Project Documentation: Highland Passive House

Abstract

Office and Warehouse facility in Highland, NY

Data of building

Year of Construction	2024	**Space heating**	**9 kWh/(m²a)**
U-value external wall	0.101/0.149 W/(m²K)		
U-value basement	0.144/0.400 W/(m²K)	Primary Energy Renewable (PER)	32 kWh/(m²a)
U-value roof	0.100/0.108 W/(m²K)	Generation of renewable Energy	84 kWh/(m²a)
U-value window	0.75/0.98 W/(m²K)	Non-renewable Primary Energy (PE)	69 kWh/(m²a)
Heat recovery	77 %	Pressurization test n_{50}	0.41 h^{-1}
Special features	Large PV array with battery backup, capacity for electric vehicle charging		

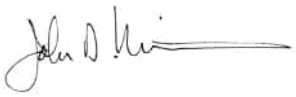
Brief Description

Highland Passive House

This multi-use building was built to house the operations of an interior design and home staging firm, providing office, warehouse and workspace for their operations, and to provide climate-controlled self-storage for the neighbouring community. In addition, electric vehicle charging, open to the public, is provided. The project seeks to demonstrate the applicability and replicability of Passive House building practices to unique commercial uses while serving the Highland community.

The project was funded in part by a generous grant from the New York State Research and Development Authority (NYSERDA).

Responsible project participants	
Architect	Ingui Architecture https://www.inguiarchitecture.com/
Implementation planning	Ingui Architecture https://www.inguiarchitecture.com/
Building systems	Bob Devilio, PE, RJD Engineering
Structural engineering	Praetorius and Conrad, P.C. https://www.praecon.com/
Building physics	John Mitchell, CPHD, bldgtyp, llc www.bldgtyp.com
Passive House project planning	John Mitchell, CPHD, bldgtyp, llc www.bldgtyp.com
Construction management	Baxter Building Corporation https://www.baxterbuilt.com/
Certifying body	
Passivhaus Institut Darmstadt www.passiv.de	
Certification ID	
7894	Project-ID (www.passivehouse-database.org)

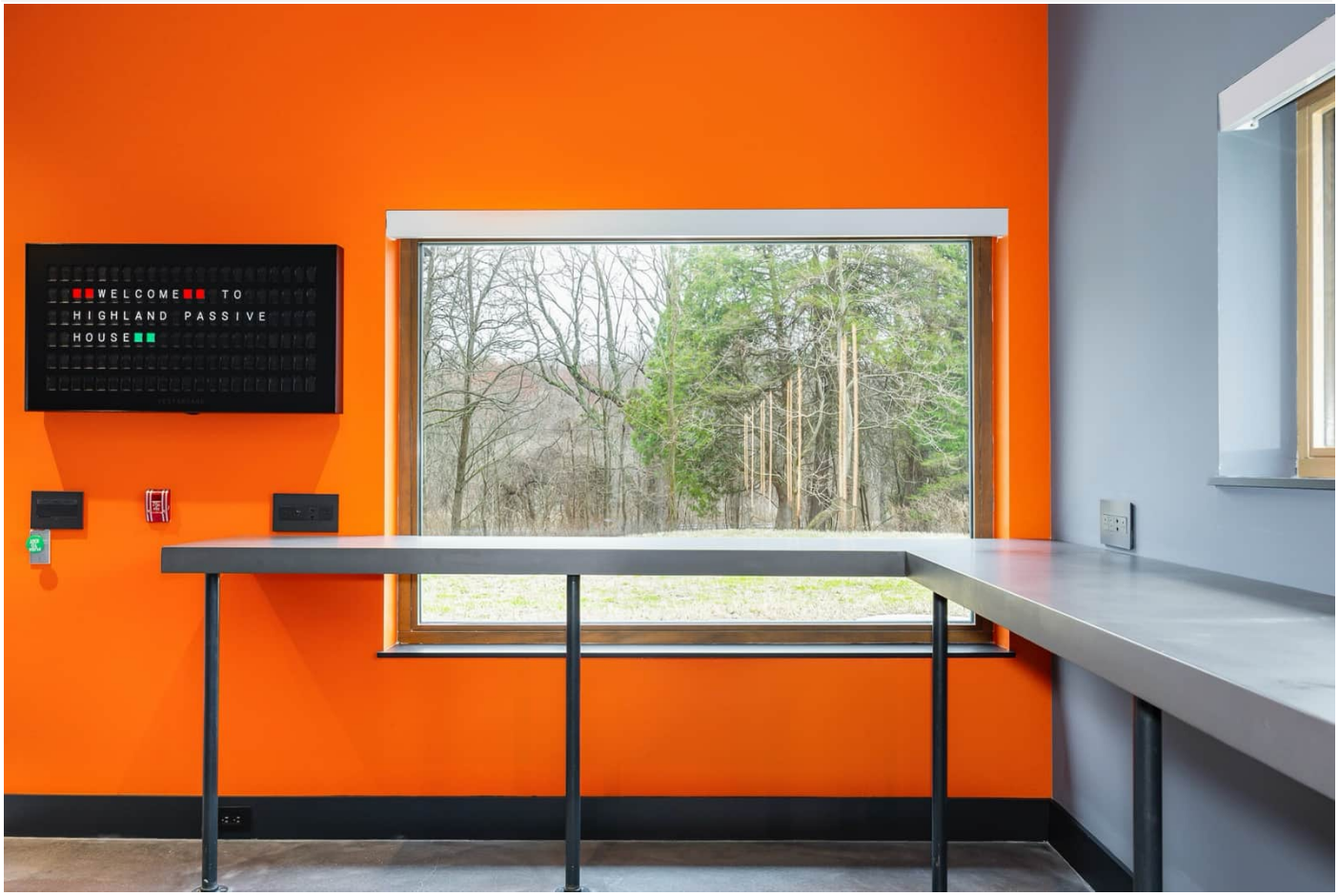
Author of project documentation	
John Mitchell, CPHD, bldgtyp, llc www.bldgtyp.com	
Date	Signature
18.07.2025	

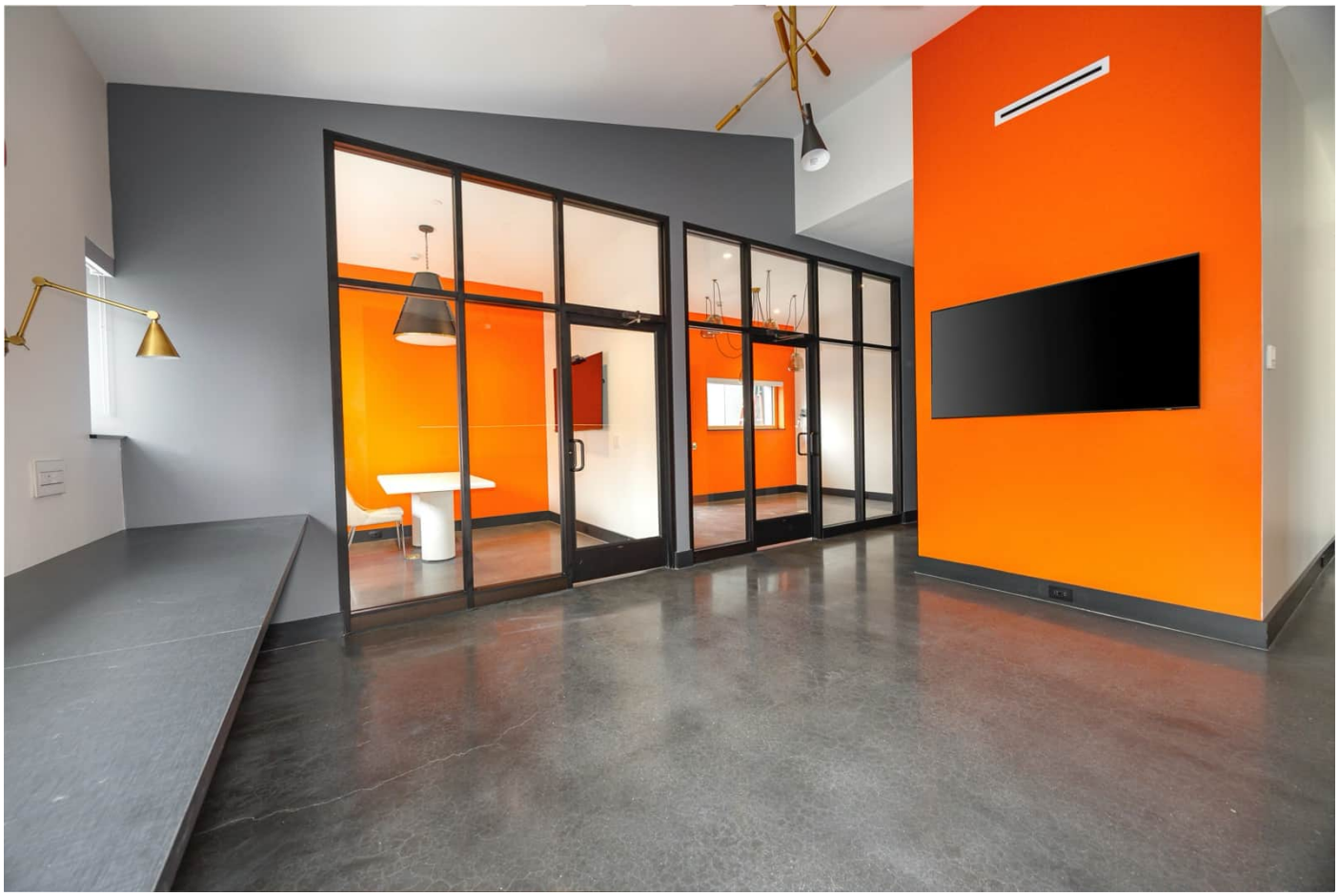
1. Exterior Photos

Northwest

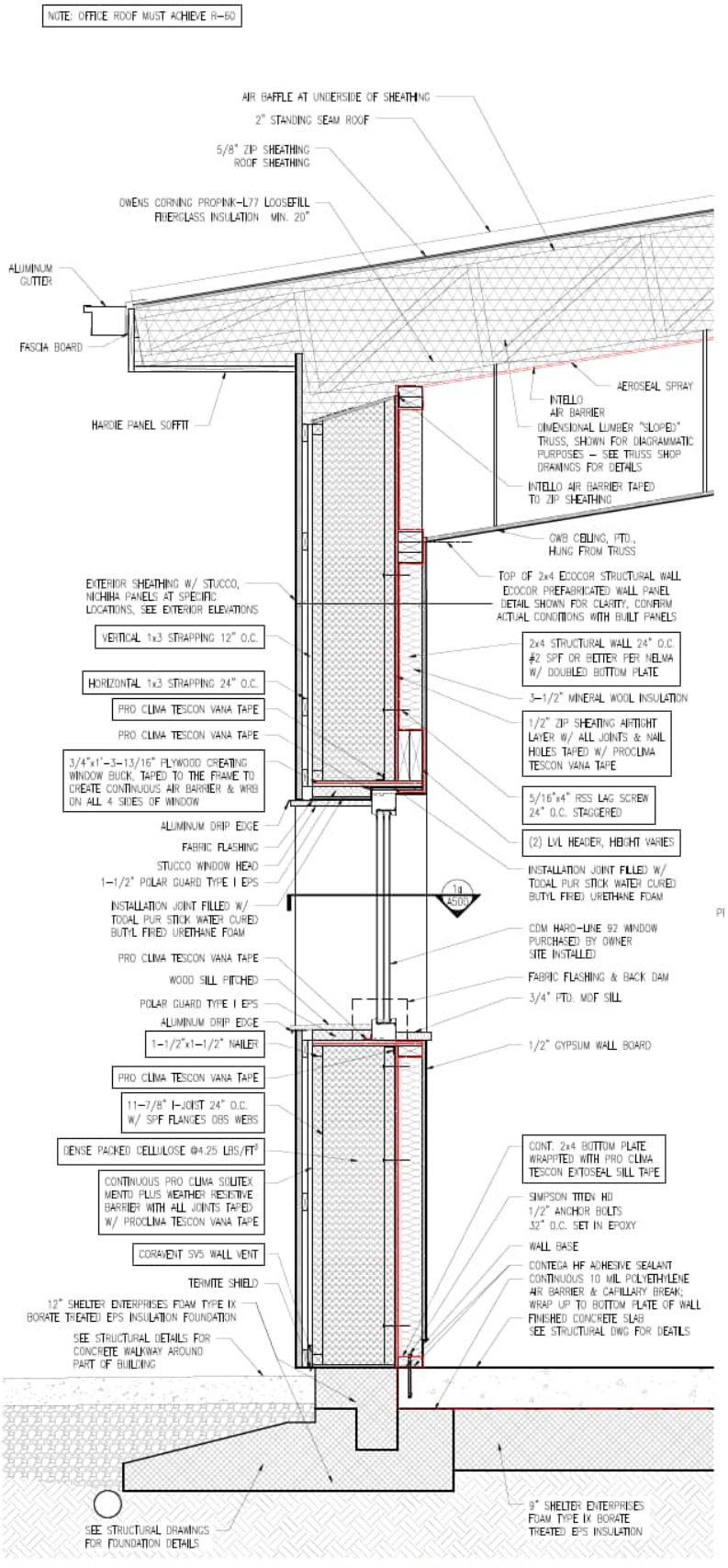
Southwest

2. Interior Photos



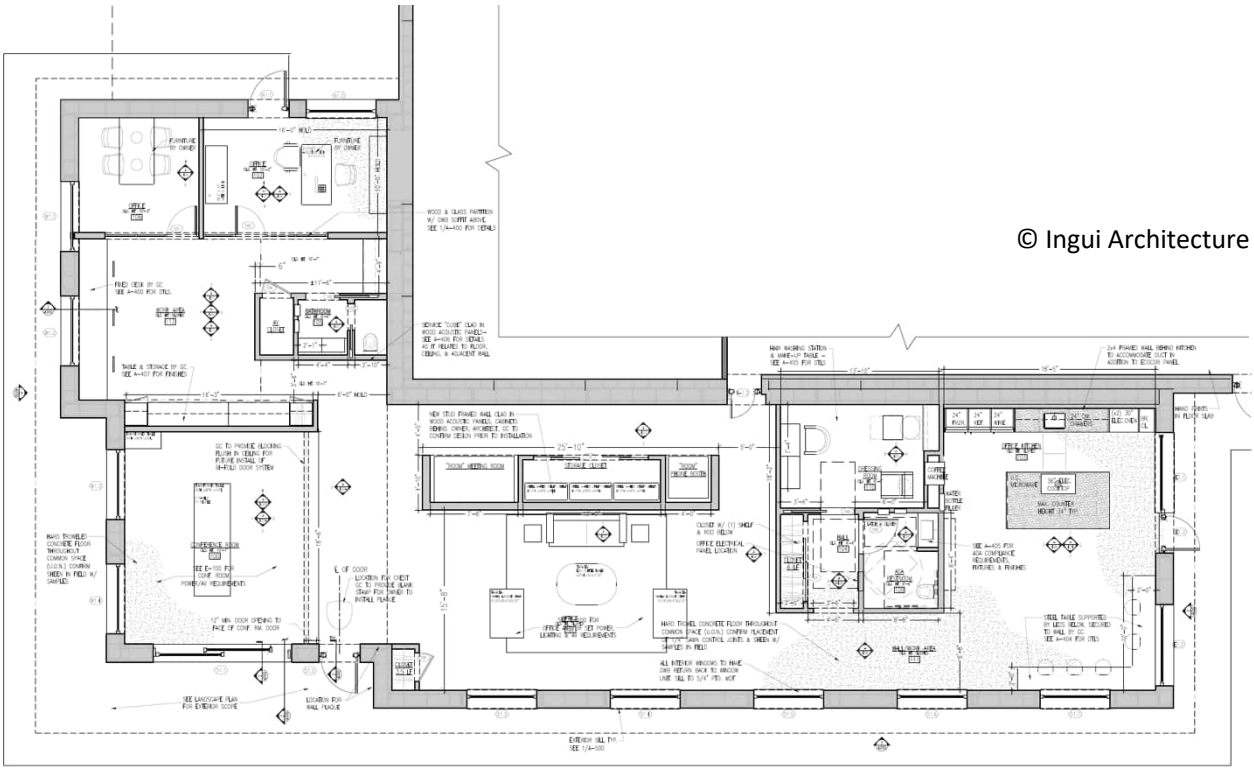


3. Building Section



1 / A-500 TYP. WALL DETAIL & WINDOW AT OFFICE
SCALE: 1" = 1'-0"

4. Floor Plan - Office

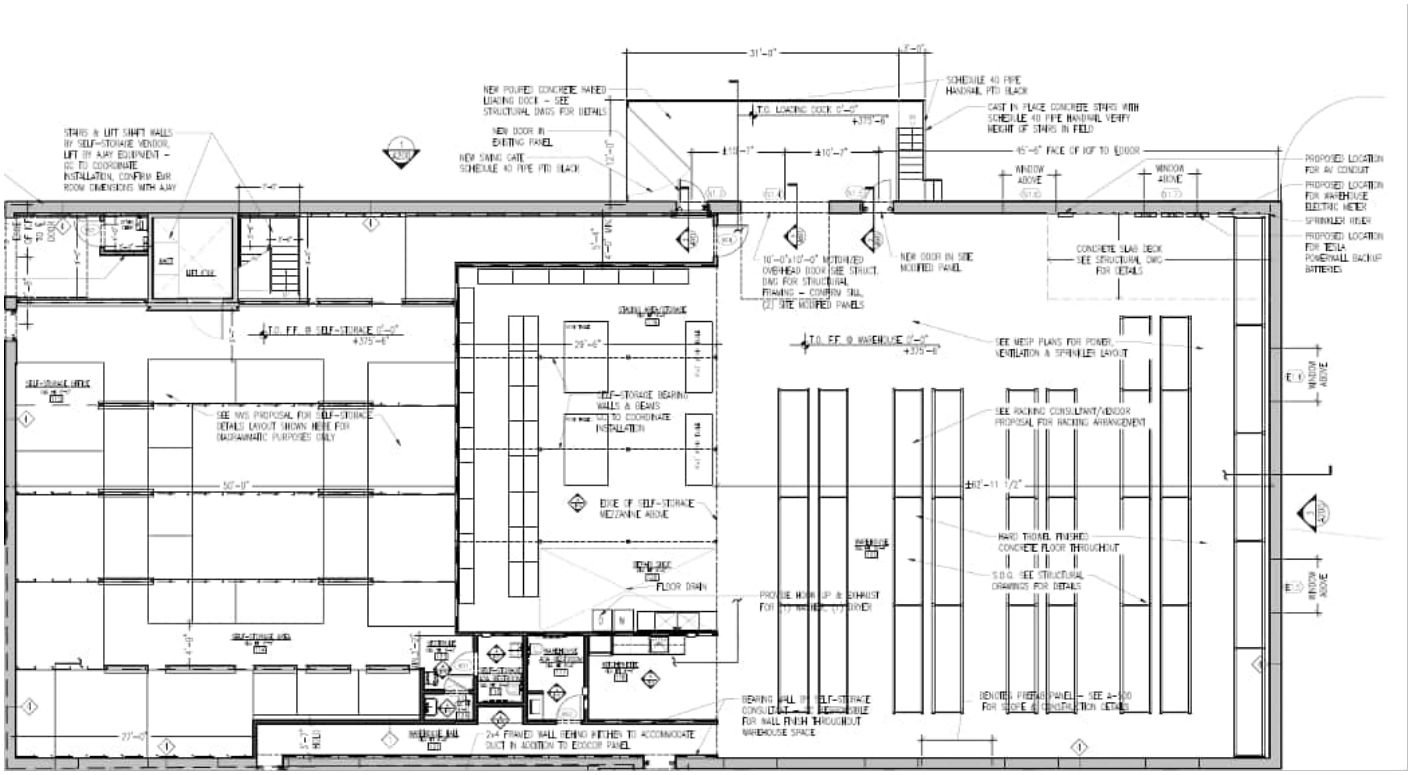


© Ingui Architecture

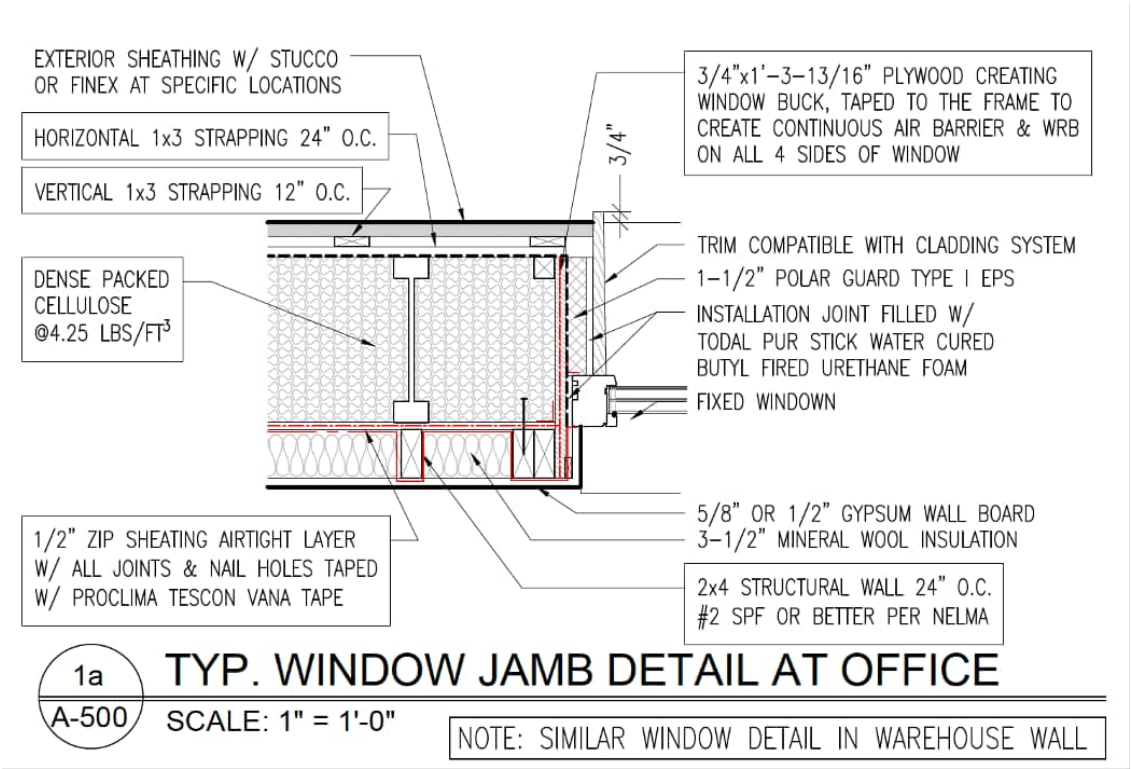
1 A-101 ENLARGED PROPOSED GROUND LEVEL OFFICE FLOOR PLAN
SCALE: 1/4" = 1'-0"

5. Floor Plan - Warehouse

© Ingui Architecture



6. Exterior Wall + Typical Window

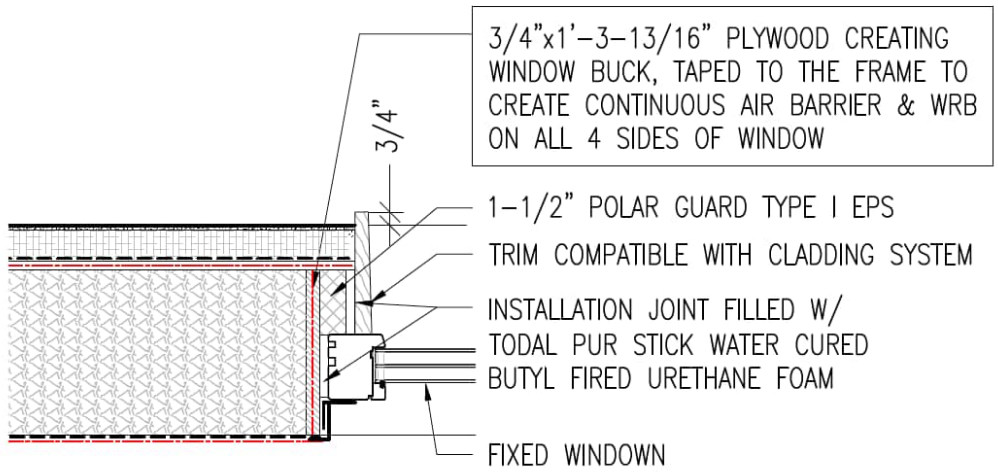


A certified Passive House building component, ECOCOR Passiv, was used for the Office wall. The service cavity was insulated with mineral wool batts for increased performance. 92mm Wood windows from CDM were over-insulated from the exterior.

Office Windows:
CDM Timber 92

U_f	1.1 W/(m^{2}K)
$Psi_{-install}$	0.13 W/(mK)
U_g	0.5 W/(m^{2}K)
g	0.54

Description of building assembly					Assembly no.	
OFFICE WALL (CALCULATED)					12ud	
Orientation of building assembly (or R_{si})	2-Wall			Interior insulation?		
Adjacent to (or R_{se})	1-Outdoor air			U-value supplement [W/(m²K)]		
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
GWB	0.158					16
MIN.WOOL INSULATION	0.035	WOOD FRAMING 24"OC	0.113			89
ZIP SHEATHING	0.104					11
CELULOSE	0.039	FLANGE	0.113			38
CELULOSE	0.039			WEB	0.104	225
CELULOSE	0.039	FLANGE	0.113			38
Percentage of sec. 1:	88%	Percentage of sec. 2:	10.4%	Percentage of sec. 3:	1.8%	
Heat transmission resistance coefficients				**Total thickness [cm]:**		**41.8**
Interior R_{si}:	0.13	m²K/W				
Exterior R_{se}:	0.04	m²K/W		**U-value [W/(m²K)]:**		**0.101**



15 / A-501 **WAREHOUSE WINDOW JAMB DETAIL, TYP.**

SCALE: 1" = 1'-0"

The Warehouse wall was built with prefabricated engineered timber panels insulated with dense-packed cellulose and 50mm exterior insulation. An interior vapor retarding membrane was included.

Description of building assembly					Assembly no.	
WT-4 WAREHOUSE WALL					01ud	
Orientation of building assembly (or R_{si})	2-Wall			Interior insulation?		
Adjacent to (or R_{se})	1-Outdoor air			U-value supplement [W/(m²K)]		
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
PLYWOOD	0.119					19
CLEAN FIBER CELLULOSE	0.040	WOOD FRAMING	0.140			235
ZIP SHEATHING	0.104					13
EPS INSULATION	0.039					51
Percentage of sec. 1:	91%	Percentage of sec. 2:	9.3%	Percentage of sec. 3:		
Heat transmission resistance coefficients				**Total thickness [cm]:**		**31.7**
Interior R_{si}:	0.13	m²K/W				
Exterior R_{se}:	0.04	m²K/W		**U-value [W/(m²K)]:**		**0.149**

Warehouse Windows:

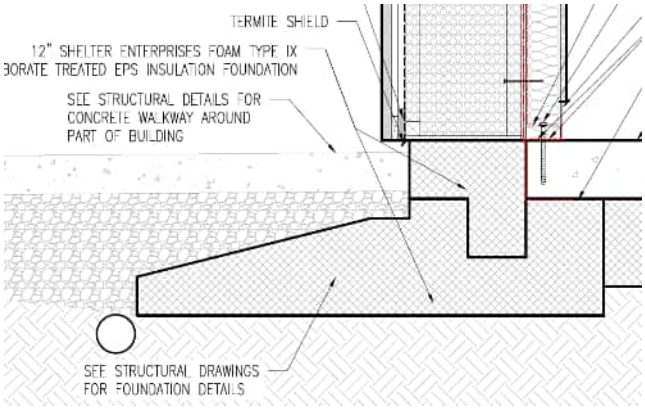
CDM Timber 68 with triple glazing

U_f	1.3 W/(m^{2}K)
$Psi_{-install}$	0.20 W/(mK)
U_g	0.7 W/(m^{2}K)
g	0.54

© CDM-OKNA

7. Slab on Grade Floor Construction

The office floor was built as a continuously insulated monolithic slab with integrated frost protection skirting.



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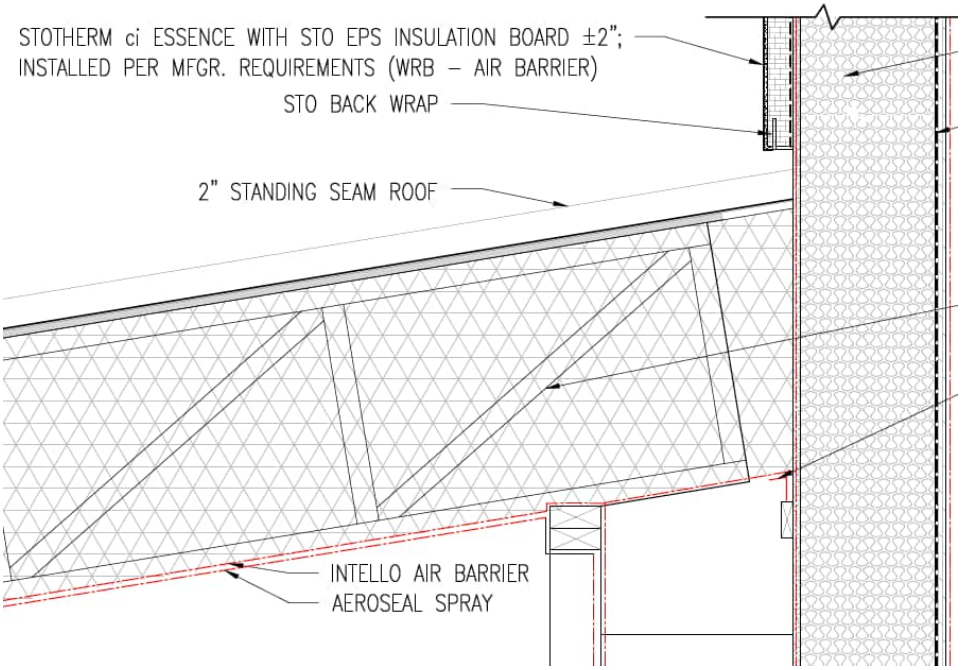
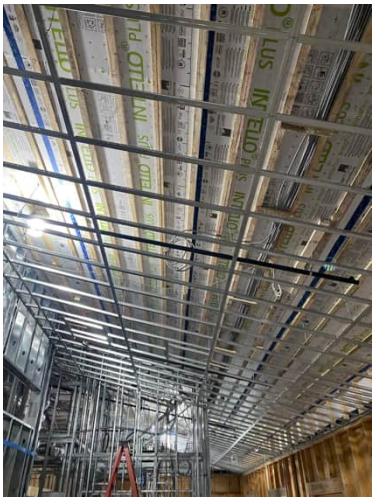
Description of building assembly					Assembly no.	
OFFICE FLOOR					10ud	
Orientation of building assembly (or R_{si})	0.17			Interior insulation?		
Adjacent to (or R_{se})	0			U-value supplement [W/(m²K)]		
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
CONCRETE	2.100					203
TYPE IX EPS	0.034					229
Percentage of sec. 1:	100%	Percentage of sec. 2:		Percentage of sec. 3:		
Heat transmission resistance coefficients				**Total thickness [cm]:**		**43.2**
Interior R_{si}:	0.17	m²K/W				
Exterior R_{se}:	0.00	m²K/W		**U-value [W/(m²K)]:**		**0.144**

The warehouse floor was built similarly, but with less insulation given the lower space conditioning requirements of the warehouse.

Description of building assembly					Assembly no.	
WAREHOUSE FLOOR SLAB					03ud	
Orientation of building assembly (or R_{si})	3-Floor			Interior insulation?		
Adjacent to (or R_{se})	2-Ground			U-value supplement [W/(m²K)]		
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
CONCRETE	2.100					125
TYPE IX EPS	0.034					76
Percentage of sec. 1:	100%	Percentage of sec. 2:		Percentage of sec. 3:		
Heat transmission resistance coefficients				**Total thickness [cm]:**		**20.1**
Interior R_{si}:	0.17	m²K/W				
Exterior R_{se}:	0.00	m²K/W		**U-value [W/(m²K)]:**		**0.408**

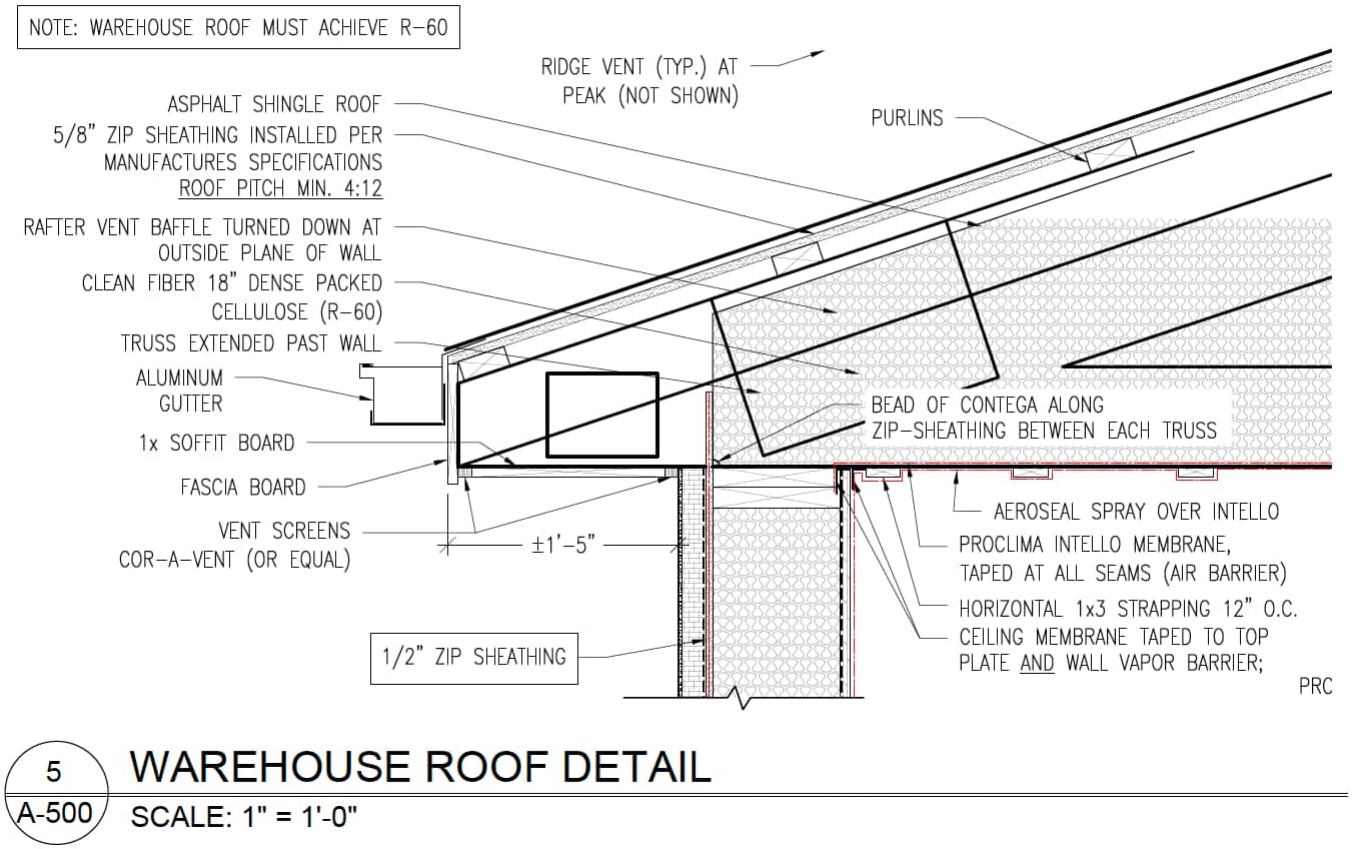
8. Roof Construction





The Office roof was built with parallel cord trusses filled with dense-packed cellulose insulation. A "smart" air barrier/vapor retarding membrane was installed below the trusses to contain the insulation, provide airtightness, and manage moisture vapor.

Description of building assembly					Assembly no.	
OFFICE ROOF					11ud	
Orientation of building assembly (or R_{si})	0.1			Interior insulation?		
Adjacent to (or R_{se})	0.04			U-value supplement [W/(m²K)]		
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
CELLULOSE INSULATION	0.040	WOOD TRUSS	0.140			457
Percentage of sec. 1:	94%	Percentage of sec. 2:	6.3%	Percentage of sec. 3:		
Heat transmission resistance coefficients				**Total thickness [cm]:**		**45.7**
Interior R_{si}:	0.10	m²K/W				
Exterior R_{se}:	0.04	m²K/W		**U-value [W/(m²K)]:**		**0.100**



5 / A-500 **WAREHOUSE ROOF DETAIL**

SCALE: 1" = 1'-0"

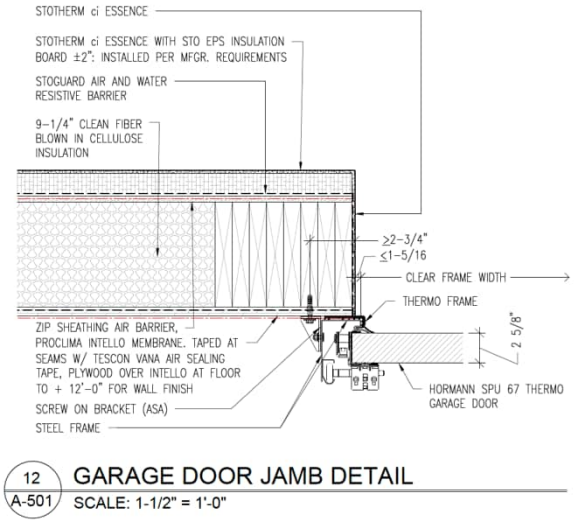
The Warehouse roof was built as a simple vented attic, with ~400mm cellulose insulation above the air barrier/vapor retarding layer.

Description of building assembly					Assembly no.	
WAREHOUSE ROOF					02ud	
Orientation of building assembly (or R_{si})	1-Roof			Interior insulation?		
Adjacent to (or R_{se})	3-Ventilated			U-value supplement [W/(m²K)]		
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
CLEAN FIBER CELLULOSE	0.040	WOOD TRUSS 36IN OC	0.140			406
Percentage of sec. 1:	96%	Percentage of sec. 2:	4.2%	Percentage of sec. 3:		
Heat transmission resistance coefficients				Total thickness [cm]:		40.6
Interior R_{si}:	0.10	m²K/W				
Exterior R_{se}:	0.10	m²K/W		U-value [W/(m²K)]:		0.106

9. Air Sealing Strategy

The air sealing approach for the building connected the sub-slab air/vapor barrier to the sheathing layer of the framed wall panels, which connected to the interior air barrier/vapor retarder via a transition membrane installed prior to setting the roof trusses. The same strategy was used for both office and warehouse assemblies.

The building airtightness was tested as a single building volume (office + warehouse combined), with openings between the office and warehouse open for the test. Initial testing revealed areas for improvement, particularly at plumbing and electrical penetrations. Considerable care was taken by the construction team to tighten up the building envelope prior to the installation of finishes. Additional measures were taken at the garage door openings to ensure airtightness.

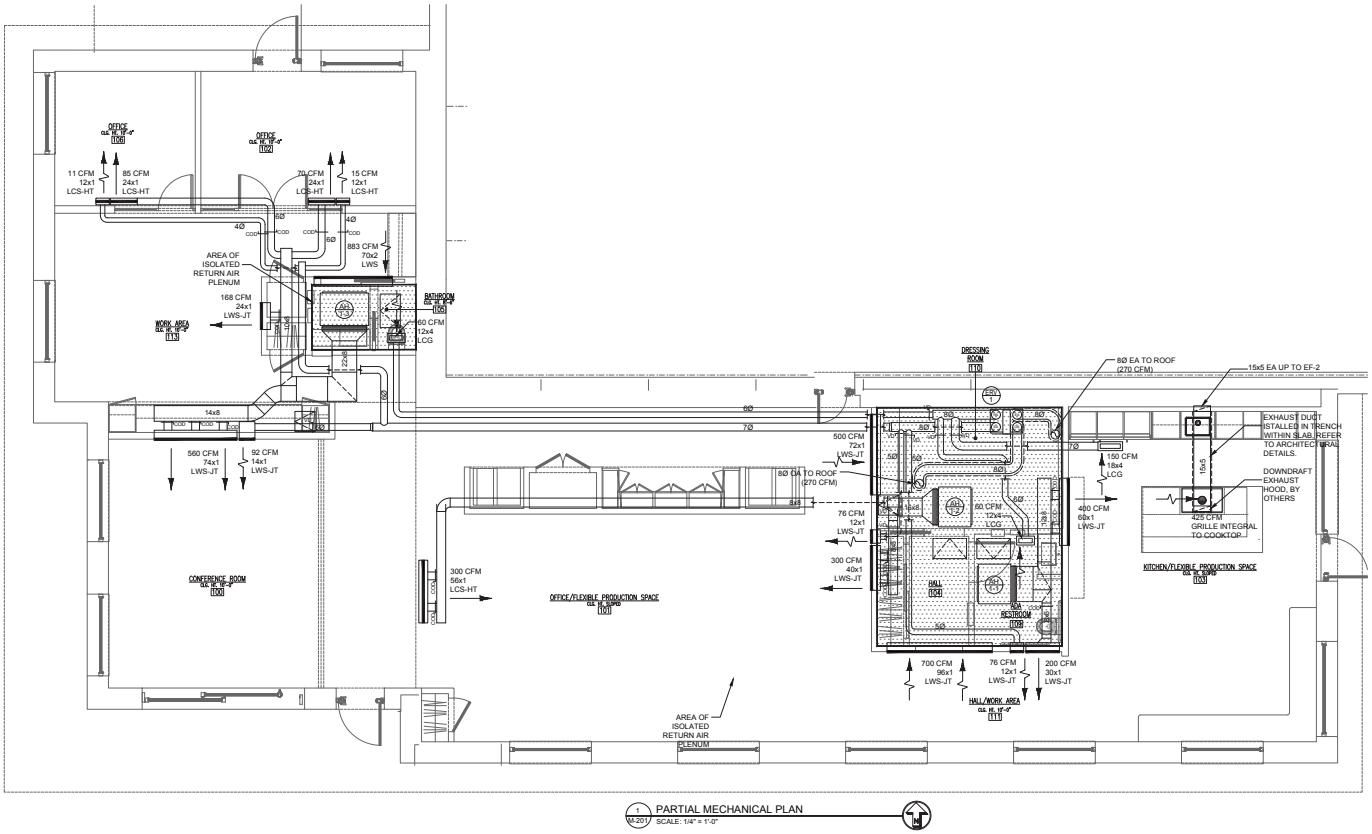


Final testing yielded a result of 0.41^{-h}.

10. Ventilation System Design

High-efficiency equipment was chosen for both the Office and Warehouse spaces. The Office is served by a PHI-Certified ERV from Zehnder, the Q600 ERV with 80% heat recovery efficiency and 68% humidity recovery efficiency.

Cascade ventilation was employed throughout, with supply to offices, extract from kitchen, baths and utility areas, and transfer through corridor and other circulation areas.



Dimensioning of air quantities

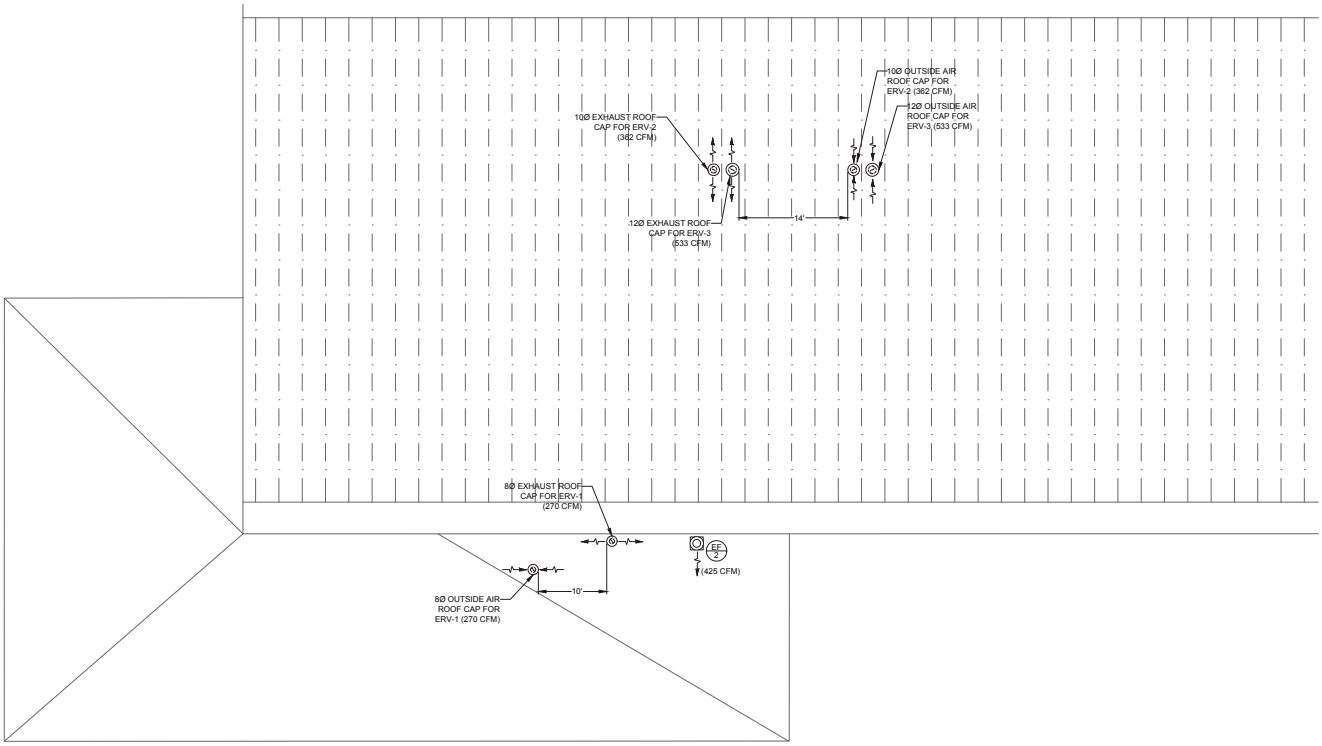
Room no.	Quantity q	Room name	Allocation to ventilation unit (No.)	Area A m²	Clear height h m	Room vol. A x h m³	Volume flow per room V_{SUP} m³/h	V_{ETA} m³/h	V_{TRANS} m³/h
1	1	100 CONFERENCE	1	45	3.23	147	165		
2	1	101 OFFICE	1	74	3.82	284	131		
3	1	102 OFFICE	1	15	3.12	46	29		
4	1	103 OFFICE KITCHEN	1	42	3.75	158		243	
5	1	104 HALL	1	3	2.59	9			34
6	1	105 BATHROOM	1	2	2.59	5			34
7	1	105 BATHROOM WC	1	1	2.59	3		100	
8	1	106 OFFICE	1	10	3.12	30	22		
9	1	109 ADA RESTROOM	1	5	2.59	13		104	
10	1	110 DRESSING ROOM	1	12	2.59	30		29	
11	1	111 HALL/WORK AREA	1	9	3.42	31	134		
12	1	113 WORK AREA	1	28	3.56	99			102
13									
14	1	RANGE HOOD ON	2	42	3.75	158	0	450	

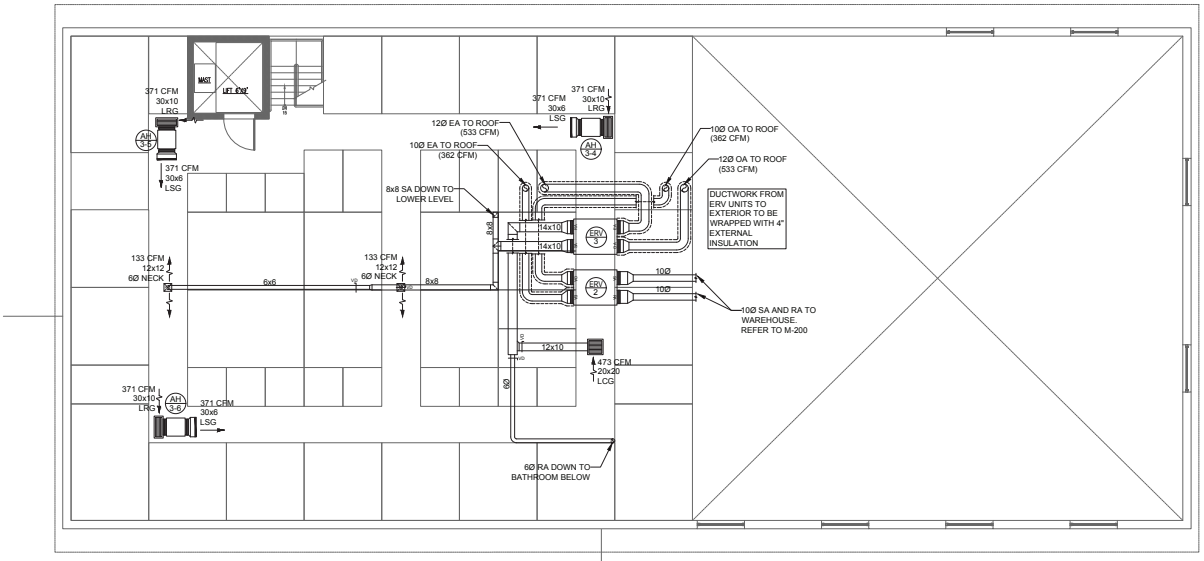
The Warehouse spaces are ventilated by two Ventacity VS900 CMe units, with combined effective heat recovery efficiencies of 76% and humidity recovery efficiencies of 67%.

Dimensioning of air quantities

cfm->m3h 1.699

Room no.	Quantity q	Room name	Allocation to ventilation unit (No.)	Area A m²	Clear height h m	Room vol. A x h m³	Volume flow per room V_{SUP} m³/h	V_{ETA} m³/h	V_{TRANS} m³/h
1	1	114 SELF STORAGE AREA	3	272	2.73	740	452		
2	1	116 S-S ADA RESTROOM	3	4	2.73	10		99	
3	1	7 WAREHOUSE ADA RESTROC	2	6	2.73	16		92	
4	1	118 KITCHENETTE	2	13	2.73	36		97	
5	1	119-120 REPAIR/STAGING	2	115	2.73	313		93	
6	1	122 WAREHOUSE	2	363	6.23	2259	579	328	
7	1	201 STORAGE MEZZANINE	3	446	3.30	1473	477	860	



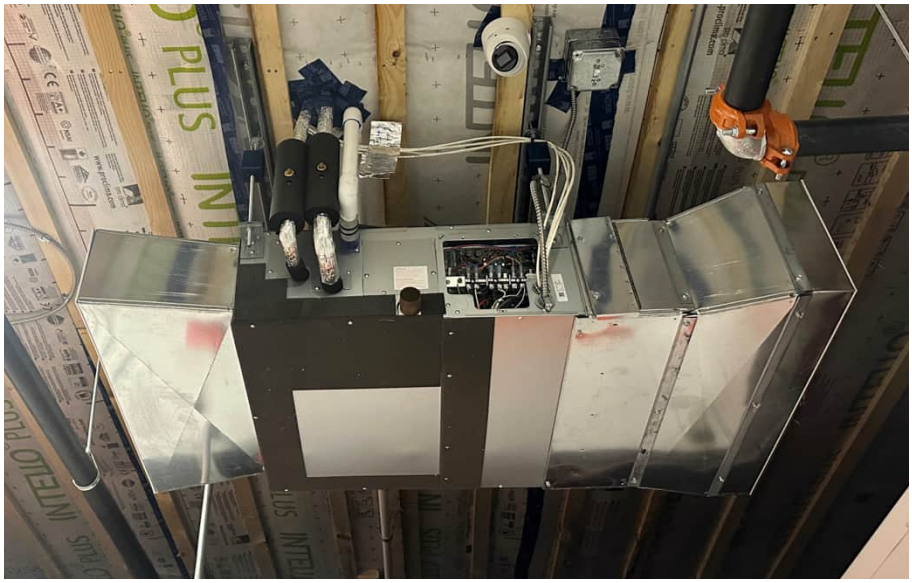


1 M-2027 MEZZANINE MECHANICAL PLAN
SCALE: 1/8" = 1' 0"

11. Heating, Cooling and Dehumidification

The mixed climate of Highland, New York calls for mechanical heating, cooling and dehumidification, making split system heat pumps the logical choice. Mitsubishi units were chosen for their high-efficiency and quality. The systems can operate down to very low temperatures with good efficiency.

Outdoor units serve ducted indoor units.



12. PHPP-Results

Passive House Verification with Combined PHPPs

Building: HIGHLAND PASSIVE HOUSE

Standard: PASSIVE HOUSE
Primary energy verification: PER
Class: PLUS

Specific building characteristics with reference to the treated floor area

			WAREHOUSE	OFFICE	TOTALS		Criteria	Alt Criteria	Fulfilled?
	Treated floor area	m²	1145.5	242.8	1388.2				
	Footprint	m²	872.0	304.5	1176.5				
	Envelope Area	m²	2551.5	1079.8	3631.2				
	Vn50	m³	4981.4	864.3	5845.8				
Space heating	Heating demand	kWh/(m²a)	6.67	17.28	**8.52**	≤	15	-	**yes**
	Heating load	W/m²	6.66	11.38	**11.38**	≤	-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	0.18	11.29	**2.12**	≤	20	20	**yes**
	Frequency of overheating (> 25 °C)	%	-	-	**-**	≤	-		**-**
	Frequency of excessively high humidity (> 12 g/kg)	%	8.59	0.77	**8.59**	≤	10		**yes**
Airtightness	Pressurization test result n50	1/h	0.41	0.41	**0.41**	≤	0.6		**yes**
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	42.4	196.2	**69.31**	≤			**-**
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	20.0	89.1	**32.07**	≤	45	30	**yes**
	Generation of renewable energy (in relation to pro-jected building footprint area)	kWh/(m²a)	113.1	0.0	**83.81**	≥	60	42	**yes**

Passive House-Verification

10.6 EN

Building:	HIGHLAND PASSIVE HOUSE - OFFICE		
Street:	UPPER NORTH ROAD		
Postcode/City:	12528	HIGHLAND	
Province/Country:	NEW YORK	US-United States of America	
Building type:	WAREHOUSE		
Climate data set:	US0106b-Poughkeepsie, Altitude corrected		
Climate zone:	3: Cool-temperate	Altitude of location:	113.9952 m
Home owner / Client:	RTH REALTY HOLDINGS		
Street:	320 ROEBLING STREET #126		
Postcode/City:	11211	BROOKLYN	
Province/Country:	NEW YORK	US-United States of America	

Architecture:	INGUI ARCHITECTURE		
Street:	20 VESEY STREET, SUITE 900		
Postcode/City:	10007	NEW YORK	
Province/Country:	NEW YORK	US-United States of America	
Energy consultancy:	BLDGTYP		
Street:	231 PARK PLACE #22		
Postcode/City:	11238	BROOKLYN	
Province/Country:	NEW YORK	US-United States of America	

Mechanical engineer:	RJD ENGINEERING		
Street:	590 FRANKLIN AVE, SUITE 4		
Postcode/City:	07110	NUTLEY	
Province/Country:	NEW JERSEY	US-United States of America	
Certification:	PASSIVE HOUSE INSTITUTE		
Street:	RHEINSTRASSE 44/46		
Postcode/City:	64283		
Province/Country:	HESSE	DE-Germany	

Year of construction:	2024	Interior temperature winter [°C]:	20.0	Interior temp. summer [°C]:	25.0
No. of dwelling units:	1	Internal heat gains (IHG) winter [W/m²]:	3.5	IHG summer [W/m²]:	4.6
No. of occupants:	8.0	Specific heat capacity [Wh/K per m² TFA]:	84	Mechanical cooling:	x

Specific building characteristics with reference to the treated floor area

					Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	242.8				
Space heating	Heating demand	kWh/(m²a)	17	≤	15	-	No
	Heating load	W/m²	11	≤	-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	11	≤	15		Yes
	Frequency of overheating (> 25 °C)	%	-	≤	-		-
	Frequency of excessively high humidity (> 12 g/kg)	%	1	≤	10		Yes
Airtightness	Pressurisation test result n_{50}	1/h	0.4	≤	0.6		Yes
Moisture protection							
	Smallest temperature factor $f_{Rsi=0.25\ m²K/W}$	-	0.91	≥	0.54	0.42	Yes
Thermal comfort	All requirements fulfilled?	-					Yes
	U-value	W/(m²K)		≤	0.82		
	U-value	W/(m²K)		≤	0.98		
	U-value	W/(m²K)		≤	1.07		
	U-value	W/(m²K)		≤	0.45		
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	196	≤	-		-
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	89	≤	60	75	No
	Renew. energy generation (in rel. to projected building footprint area)	kWh/(m²a)	0	≥	-	-	

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

I confirm that the values given here 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 Classic? No

Task:	First name:	Surname:	Signature:
	john	mitchell	

Certificate-ID	Issued on:	City:

Project data imported from designPH 2.1.15a 2023-06-16 14:03:55 -0400

Passive House-Verification

10.6 EN

Building:	HIGHLAND PASSIVE HOUSE - WAREHOUSE		
Street:	UPPER NORTH ROAD		
Postcode/City:	12528	HIGHLAND	
Province/Country:	NEW YORK	US-United States of America	
Building type:	WAREHOUSE		
Climate data set:	ud---01-US0106b-Poughkeepsie, Altitude corrected		
Climate zone:	3: Cool-temperate	Altitude of location:	113.9952 m
Home owner / Client:	RTH REALTY HOLDINGS		
Street:	320 ROEBLING STREET #126		
Postcode/City:	11211	BROOKLYN	
Province/Country:	NEW YORK	US-United States of America	

Architecture:	INGUI ARCHITECTURE		
Street:	20 VESEY STREET, SUITE 900		
Postcode/City:	10007	NEW YORK	
Province/Country:	NEW YORK	US-United States of America	
Energy consultancy:	BLDGTYP		
Street:	231 PARK PLACE #22		
Postcode/City:	11238	BROOKLYN	
Province/Country:	NEW YORK	US-United States of America	

Mechanical engineer:	RJD ENGINEERING		
Street:	590 FRANKLIN AVE, SUITE 4		
Postcode/City:	7110	NUTLEY	
Province/Country:	NEW JERSEY	US-United States of America	
Certification:	PASSIVE HOUSE INSTITUTE		
Street:	RHEINSTRASSE 44/46		
Postcode/City:	64283		
Province/Country:	HESSE	DE-Germany	

Year of construction:	2023	Interior temperature winter [°C]:	10.0	Interior temp. summer [°C]:	25.0
No. of dwelling units:	1	Internal heat gains (IHG) winter [W/m²]:	1.0	IHG summer [W/m²]:	0.9
No. of occupants:	2.0	Specific heat capacity [Wh/K per m² TFA]:	84	Mechanical cooling:	x

Specific building characteristics with reference to the treated floor area

					Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	1145.5				
Space heating	Heating demand	kWh/(m²a)	**7**	≤	15	-	**Yes**
	Heating load	W/m²	**7**	≤	-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	**0**	≤	15		**Yes**
	Frequency of overheating (> 25 °C)	%	**-**	≤	-		**-**
	Frequency of excessively high humidity (> 12 g/kg)	%	**9**	≤	10		**Yes**
Airtightness	Pressurisation test result n_{50}	1/h	**0.4**	≤	0.6		**Yes**
Moisture protection							
	Smallest temperature factor $f_{Rsi=0.25\ m^2K/W}$	-	**0.59**	≥	0.33	0.16	**Yes**
Thermal comfort	All requirements fulfilled?	-					**Yes**
	U-value	W/(m²K)		≤	0.86		
	U-value	W/(m²K)		≤	1.02		
	U-value	W/(m²K)		≤	1.12		
	U-value	W/(m²K)		≤	0.47		
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	**42**	≤	-		**-**
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	**20**	≤	45	30	**Yes**
	Renew. energy generation (in rel. to projected building footprint area)	kWh/(m²a)	**113**	≥	60	40	

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

I confirm that the values given here 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:
	john	mitchell	

Certificate-ID	Issued on:	City:

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