Project Documentation

Abstract

High-rise dormitory in Roosevelt Island, NY USA

Data of building			
Year of construction	2017	**Space heating**	**12 kWh/(m²a)**
U-value external wall	0.22 W/(m²K)		
U-value 1st floor slab	1.613 W/(m²K)	**Primary Energy Renewable (PER)**	0 kWh/(m²a)
U-value roof	0.11 W/(m²K)	**Generation of renewable energy**	0 kWh/(m²a)
U-value window	1.35 W/(m²K)	**Non-renewable Primary Energy (PE)**	119 kWh/(m²a)
Heat recovery	69 %	Pressure test n_{50}	0.1 h-1
Special features	galvanized steel framing and custom prefabricated wall panels		

Brief Description

The House at Cornell Tech is located on the new Cornell Tech campus located on Roosevelt Island which opened for the 2017-2018 academic year in August 2017. Towering at 26 stories high with 352 units that can house about 530 graduate students, faculty, and staff. It is the tallest building built to the Passive House standard in the world.

Being the first development and design team to pioneer designing and building the tallest high-rise Passive House residential building was a challenging. When the team began designing this building over four years ago there were few products on the market that met Passive House standards and fewer contractors, sub-contractors and consultants that knew how to build a Passive House building.

Obtaining city approvals for the building was definitely more complicated than for more typical projects built to code. There were technical issues where the requirements for Passive House and the city building code came into conflict. Since then the city has worked with the Passive House community to solve any conflicts with the code.

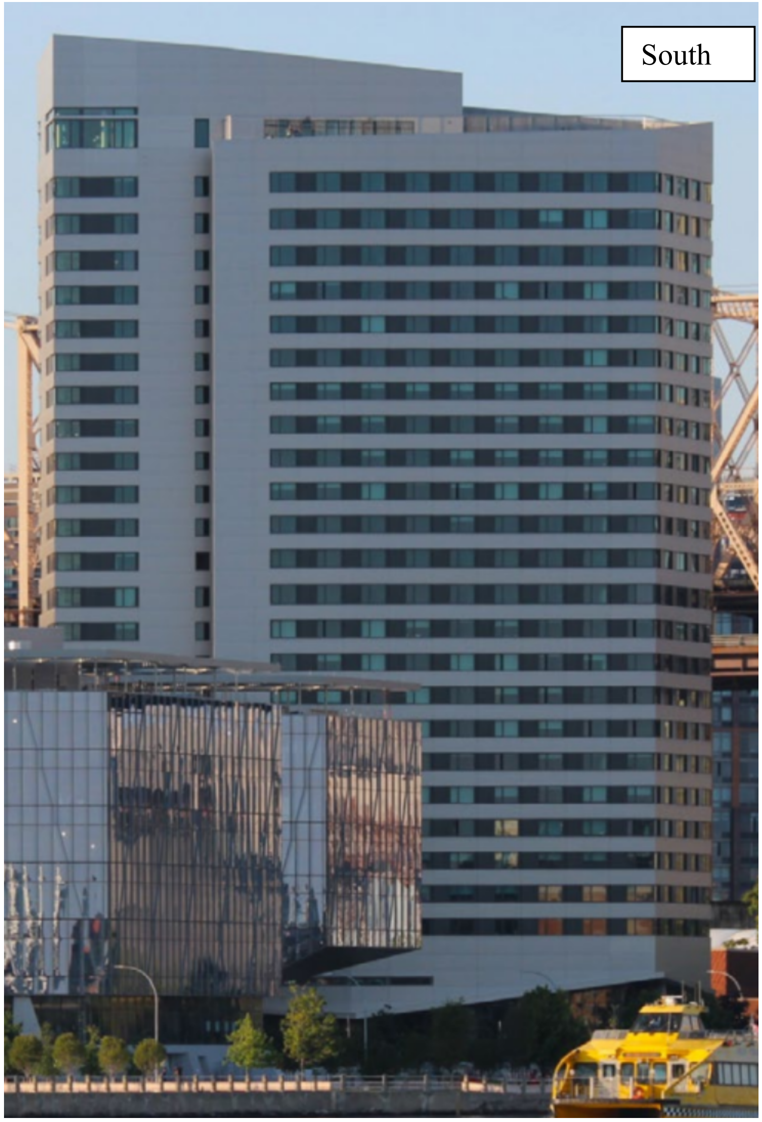
Responsible project participants	
Architect	Handel Architects LLP https://handelarchitects.com/
Building systems MEP	Buro Happold https://www.burohappold.com/
Structural engineering	Buro Happold https://www.burohappold.com/
Building physics	Vidaris http://www.vidaris.com/
Passive House project planning	Lois Arena, Steven Winter Associates www.swinter.com
Construction management	Monadnock Construction Inc. http://moncon.com/

Certifying body
Tomás O'Leary, Passive House Academy https://www.passivehouseacademy.com/

Certification ID	
5202	Project-ID (www.passivehouse-database.org)

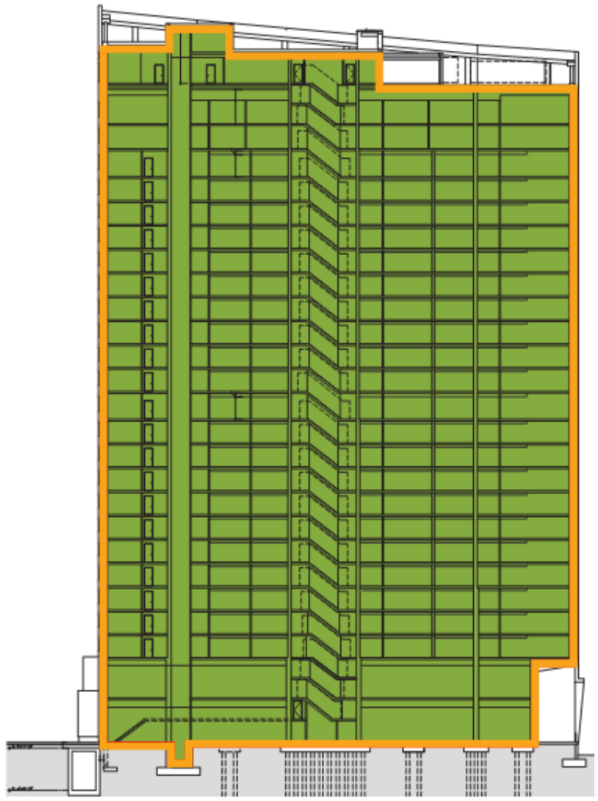
Author of project documentation	
Lois Arena (Steven Winter Associates)	
Date	**Signature**
05/09/19	

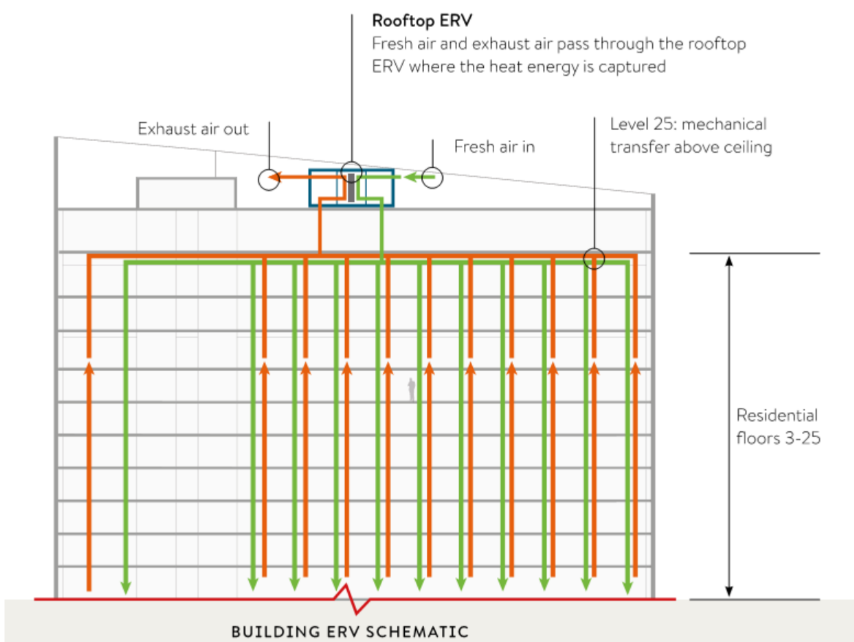
Building Elevations



Interior Photo

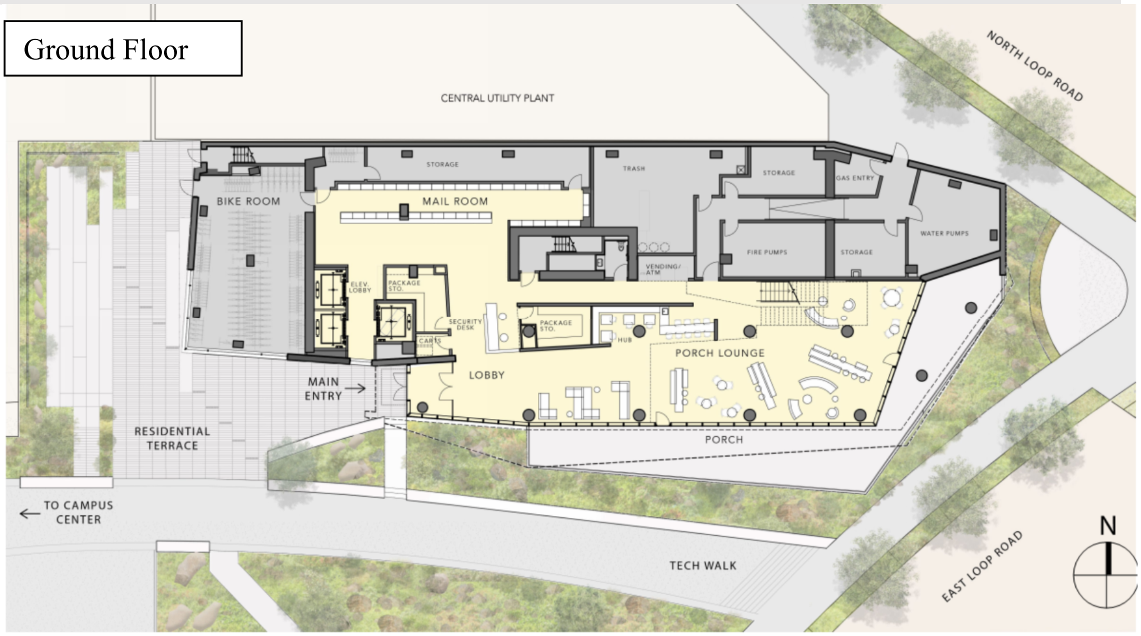
Section




Rooftop ERV
Fresh air and exhaust air pass through the rooftop ERV where the heat energy is captured
Exhaust air out
Fresh air in
Level 25: mechanical transfer above ceiling
Residential floors 3-25
BUILDING ERV SCHEMATIC

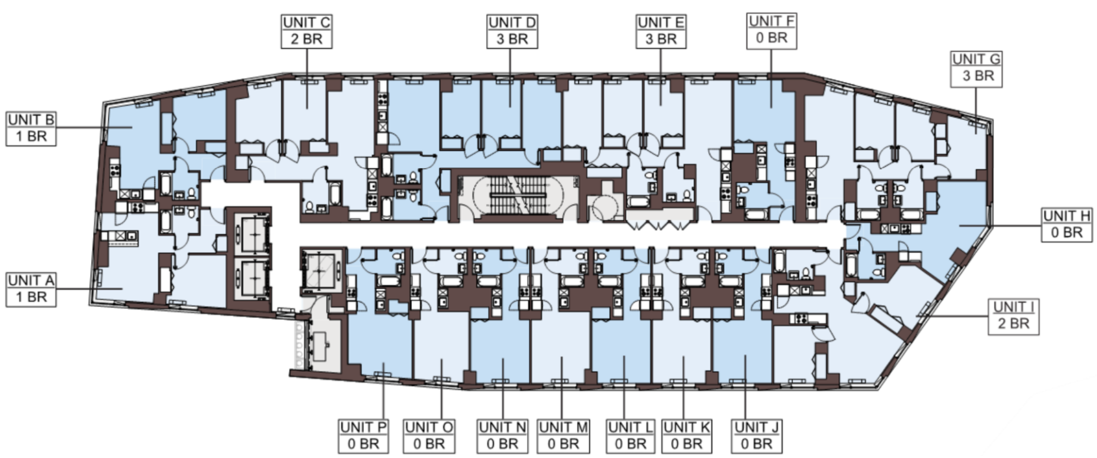
Floor Plans

Ground Floor

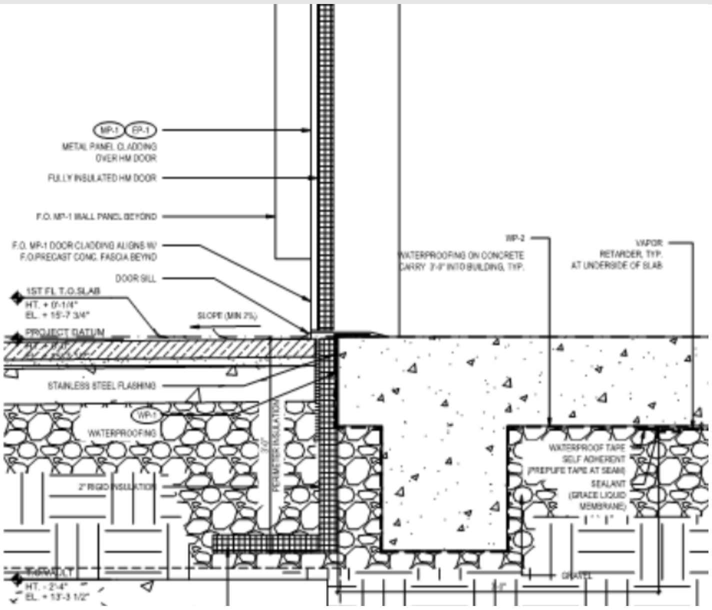


Typical Floor

16 Units per Floor



Floor Slab Construction



Description of construction
Poured concrete slab on concrete casons that go down to bedrock with no insulation under slab

Assembly no.	Building assembly description	Interior insulation?
07ud	1st Floor Slab	0

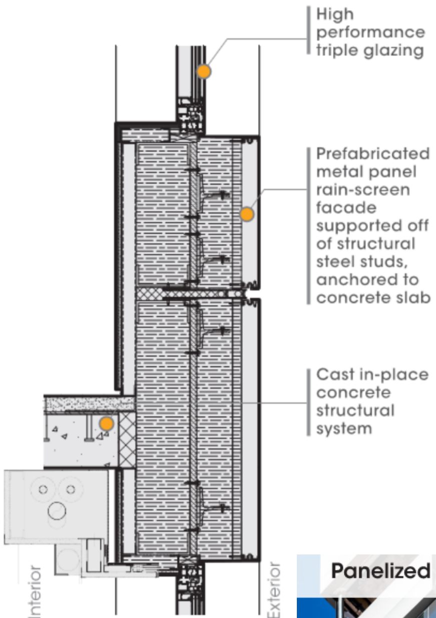
Surface Film Resistance [hr.ft².F/BTU] — interior Rsi : 0.97 — exterior Rse : 0.00

	Area section 1	R per inch	Area section 2 (optional)	R per inch	Area section 3 (optional)	R per inch	Thickness [in]
1.	concrete	0.20					12.00
2.	Terazzo	0.20					0.75
3.							
4.							
5.							
6.							
7.							
8.							
	Percentage of sec. 1	100%	Percentage of sec. 2	0.0%	Percentage of sec. 3	0.0%	Total 12.75 in

U-value supplement 0.00 BTU/hr.ft².°F

R-Value: 3.5 hr.ft².°F/BTU

Exterior Wall Construction



Description of construction & insulation

Pre-fabricated metal wall panel that hangs off the slab edge

3.1.4_Wall Thick Report

```
Name                 Length  Basis        U-factor
                      in.                 Btu/h-ft2-F
-------------------- ------- ------------ --------
Wall                  47.95  Projected Y   0.0269


Solid Materials

Name                                Conductivity   Emissivity
                                     Btu/h-ft-F
------------------------------      ------------   ----------
Steel - Galvanized Sheet (0.14
%C)*                                   35.82          0.20
TB_COS2 Thick Clear Wall Secti
on_SWA:Mineral Fiber 0.02               0.02          0.90
TB_COS2 Thick Clear Wall Secti
on_SWA:6mm Composite Aluminum
Panel                                   0.04          0.92
TB_COS2 Thick Clear Wall Secti
on_SWA:1.8" Air Gap 0.582 ft2
hr F/Btu in                             0.14          0.90
TB_COS2 Thick Clear Wall Secti
on_SWA:DensGlass Gold Fireguar
d                                       0.12          0.90
Butyl rubber*                           0.14          0.90
TB_COS2 Thick Clear Wall Secti
on_SWA:1" Air Gap R-1.913 ft2
hr F/Btu in                             0.04          0.35
```

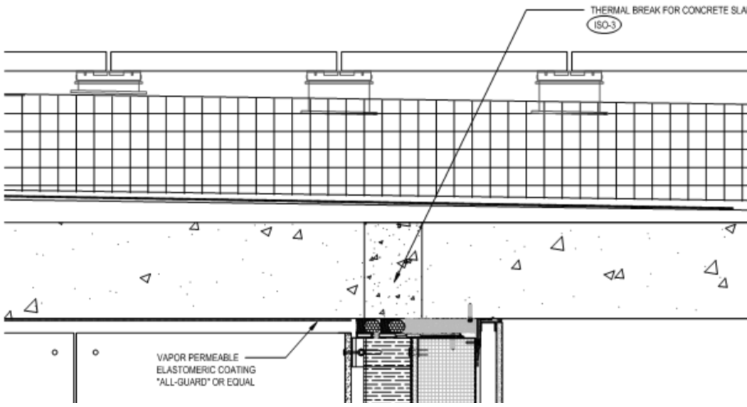
Assembly no. 02ud | Building assembly description: Panel Normal | Interior insulation: 0

Surface Film Resistance [hr.ft².F/BTU] interior Rsi: 0.00 exterior Rse: 0.00

	Area section 1	R per inch	Area section 2 (optional)	R per inch	Area section 3 (optional)	R per inch	Thickness [in]
1.	Blended R-value from therm: See "3.1.4_Wall Thick Report.pdf"	2.61					14.25
2.							
3.							
4.							
5.							
6.							
7.							
8.							
	Percentage of sec. 1	100%	Percentage of sec. 2	0.0%	Percentage of sec. 3	0.0%	Total 14.25

U-value supplement 0.00 BTU/hr.ft².°F | **R-Value:** 37.2 hr.ft².°F/BTU

Roof Construction



Description of construction & insulation

Poured concrete roof with 10“ of rigid XPS insulation on top

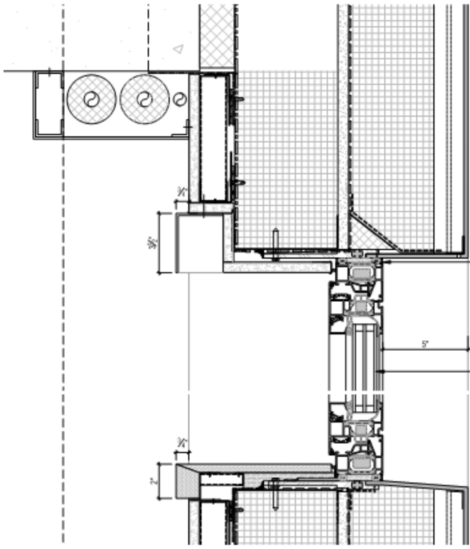
Assembly no.	Building assembly description	Interior insulation?
09ud	26th Floor Roof	0

Surface Film Resistance [hr.ft².F/BTU] interior Rsi : 0.57 exterior Rse : 0.23

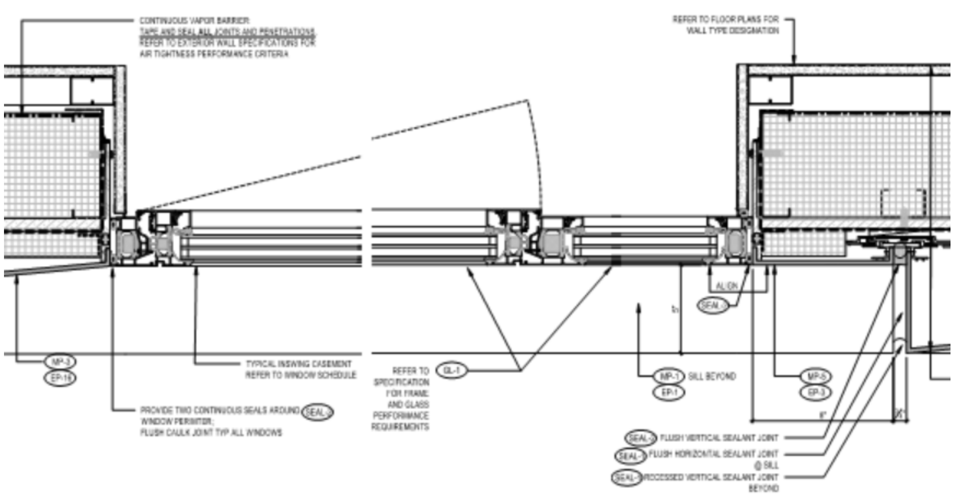
	Area section 1	R per inch	Area section 2 (optional)	R per inch	Area section 3 (optional)	R per inch	Thickness [in]
1.	10" of xps	5.00					10.00
2.	10" concrete	0.20					10.00
3.	air gap	0.06					25.30
4.	gyp	0.97					0.63
5.							
6.							
7.							
8.							
		Percentage of sec. 1		Percentage of sec. 2		Percentage of sec. 3	Total
		100%		0.0%		0.0%	45.92 in

U-value supplement 0.00 BTU/hr.ft^2.°F **R-Value:** 54.8 hr.ft^2.°F/BTU

Window Construction & Installation



Product & type	Schueco, ASW 75 Aluminium frame Operable and fixed apartment windows, fire rated windows, and storefront windows
Frame U-value Uf	1.35 W/(m²K)
Glazing U-value Ug	0.6 W/(m²K)
Glazing g-value	29%



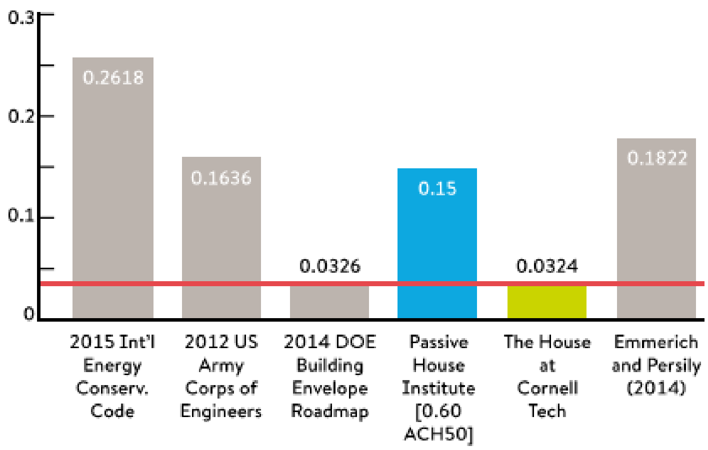
Airtight Building Envelope

Description of airtight cover

Air barrier spans the concrete slab on grade, transitions to the metal wall panel that has an interior air and vapor barrier which tranisitions to the concrete roof slab

WHOLE BUILDING LEAKAGE REQUIREMENTS & RESULTS

[leakage est. cubic feet per minute (CFM) per square foot at 50.00 Pascal]



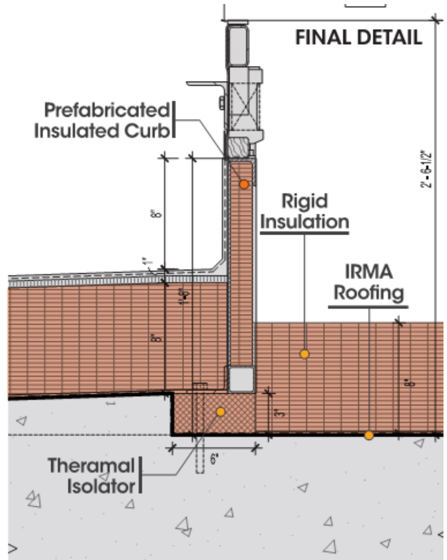
Sealed envelope construction

A whole-building pressure test measures total leakage through the building envelope - with external windows and doors closed - to ensure a project achieves the Passive House criteria. The results of the test on June 3rd, 2017 resulted in a measured airtightness of just 0.13 air changes per hour (ACH50) at 50 pascals – an exceptionally successful result against the maximum 0.60 ACH50 criteria. Based on calculations by Steven Winter Associates, 0.60 ACH50 is approximately equivalent to 0.15 CFM/SF for this building.

Note: CFM/SF at 50 Pa has been estimated as 66.5% of CFM/SF at 75 Pa where applicable so units are comparable in the graph shown above.

Note: Emmerich and Persily (2014) provide six-sided average results from 79 buildings with an air barrier from the NIST US Commerical Building Air Leakage Database.

Eliminate Thermal Bridging



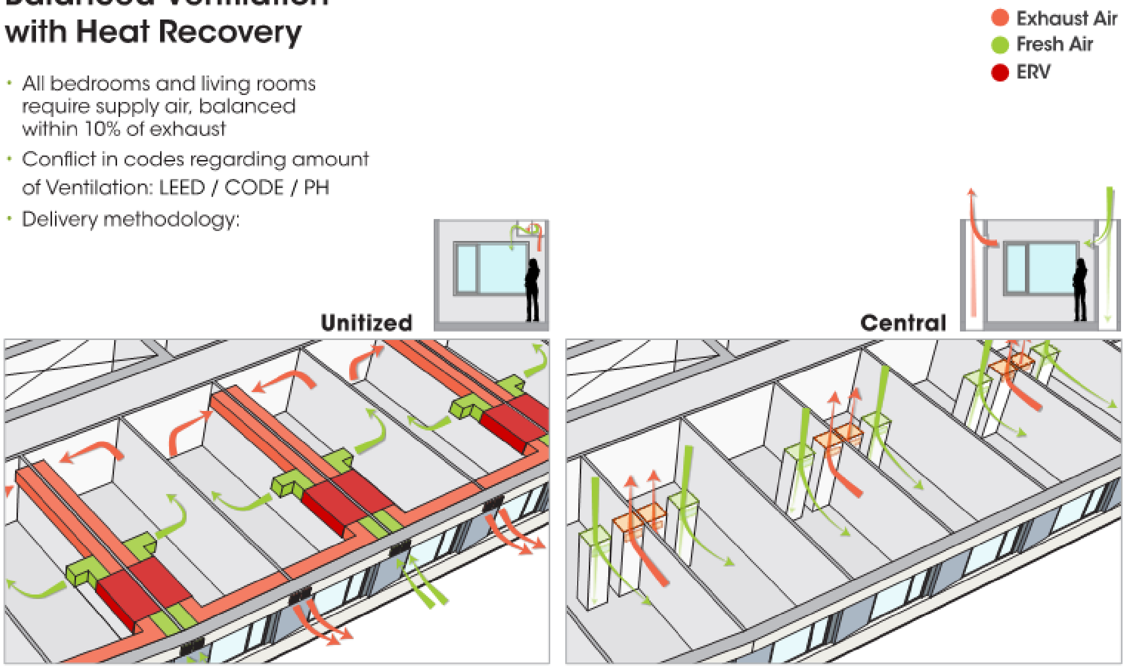
Before Panel Supports Sealed

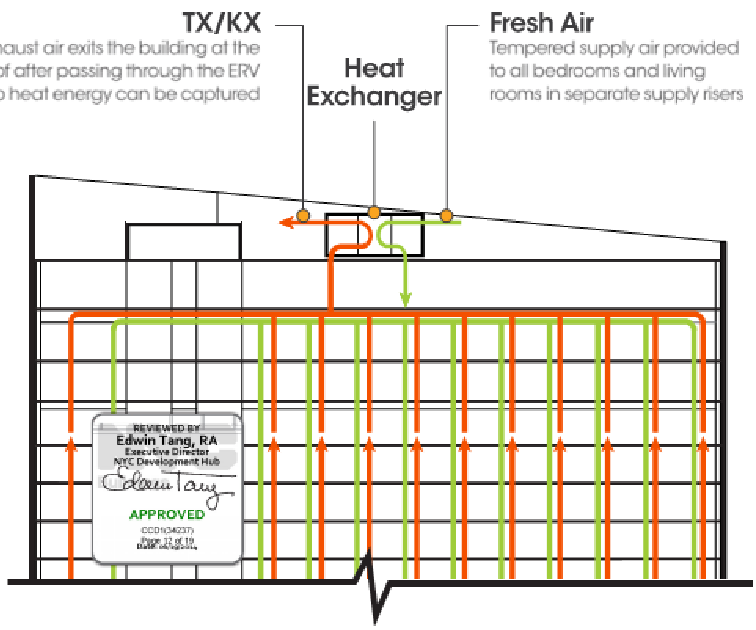
After Panel Supports Sealed

Ventilation System

Balanced Ventilation with Heat Recovery

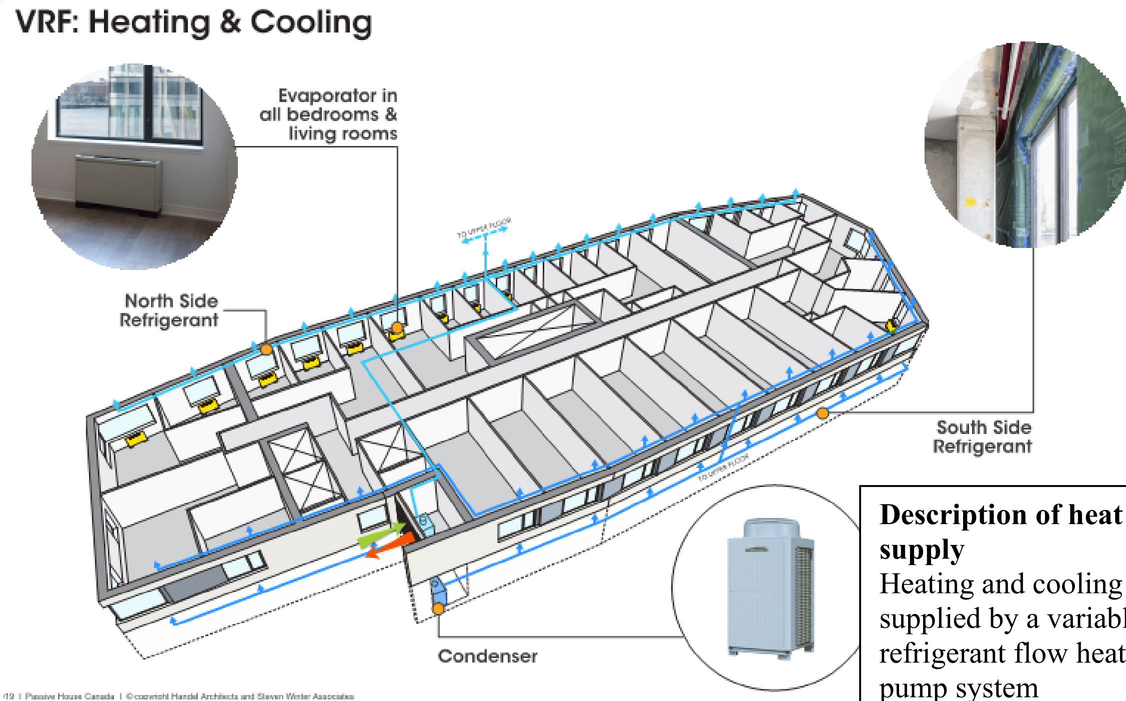
- All bedrooms and living rooms require supply air, balanced within 10% of exhaust
- Conflict in codes regarding amount of Ventilation: LEED / CODE / PH
- Delivery methodology:





Semco ERV
3 ventilation units
Centralized system - 2 roof mounted ERV's for residential. 1 additional dedicated ERV for public spaces.
Electrical efficiency in 1 W/CFM

Heating System



Description of heat supply

Heating and cooling is supplied by a variable refrigerant flow heat pump system

PHPP Results

Passive House verification

Building:	The House at Cornell Tech
Street Address:	1 East Loop Road
City, State, Zip:	Roosevelt Island, New York 10044
Country:	United States
Building type:	Student Housing
Climate:	NY, New York — Altitude of building site (feet above sea level): 130
Home owner / Client:	Cornell University
Street Address:	1 East Loop Road
City, State, Zip:	Roosevelt Island, New York 10044
Architecture:	Handel Architects
Street Address:	120 Broadway, 6th Floor
City, State, Zip:	New York, NY 10271
Passive House Consultants:	Steven Winter Associates, Inc
Street Address:	61 Washington Street
City, State, Zip:	Norwalk, CT 06854

Year of construction:	2015-17	Interior temperature winter:	68.0	°F	Enclosed volume V_e ft³:	2716322
No. of dwelling units:	352	Interior temperature summer:	77.0	°F	Mechanical cooling:	x
No. of occupants:	526.5	Internal heat sources winter:	1.30	BTU/h.ft²		
Spec. capacity:	19 BTU/F per ft² TFA	Ditto summer:	1.36	BTU/h.ft²		

Specific building demands with reference to the treated floor area

					Requirements	Fulfilled?*
	Treated floor area	198339	ft²			
Space heating	Heating demand	**3.91**	**kBTU/(ft²yr)**	82% of	4.75 kBTU/(ft²yr)	**yes**
	Heating load	**3.75**	**BTU/(hr.ft²)**	118% of	3.17 BTU/(hr.ft²)	-
Space cooling	Overall specif. space cooling demand	**3.39**	**kBTU/(ft²yr)**	63% of	5.39 kBTU/(ft²yr)	**yes**
	Cooling load	**2.88**	**BTU/(hr.ft²)**		-	-
	Frequency of overheating (> 77 °F)		%		-	-
Primary energy	Heating, cooling, dehumidification, DHW, auxiliary electricity, lighting, electrical appliances	**37.8**	**kBTU/(ft²yr)**	99% of	38.0 kBTU/(ft²yr)	**yes**
	DHW, space heating and auxiliary electricity	19.8	kBTU/(ft²yr)		-	-
	Specific primary energy reduction through solar electricity		kBTU/(ft²yr)		-	-
Airtightness	Pressurization test result n_{50}	**0.1**	**1/h**		0.6 1/h	**yes**

* empty field: data missing; '-': no requirement

Passive House?	**yes**

Building Challenges and Solutions

Design Challenges

Due to the long construction period of a high rise residential building, a testing method for airtightness needed to be found during the construction process before the entire building was sealed off, but before the lower floors of the building were going to get sheet rock and finishes. The design and construction team worked to develop a “guarded blower door test,” whereby the team sealed off three floors to create a chamber to do a blower door test.

Design Solutions- Envelope

Specifying a building envelope that would meet Passive House criteria and withstand very high wind loads. The solution involved galvanized steel framing and custom prefabricated wall panels—30 ft long by 12 ft high—with built-in windows. The insulation and air barrier membrane from one wall panel were taped to the next one on site to ensure continuity. Keeping those panels securely attached to the framing required 123 anchors on each floor, and each one of those anchors had to be insulated and air sealed.

Design Solutions- MEP Systems

Even though this building is in a heating-dominated climate, energy modeling showed that it would require much more cooling than heating. The solution was to use variable refrigerant flow (VRF) mini-split heat pumps, ganging up multiple evaporators with one 8-ton condenser on each floor, placed on a small mechanical equipment balcony.

User Experiences

A small survey of 7 units was completed with the majority of occupants indicating they were very happy with the green features in the building, including that it is Passive House. They liked that the bulding was quiet inside, energy is being saved, and fresh air. A single occupant commented on hiw abesence of asthma symptoms since moving into the building. Occupants noted that they would pay more for a Passive House and on average are getting sick less often since moving in.

More Resources

- https://www.dropbox.com/sh/x63fcomnnsix7yk/AACvepiiphP3R3lkaaQbqJIDa?dl=0
- https://thehouseatcornelltech.com/
- https://tech.cornell.edu/campus/the-house-at-cornell-tech/
- https://handelarchitects.com/project/the-house-at-cornell-tech
- https://passivhausprojekte.de/index.php?lang=en#d_5202