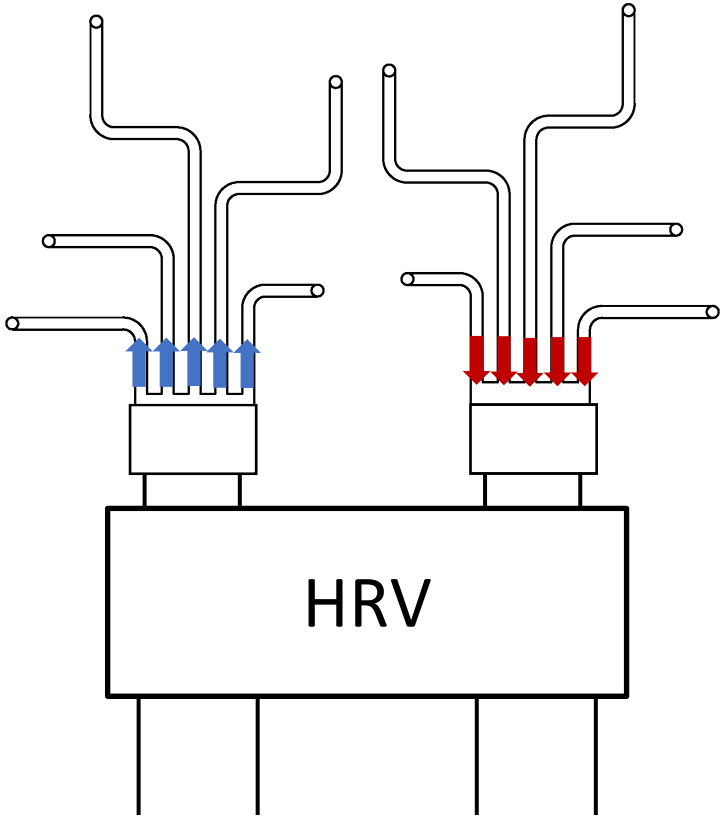
1,200SF * 8.2FT = 9,840 CF at 0.30 ACH (*1.3)	108 m^3/h (64 CFM)
4 People * 30 m^3/h /P (18cfm)	120 m^3/h 72 CFM
Kitchen + 2 Bathrooms	140 m^3/h 82 CFM*

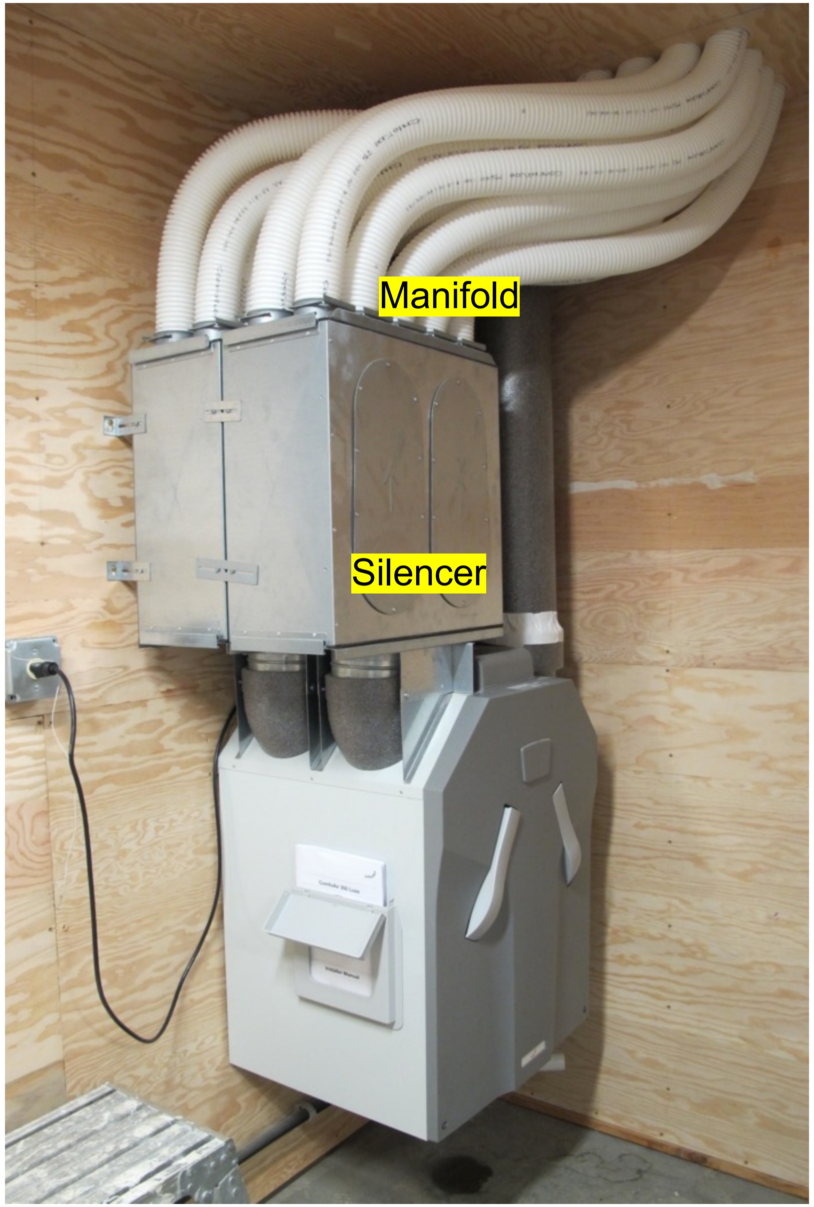
Duct System Types

Home Run - Manifold & Silencer

A manifold divides up all the air at one point, and smaller individual ducts (usually all the same size) run to and from each space. One manifold for supply air, one for extract air. The Silencer reduces fan noise.

Home Run Ducting





Avoid Flexible Ducting Where Possible

Semi-rigid ducting kinks, sags (increasing pressure losses), tears and is very easily damaged on-site

Trunk & Branch are Hard to Commission

Regardless of flow direction, these sharp turns will be very challenging to get design flow at low static pressure.

Plan.
Don’t make a Ductapus

- Exterior – still needs insulation!
- Heating/Cooling Coil.
- Conditioned Room Supply
- HRV

Extract From Kitchens – Recirculating Hood Preferred

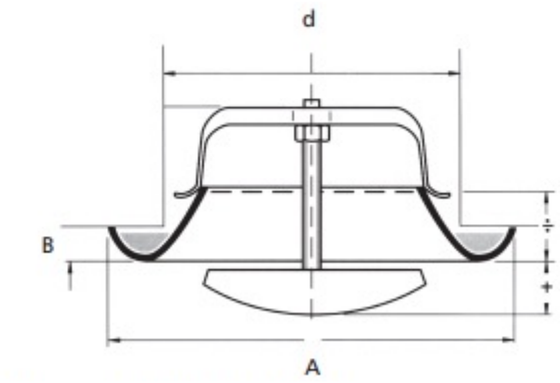
This subject is under debate

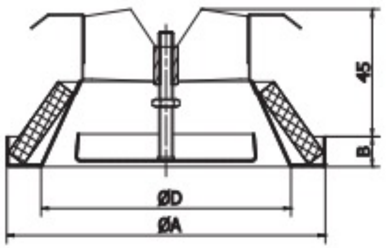
A re-circulating extract hood is provided over the electric stove

Kitchen exhaust is located on the wall (or ceiling)

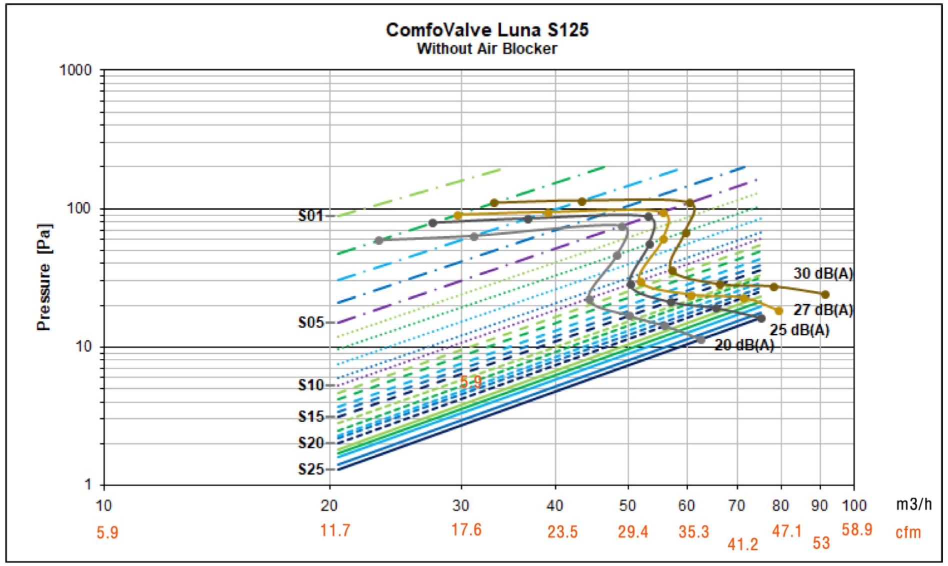
Kitchen extract if connected to the H/ERV should NOT be positioned over the cooking surface - high risk of fats and oils getting into ducts

Adjustable Ventilation Register Types





regarding Settings S01 to S25



Fresh-r

Smart indoor air care

Fresh-r In-the-Wall
Specifications and Data

Smart measurement and control technology that reuses heat in the winter and coolness in the summer.

Keeps buildings comfortable and the air healthy, without losing energy.

Demand-driven and balanced ventilation that fits into the facade.

Key Features

1. The heat exchanger is made of copper, that conducts heat 1000 times better than polyethylene, the material used in other heat exchangers. Therefore temperature is exchanged from the outgoing air to the incoming air in a much shorter air path, which has multiple advantages:
   1. Keeps the unit thin so it fits in an outside wall;
   2. Low pressure drop, resulting in low fan energy usage and low noise levels;
   3. Sub-zero efficiency;
   4. A thermal efficiency of 90%.
2. Fine dust filter keeps pollen and particulates out.
3. Air quality is monitored by CO_2 sensor and humidity sensor and optionally a fine dust sensor.
4. Ventilators refresh the indoor air if necessary, with a capacity of up to 120 m^3 per hour.
5. Wifi antenna sends collected data, for online insight into performance.
6. Fits a maximum of 10 meter extract duct ø125mm to enable cascade ventilation.
7. Wooden frame for easy mounting during installation and prefab construction.

3 year warranty when WiFi connected. 2 year without WiFi connection.

CERTIFIED COMPONENT
Passive House Institute

COMPONENT AWARD 2018
Passive House Institute

World champion in ventilation

Decentralized Demand Driven Ventilation

Large Building Passive House Ventilation

DOAS Is Passive House

Existing RTU's

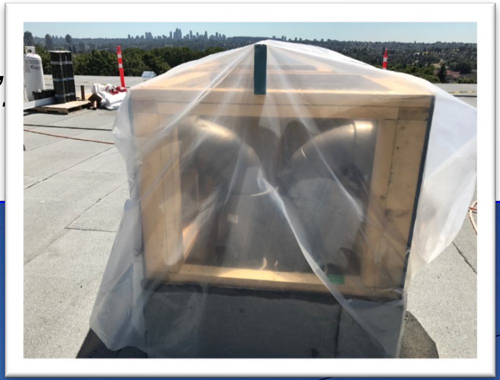
Passive House Ventilation

Brixton Flats – 56 unit PHI

The Heights - 85 unit PHI

Connect units to the exterior by going up through the roof.

Units are vented directly through the roof membrane into a “dog house”.




Set fresh air supply as far above roof deck as practical
Exhaust
Supply Grille

Units are placed on top floor within the thermal envelope

Create 8” diameter risers that drop to the bottom of the residential floors. Stub out a connection per floor to serve a single suite.

Multi-Family Options

Centralized Plant uses distributed HRV's

Skeena Project

Vancouver BC

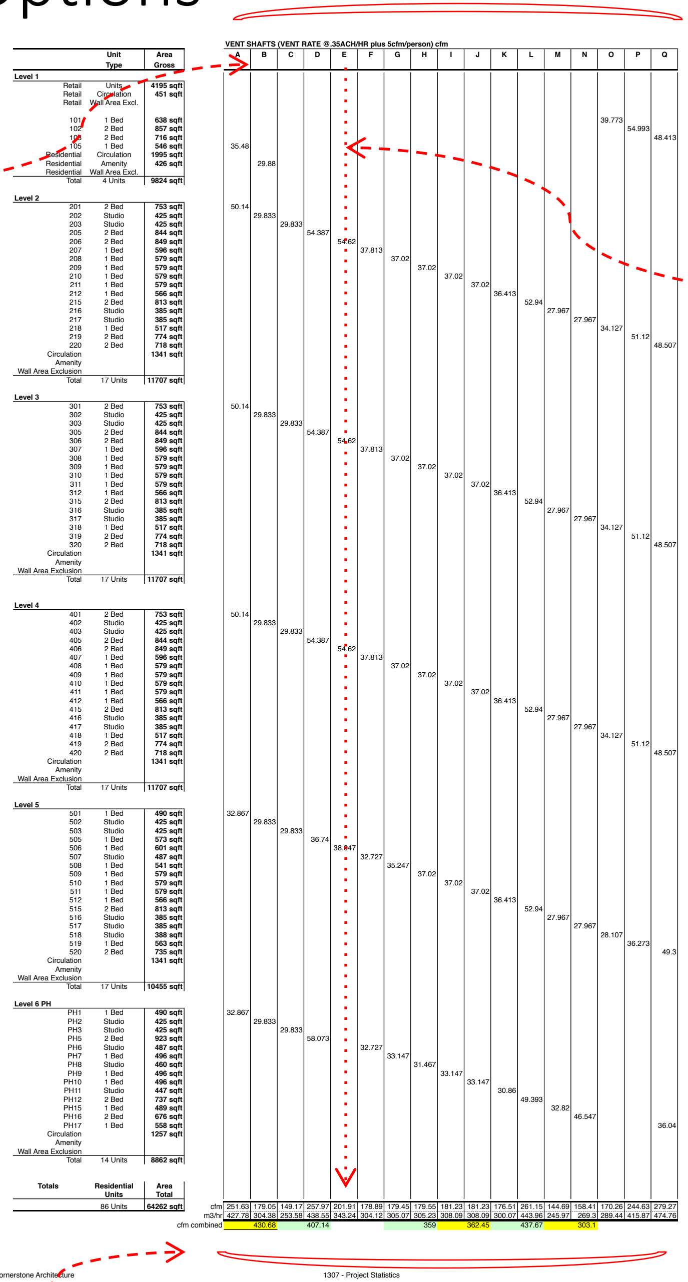
Dispersed HRV's with dedicated shaft

- Create shaft runs.
- Calculate capacity per run.
- Penetrate fire wall with fire damper.
- Balanced ventilation within suite.
- Kitchen exhaust by HRV.
- All units on shaft share boost function.

Flow per living unit

Single HRV Shaft

Flow totals per HRV/Shaft

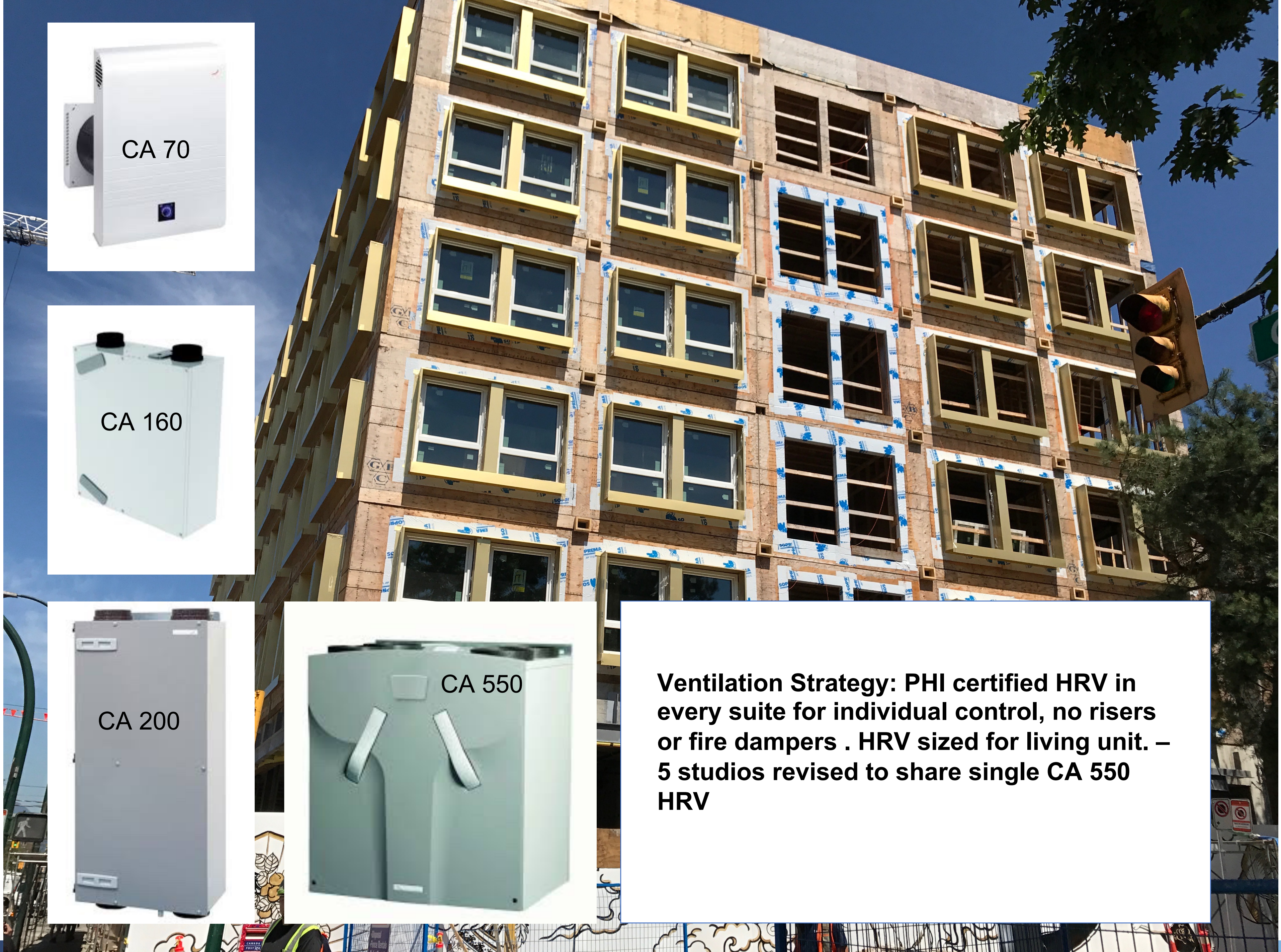


VENT SHAFTS (VENT RATE @.35ACH/HR plus 5cfm/person) cfm

	Unit Type	Area Gross	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Level 1																			
Retail	Units	4195 sqft																	
Retail	Circulation	451 sqft																	
Retail	Wall Area Excl.																		
101	1 Bed	638 sqft															39.773		
102	2 Bed	857 sqft																54.993	
103	2 Bed	716 sqft																	48.413
105	1 Bed	546 sqft	35.48																
Residential	Circulation	1995 sqft																	
Residential	Amenity	426 sqft		29.88															
Residential	Wall Area Excl.																		
Total	4 Units	9824 sqft																	
Level 2																			
201	2 Bed	753 sqft	50.14																
202	Studio	425 sqft		29.833															
203	Studio	425 sqft			29.833														
205	2 Bed	844 sqft				54.387													
206	2 Bed	849 sqft					54.62												
207	1 Bed	596 sqft						37.813											
208	1 Bed	579 sqft							37.02										
209	1 Bed	579 sqft								37.02									
210	1 Bed	579 sqft									37.02								
211	1 Bed	579 sqft										37.02							
212	1 Bed	566 sqft											36.413						
215	2 Bed	813 sqft												52.94					
216	Studio	385 sqft													27.967				
217	Studio	385 sqft														27.967			
218	1 Bed	517 sqft															34.127		
219	2 Bed	774 sqft																51.12	
220	2 Bed	718 sqft																	48.507
Circulation		1341 sqft																	
Amenity																			
Wall Area Exclusion																			
Total	17 Units	11707 sqft																	
Level 3																			
301	2 Bed	753 sqft	50.14																
302	Studio	425 sqft		29.833															
303	Studio	425 sqft			29.833														
305	2 Bed	844 sqft				54.387													
306	2 Bed	849 sqft					54.62												
307	1 Bed	596 sqft						37.813											
308	1 Bed	579 sqft							37.02										
309	1 Bed	579 sqft								37.02									
310	1 Bed	579 sqft									37.02								
311	1 Bed	579 sqft										37.02							
312	1 Bed	566 sqft											36.413						
315	2 Bed	813 sqft												52.94					
316	Studio	385 sqft													27.967				
317	Studio	385 sqft														27.967			
318	1 Bed	517 sqft															34.127		
319	2 Bed	774 sqft																51.12	
320	2 Bed	718 sqft																	48.507
Circulation		1341 sqft																	
Amenity																			
Wall Area Exclusion																			
Total	17 Units	11707 sqft																	
Level 4																			
401	2 Bed	753 sqft	50.14																
402	Studio	425 sqft		29.833															
403	Studio	425 sqft			29.833														
405	2 Bed	844 sqft				54.387													
406	2 Bed	849 sqft					54.62												
407	1 Bed	596 sqft						37.813											
408	1 Bed	579 sqft							37.02										
409	1 Bed	579 sqft								37.02									
410	1 Bed	579 sqft									37.02								
411	1 Bed	579 sqft										37.02							
412	1 Bed	566 sqft											36.413						
415	2 Bed	813 sqft												52.94					
416	Studio	385 sqft													27.967				
417	Studio	385 sqft														27.967			
418	1 Bed	517 sqft															34.127		
419	2 Bed	774 sqft																51.12	
420	2 Bed	718 sqft																	48.507
Circulation		1341 sqft																	
Amenity																			
Wall Area Exclusion																			
Total	17 Units	11707 sqft																	
Level 5																			
501	1 Bed	490 sqft	32.867																
502	Studio	425 sqft		29.833															
503	Studio	425 sqft			29.833														
505	1 Bed	573 sqft				36.74													
506	1 Bed	601 sqft					38.047												
507	Studio	487 sqft						32.727											
508	1 Bed	541 sqft							35.247										
509	1 Bed	579 sqft								37.02									
510	1 Bed	579 sqft									37.02								
511	1 Bed	579 sqft										37.02							
512	1 Bed	566 sqft											36.413						
515	2 Bed	813 sqft												52.94					
516	Studio	385 sqft													27.967				
517	Studio	385 sqft														27.967			
518	Studio	388 sqft															28.107		
519	1 Bed	563 sqft																36.273	
520	2 Bed	735 sqft																	49.3
Circulation		1341 sqft																	
Amenity																			
Wall Area Exclusion																			
Total	17 Units	10455 sqft																	
Level 6 PH																			
PH1	1 Bed	490 sqft	32.867																
PH2	Studio	425 sqft		29.833															
PH3	Studio	425 sqft			29.833														
PH5	2 Bed	923 sqft				58.073													
PH6	Studio	487 sqft						32.727											
PH7	1 Bed	496 sqft							33.147										
PH8	Studio	460 sqft								31.467									
PH9	1 Bed	496 sqft									33.147								
PH10	1 Bed	496 sqft										33.147							
PH11	Studio	447 sqft											30.86						
PH12	2 Bed	737 sqft												49.393					
PH15	1 Bed	489 sqft													32.82				
PH16	2 Bed	676 sqft														46.547			
PH17	1 Bed	558 sqft																	36.04
Circulation		1257 sqft																	
Amenity																			
Wall Area Exclusion																			
Total	14 Units	8862 sqft																	
Totals	**Residential Units**	**Area Total**																	
cfm	86 Units	64262 sqft	251.63	179.05	149.17	257.97	201.91	178.89	179.45	179.55	181.23	181.23	176.51	261.15	144.69	158.41	170.26	244.63	279.27
m3/hr			427.78	304.38	253.58	438.55	343.24	304.12	305.07	305.23	308.09	308.09	300.07	443.96	245.97	269.3	289.44	415.87	474.76
cfm combined				430.68		407.14				359		362.45		437.67		303.1			

Cornerstone Architecture   1307 - Project Statistics   1 / 1

Cornerstone Architecture



Ventilation Strategy: PHI certified HRV in every suite for individual control, no risers or fire dampers . HRV sized for living unit. – 5 studios revised to share single CA 550 HRV

Burquitlam Park – Vancouver BC

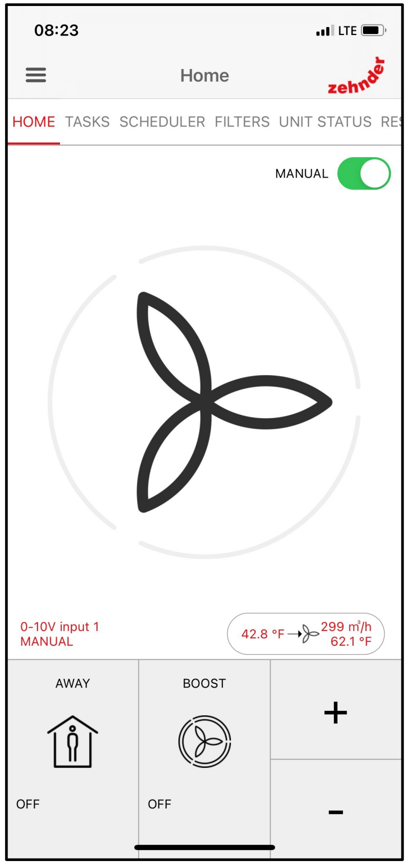
Ventilation Commissioning

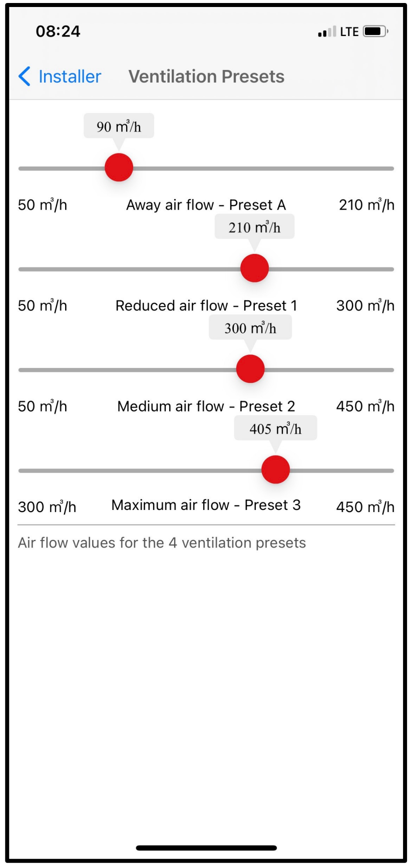
Heat Recovery reaches highest efficiency stated in energy model with balanced flows.
Design flows maintain humidity levels and comfort.

Steps to balance a ventilation system:

1. Performed by qualified tradesperson.
2. Inspect the overall system and installation.
3. Measure flows at exterior.
4. Measure flows at interior.
5. Calculate difference to note any leakage.
6. Equalize flows.
7. Set normal flows to design.
8. Set additional levels, (boost, low occupancy).
9. Record all settings

Self Balancing Unit





Phone/Tablet Ap

Closing

- Continuing Education Units Available
  - Contact spburns@countyofsb.org for AIA HSW and ICC LUs
- Coming to Your Inbox Soon!
  - Slides, Recording, & Survey – Please Take It and Help Us Out!
- Upcoming Courses:
  - All About ADUs for Realtors (11/2)
  - High-Performance as the Baseline (11/8)
  - Shifts in Power: Ensuring the IRA, 2022 Energy Code, and California's Climate Policies Benefit the Tri-County Region (11/9)
  - 2022 Energy Code Preview for Single Family Projects (11/10)

Thank you!

For more info:
3c-ren.org

For questions:
info@3c-ren.org

3C REN

TRI-COUNTY REGIONAL ENERGY NETWORK
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