Project Documentation
Gebäude-Dokumentation

Abstract | Zusammenfassung


Photos: Chuck Baker Photography

206 E 20th St, NY NY 10003

Data of building | Gebäudedaten

Year of construction Baujahr	2013-2017	**Space heating Heizwärmebedarf**	**21 kWh/(m²a)**
U-value exterior (interior) insulation external wall U-Wert Außenwand	0,15 (0,5) W/(m²K)		
U-value insulation interior underground U-Wert Kellerdecke	0,20 W/(m²K)	Primary Energy Renewable (PER) Erneuerbare Primärenergie (PER)	N.A. kWh/(m²a)
U-value roof U-Wert Dach	0,131 W/(m²K)	Generation of renewable Energy Erzeugung erneuerb. Energie	N.A. kWh/(m²a)
U-value window U-Wert Fenster	0,79 W/(m²K)	Primary Energy (PE) Primärenergie (PE)	122.59 kWh/(m²a)
Heat recovery Wärmerückgewinnung	85 %	Pressurization test n_{50} Drucktest n_{50}	1,0 h^{-1}
Special features Besonderheiten	Balconies, terraces, skylight		

Brief Description

EnerPHit Retrofit: NYC urban infill residential retrofit and extension

.
A mosaic of different building assemblies (poured-in-place concrete, concrete masonry units, structural steel, light gauge metal, timber frame, rain screen and solid masonry) was used for structural remediation, to maximize performance and enlarge the existing building horizontally and vertically while maintaining a strong relationship with the front façade of the neighboring sister building. The addition includes balconies and terraces which provide access to the outdoors from almost every room.
This project was certified by the Passive House Academy (PHA).

Responsible project participants
Verantwortliche Projektbeteiligte

Architect Entwurfsverfasser	In Cho (ChoShields Studio) http://www.choshields.com
Implementation planning Ausführungsplanung	
Building systems Haustechnik	Baukraft Engineering
Structural engineering Baustatik	Becker Engineering
Building physics Bauphysik	Diesel Contracting of NY
Passive House project planning Passivhaus-Projektierung	PH Consultant: In Cho (ChoShields Studio); PH Certifier:Passive House Academy (PHA)
Construction management Bauleitung	-

Certifying body
Zertifizierungsstelle

Passivhaus Institut Darmstadt
www.passiv.de

Certification ID
Zertifizierungs ID

5595	Project-ID (https://passivehouse-database.org/index.php?lang=en#d_5595) Projekt-ID (https://passivehouse-database.org/index.php?lang=de#d_5595)

Author of project documentation
Verfasser der Gebäude-Dokumentation

In Cho, R.A., ChoShields Studio

Date Datum	Signature Unterschrift
20.09.2019	

1. Ansichtsfotos

Photo: Chuck Baker Photography

Südt

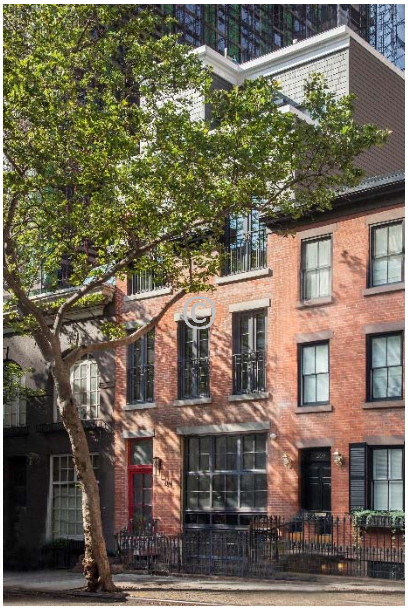
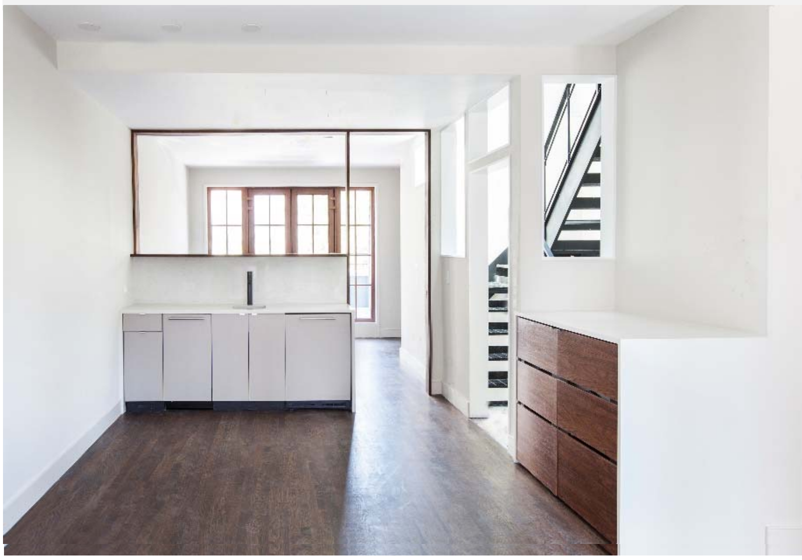
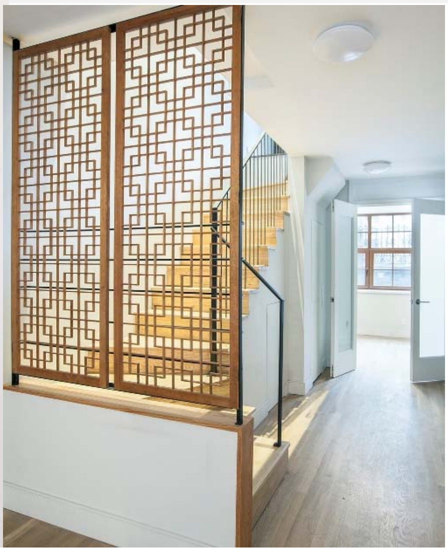


Photo: Chuck Baker Photography

Nord

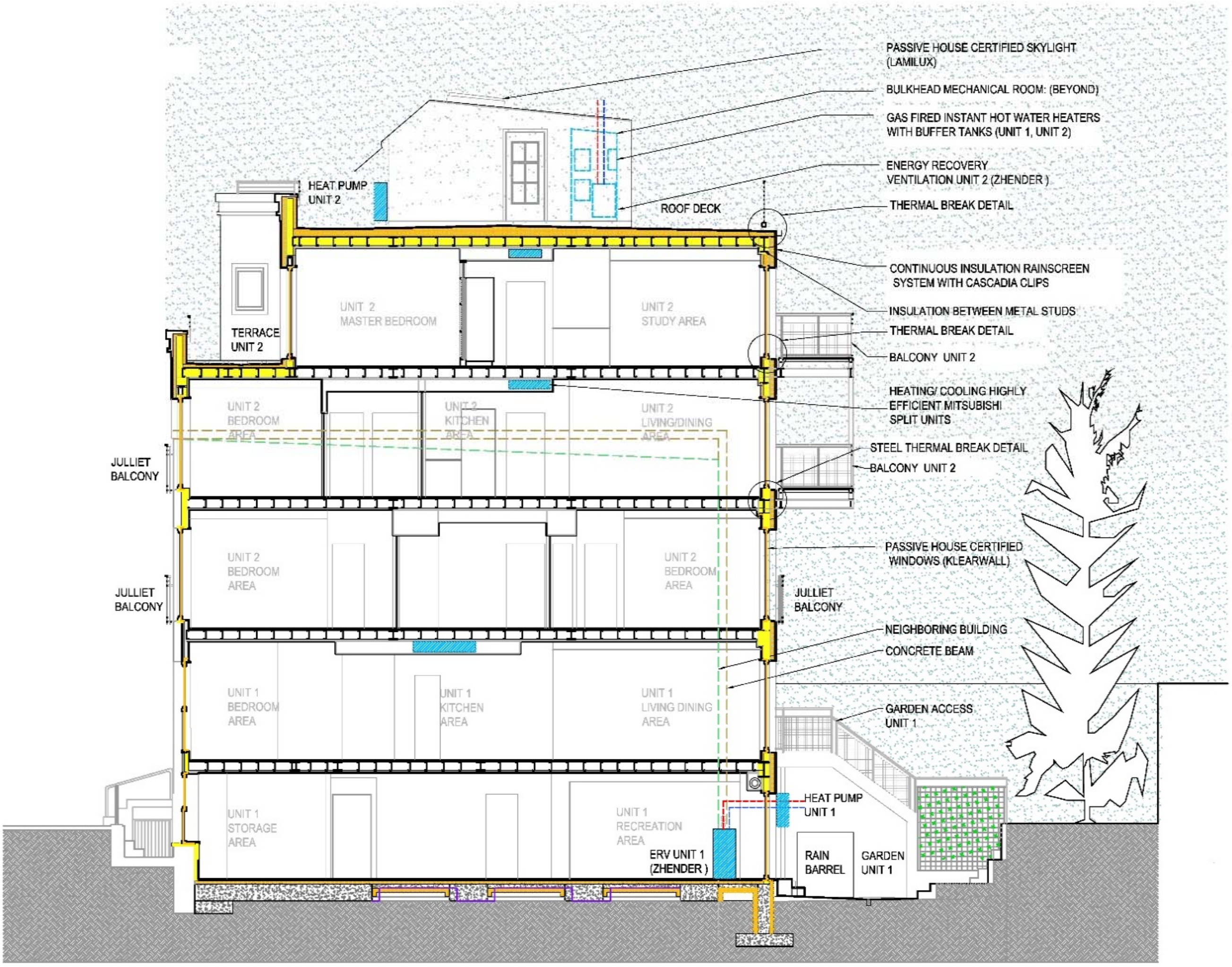
2. Innenfoto exemplarisch



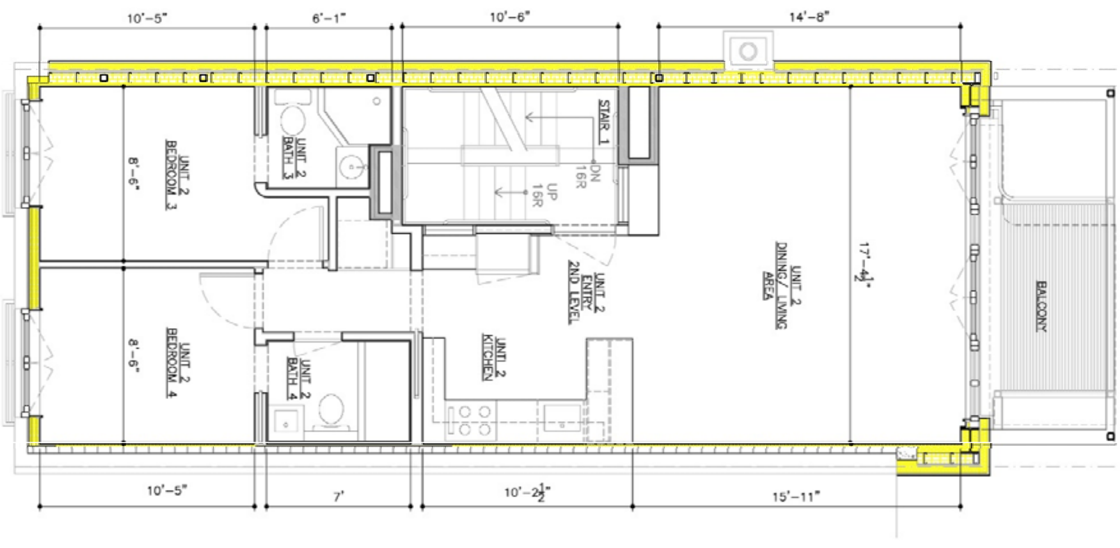


Photos: Chuck Baker Photography

3. Schnittzeichnung

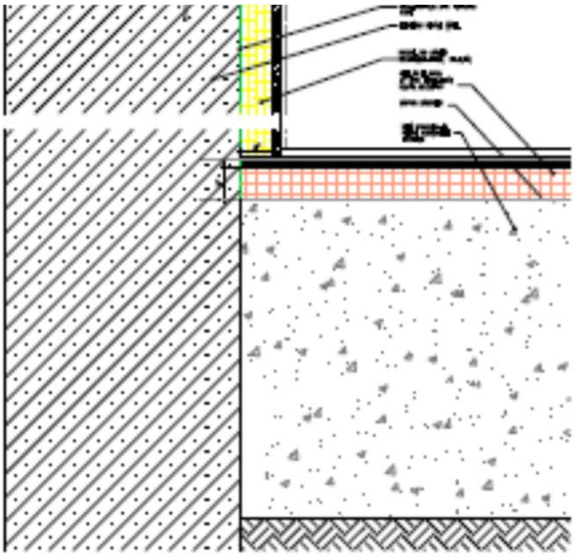


4. Grundrisse

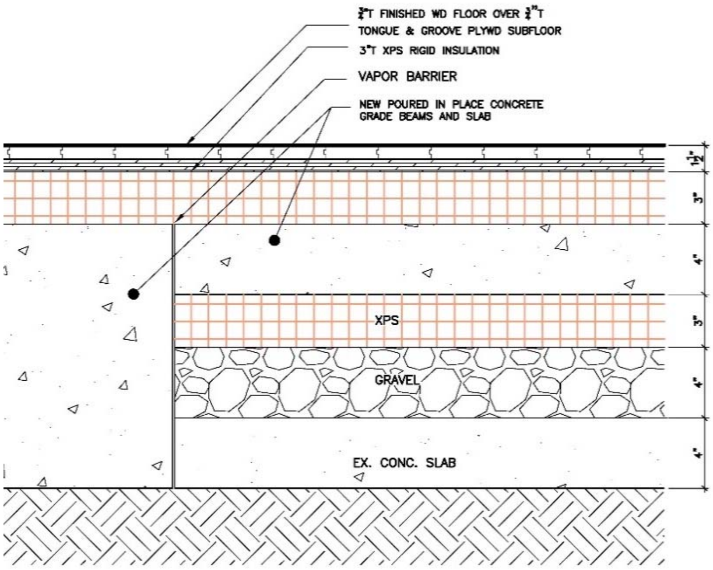


5. Construction of Floor Slab

A continuous 3" layer of R5/inch XPS was installed over the new slab throughout the cellar with an additional layer of insulation under the slab where grade beams were not required to reinforce the existing cellar walls. The existing stone walls were air-sealed with Sto Emerald Coat, and taped (with ProClima Vana) to the vapor barrier for continuous air-sealing.



Wall to slab detail



Enlarged slab detail

EnerPHit planning: U-VALUES OF BUILDING ELEMENTS

Assembly no.	Building assembly description	Interior insulation?
10	Floor Slab	yes

Heat transfer resistance [m²K/W]	
interior R_{si} :	0.17
exterior R_{se} :	0.00

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Finish flooring	0.130					25
2.	Roxul	0.036					76
3.	Concrete	2.100					102
4.	XPS	0.032					76
5.	Gravel	5.000					102
6.	Exist Concrete	3.000					102
7.							
8.							
	Percentage of sec. 1	100%	Percentage of sec. 2		Percentage of sec. 3		Total 48.3 cm

U-value supplement ____ W/(m²K)

U-Value: 0.201 W/(m²K)

6. Construction of Wall: Assembly no. 8, Metal Stud Wall

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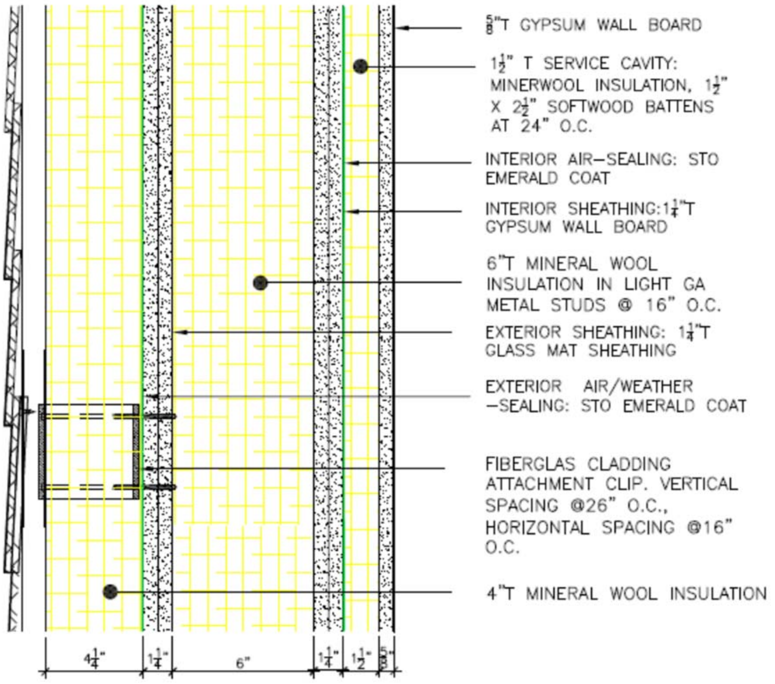
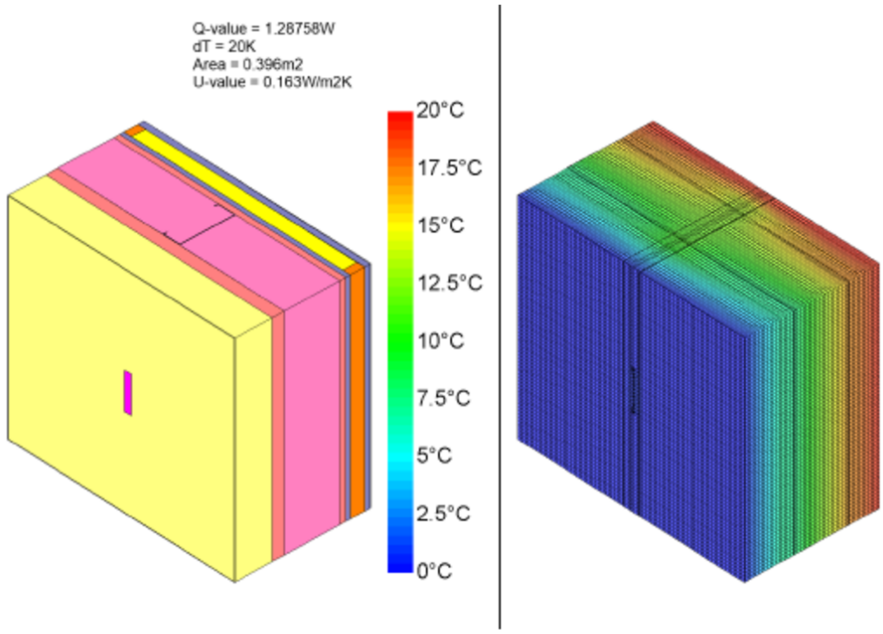


The vertical extension of the party wall required a 2-hour fire-rating. The structural wall consists of light gauge metal stud walls encapsulated in gypsum sheathing (cavities filled with mineral wool). 4" continuous exterior insulation is attached using Fiberglas clips, which also support a rain screen. Additional mineral wool insulation was provided in the 1½" service cavity at all exterior exposed walls. We submitted the thermal performance of this assembly in PSI Therm 3D as part of our certification.

PSI Therm modeling:
Passive House Academy



Assembly no.	Building assembly description		Interior insulation?
8	Metal Stud External Wall Sides & Back	Psi THERM	no

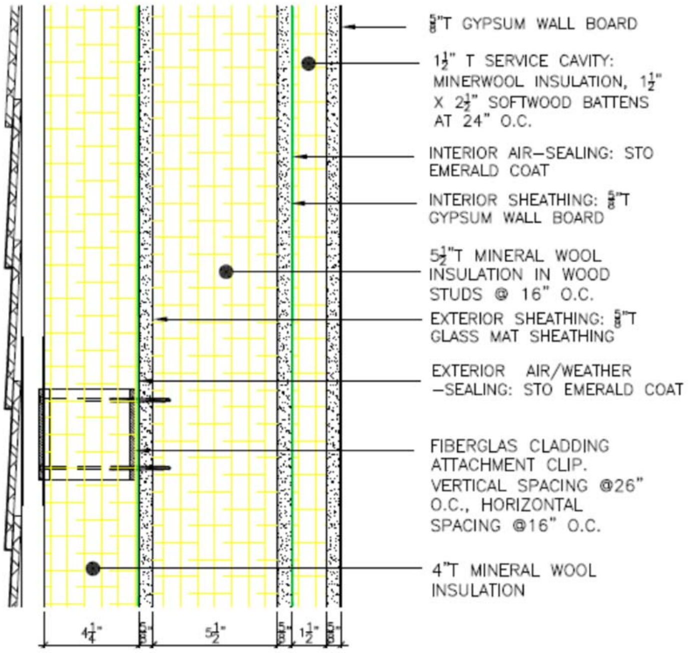
Heat transfer resistance [m²K/W] interior R_{si}: 0.00 exterior R_{se}: 0.00

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	PHPP Wall element 08 U-	0.163					1000
2.							
3.							
4.							
5.							
6.							
7.							
8.							

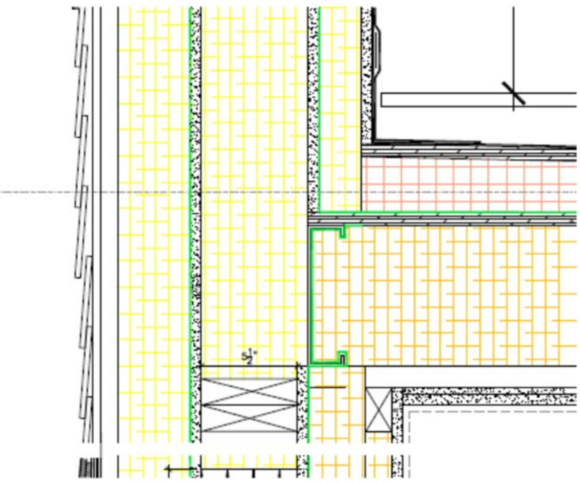
Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			100.0 cm

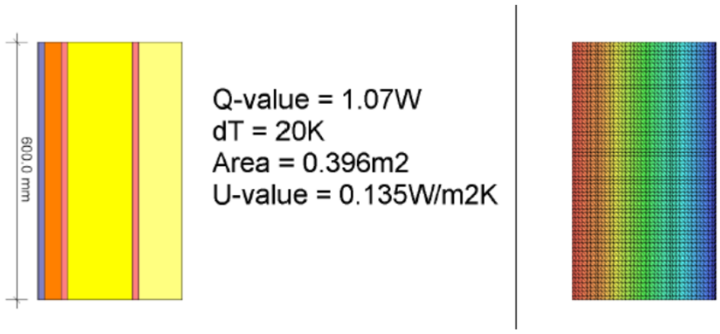
U-value supplement W/(m²K) **U-Value: 0.163** W/(m²K)

6. Construction of Wall: Assembly no. 1, Timber Wall



The front and rear facades of the building require a 1-hour fire-rating which is achieved with fire-treated wood studs. The structural wall consists of wood stud walls encapsulated in gypsum sheathing (cavities filled with mineral wool). 4" continuous exterior insulation is attached using fiberglas clips, which also support a rain screen. Additional mineral wool insulation was provided in the 1½" service cavity at all exterior exposed walls. We submitted the thermal performance of this assembly in PSI Therm as part of our certification.





PSI Therm modeling:
Passive House Academy

Wall to ceiling /roof connection The air-sealing (shown green) is continuous from the structural wall wall, around the steel joist, and to the underside of the plywood, which was then air-sealed from above.

Assembly no.: 1
Building assembly description: Timber Frame External Wall — Psi- Therm
Interior insulation?: no

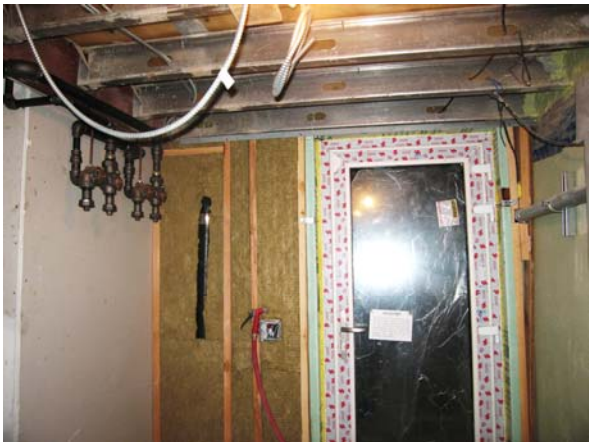
Heat transfer resistance [m²K/W]: interior R_{si}: 0.00; exterior R_{se}: 0.00

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Timber frame external w	0.135					1000
2.							
3.							
4.							
5.							
6.							
7.							
8.							

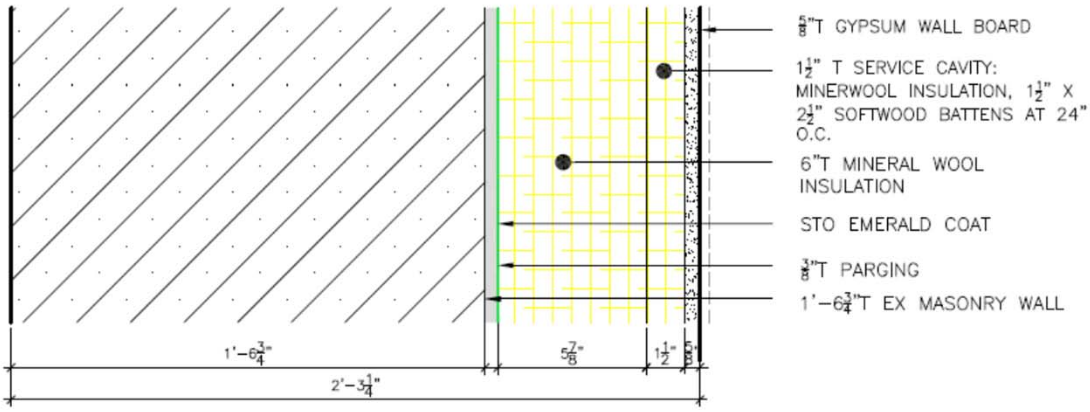
Percentage of sec. 1: 100% Percentage of sec. 2: Percentage of sec. 3: Total: 100.0 cm

U-value supplement: U-Value: 0.135 W/(m²K)

6. Construction of Wall: Assembly no. 2, Front Cellar Wall



Interior insulation was added to the existing front cellar wall. Insulation was installed continuously and between wood battens which support the finished wall.



Assembly no.: 2
Building assembly description: Front Cellar Wall
Interior insulation?: yes

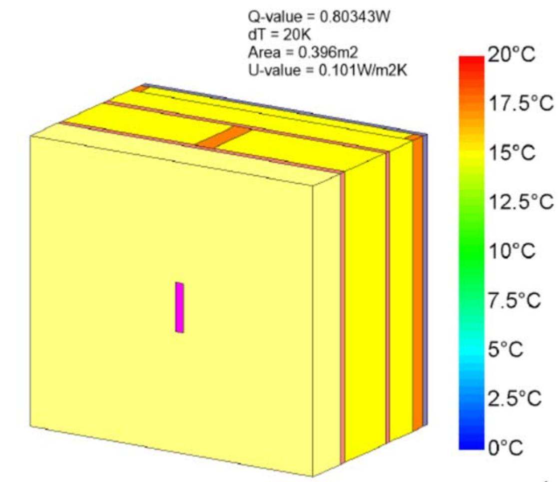
Heat transfer resistance [m²K/W] interior R_{si}: 0.13
exterior R_{se}: 0.04

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Gypsum board	0.250					16
2.	roxul	0.036	battens	0.130			38
3.	Roxul	0.036					152
4.	mortar	1.000					10
5.	Exist. Masonry	2.000					476
6.							
7.							
8.							
	Percentage of sec. 1	94%	Percentage of sec. 2	6.3%	Percentage of sec. 3		Total 69.2 cm

U-value supplement: W/(m²K)

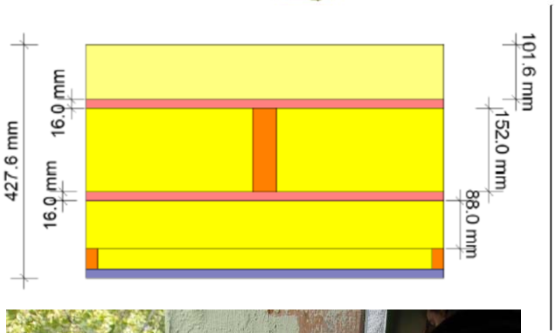
U-Value: 0.176 W/(m²K)

6. Construction of Wall, Assembly no. 3, Timber Wall Extra Insulation



This wall assembly is the same as assembly no 1, the timber frame wall, except that since the juncture between the existing masonry and the new vertical extension occurred approximately 4' above the finish floor, there was room to add extra insulation on the interior of the upper part of the wall. We submitted the thermal performance of this assembly in PSI Therm as part of our certification.

PSI Therm modeling:
Passive House Academy



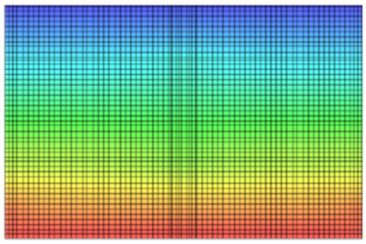


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Photo left: step 1 flush air-sealed wall at transition between existing brick and new timber constuction. Photo right: step 2 interior (service) cavities upper part of 3rd floor wall- later filled with mineral wool insulation

Assembly no.	Building assembly description					Interior insulation?
3	Front Wall				Psi Therm	yes

Heat transfer resistance [m²K/W] interior R_{si}: 0.00 exterior R_{se}: 0.00

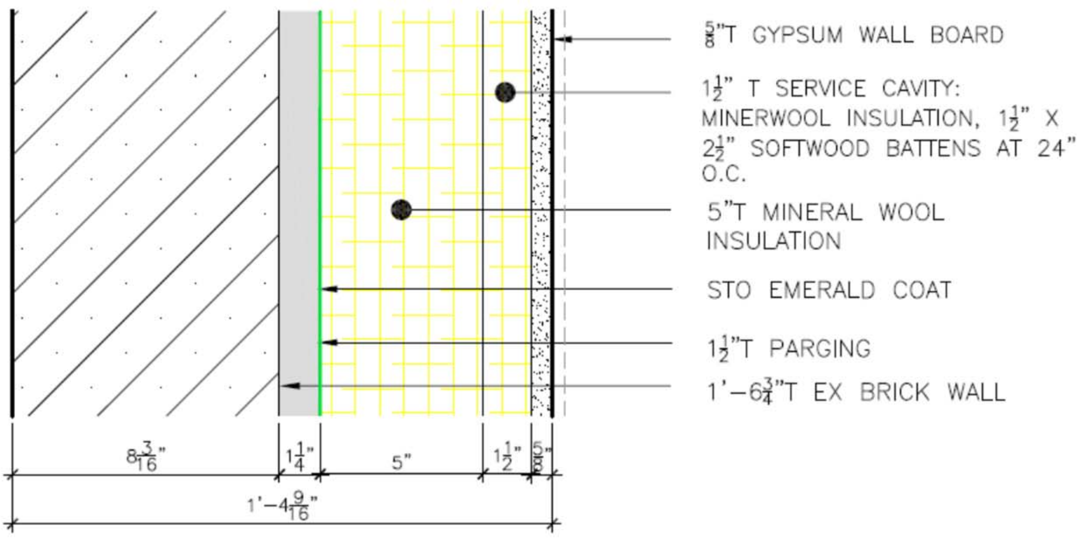
	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Project 3119 Wall 03 Up	0.101					1000
2.							
3.							
4.							
5.							
6.							
7.							
8.							
	Percentage of sec. 1		Percentage of sec. 2		Percentage of sec. 3		Total
	100%						100.0 cm

U-value supplement W/(m²K) **U-Value:** 0.101 W/(m²K)

6. Construction of Wall, Assembly no. 4, Front Brick Extra Insulation

Photos: 2nd floor front facade

On the front facade, we have used wood furring adjacent to the finish wall and filled the areas within and behind the furring with mineral wool insulation. This assembly has shallower existing brick which allows deeper insulation.



Assembly no.	Building assemby description	Interior insulation?
4	Front Wall Brick with extra insulation	yes

Heat transfer resistance [m²K/W] interior R_{si}: 0.13; exterior R_{se}: 0.04

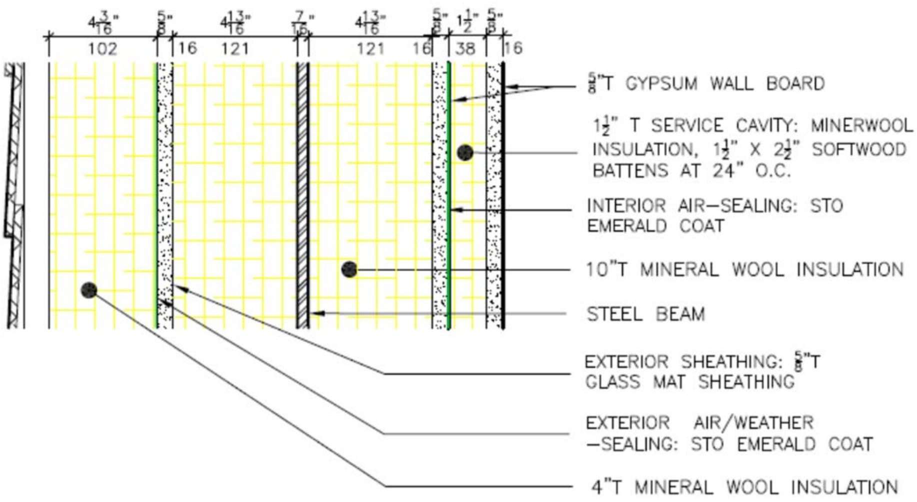
	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Gypsum board	0.250					19
2.	roxul	0.036	battens	0.130			38
3.	roxul	0.036					127
4.	mortar	1.000					32
5.	existing brick	1.200					208
6.							
7.							
8.							

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
94%	6.3%	0.0%	42.3 cm

U-value supplement: W/(m²K)

U-Value: 0.203 W/(m²K)

6. Construction of Wall, Assembly no. 5, Metal Beam in Timber Frame



All cavities in the rear addition steel moment frame were filled with mineral wool insulation. The wall was insulated on the interior with a 1½" service cavity and on the exterior with 4" continuous mineral wool.

Photo left: wood framing for insulation of structural steel. Photo right: wall left open to show the cavities filled with mineral wool insulation.

Assembly no.	Building assembly description	Interior insulation?
5	Metal Beam in Timber Frame	no

Heat transfer resistance [m²K/W]

interior R_{si}	0.13
exterior R_{se}	0.04

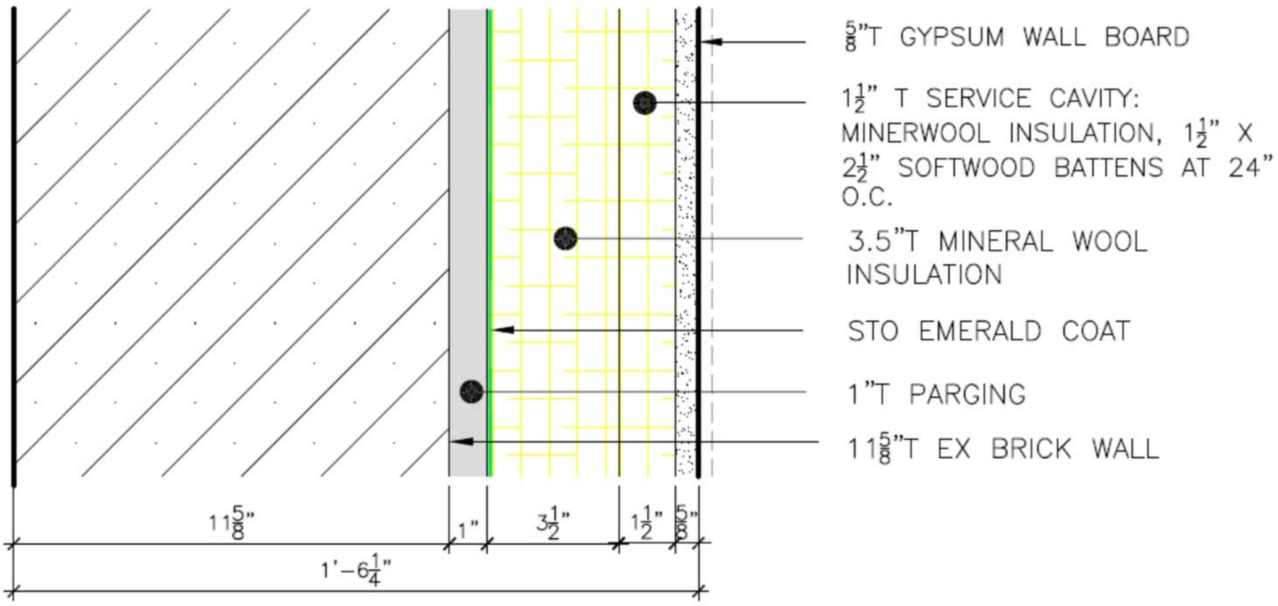
	Area section 1	λ [Ω/(μK)]	Area section 2 (optional)	λ [Ω/(μK)]	Area section 3 (optional)	λ [Ω/(μK)]	Thickness [mm]
1.	Gypsum board	0.250					16
2.	Roxul	0.036	battens	0.130			38
3.	Gypsum board	0.250					16
4.	Roxul	0.036					121
5.	Metal Beam	70.000					20
6.	Roxul	0.036					121
7.	Gypsum board	0.250					16
8.	Roxul	0.036					102
		Percentage of sec. 1		Percentage of sec. 2		Percentage of sec. 3	Total
		94%		6.3%			45.0 cm

U-value supplement: W/(m²K)

U-Value: 0.092 W/(m²K)

6. Construction of Wall, Assembly no. 6, Front Existing Brick Wall

On the front facade, we have used wood furring adjacent to the finish wall and filled the areas within and behind the furring with mineral wool insulation.



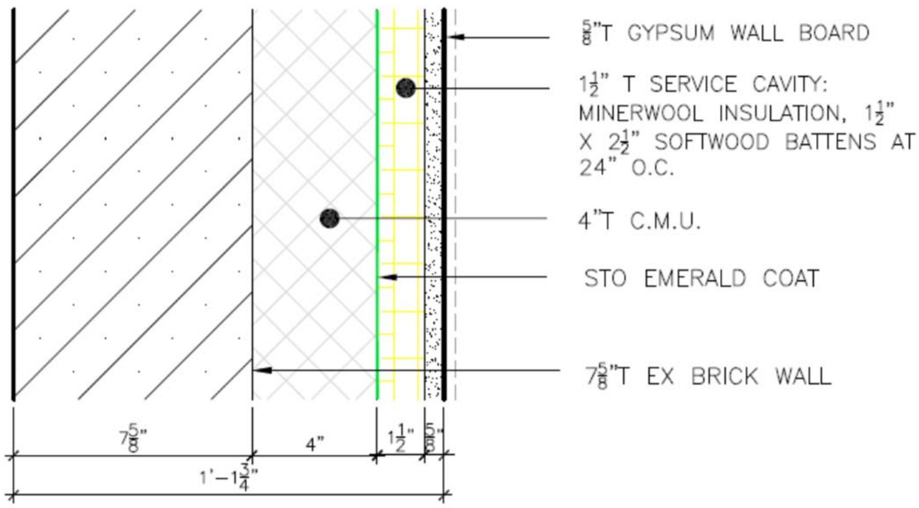
Assembly no.	Building assembly description	Interior insulation?
6	Existing Front Wall Brick	yes

Heat transfer resistance [m²K/W] interior R_{si}: 0.13 exterior R_{se}: 0.04

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Gypsum board	0.250					19
2.	Roxul	0.036	battens	0.130			38
3.	Dense pack Cellulose	0.038					88
4.	Mortar	1.000					25
5.	Exist Brick	1.200					295
6.							
7.							
8.							
	Percentage of sec. 1	94%	Percentage of sec. 2	6.3%	Percentage of sec. 3	0.0%	Total 46.6 cm

U-value supplement 0.00 W/(m²K) **U-Value: 0.266** W/(m²K)

6. Construction of Wall, Assembly No. 9, Party Wall



On the existing brick party walls, we added an additional wythe of 4" CMU block as part of the structural remediation. Although these walls were adjacent to another building, we insulated all 1 ½" service cavities 3' in from exterior exposed walls.

Photo right: 2nd floor party wall insulation and wood battens extend inside 3' min. from exterior exposed front wall. The party wall is adjacent to the neighbor's conditioned space.

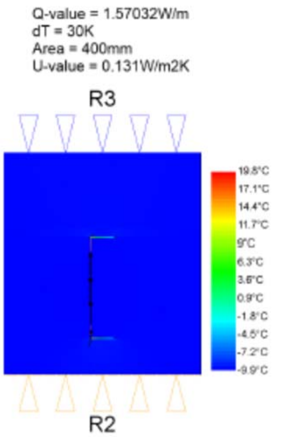
Assembly no.	Building assembly description	Interior insulation?
9	Party Wall	yes

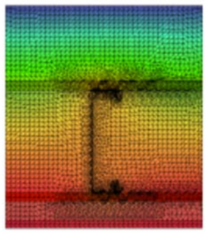
Heat transfer resistance [m²K/W] interior R_{si}: 0.13; exterior R_{se}: 0.13

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Gypsum board	0.250					16
2.	Fiberglass	0.036	battens	0.130			38
3.	CMU	2.100					102
4.	Exist Brick	1.200					194
5.							
6.							
7.							
8.							
	Percentage of sec. 1	100%	Percentage of sec. 2		Percentage of sec. 3		Total 34.9 cm

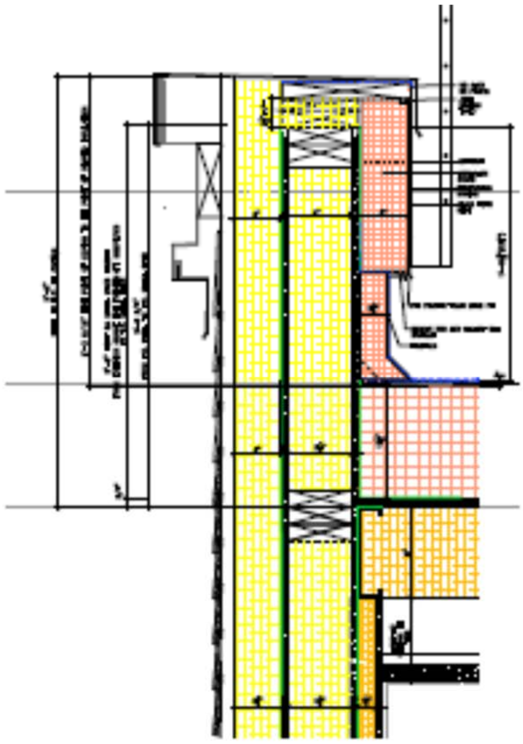
U-value supplement: W/(m²K) — **U-Value: 0.629** W/(m²K)

7. Construction of Roof, Assembly No. 7

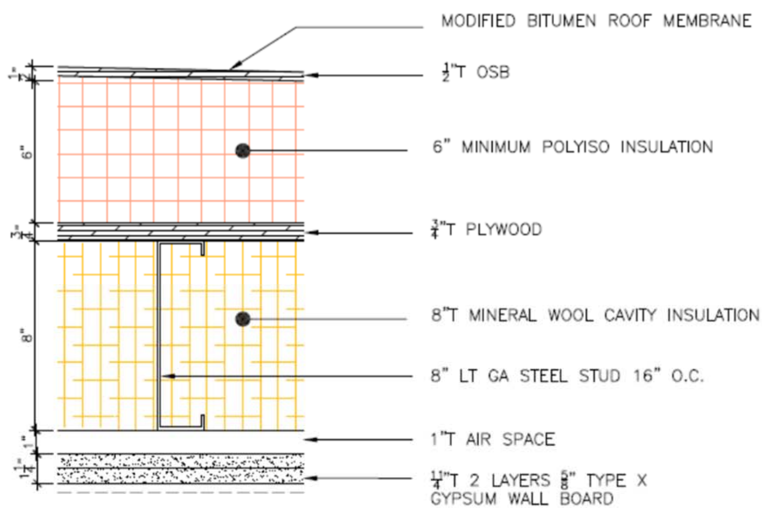




The 1-hour fire-rated roof assembly has an average of 7″ deep continuous polyiso insulation under the modified bitumen roof membrane. The structural roof deck is made from light gauge steel joists at 16″ o.c. with mineral wool cavity insulation.



Roof to wall connection



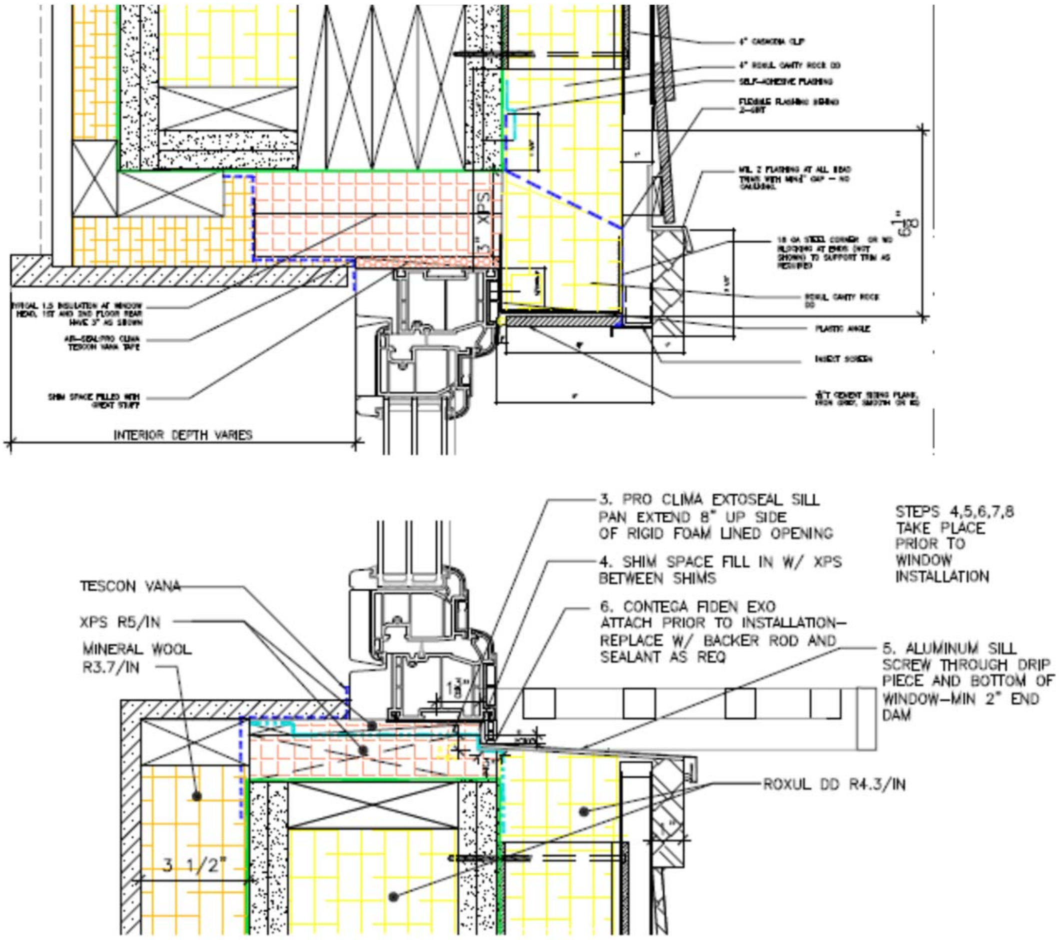
Assembly no.	Building assembly description		Interior insulation?
7	Roof	Psi-Therm	no

Heat transfer resistance [m²K/W] interior R_{si}: 0.00 exterior R_{se}: 0.00

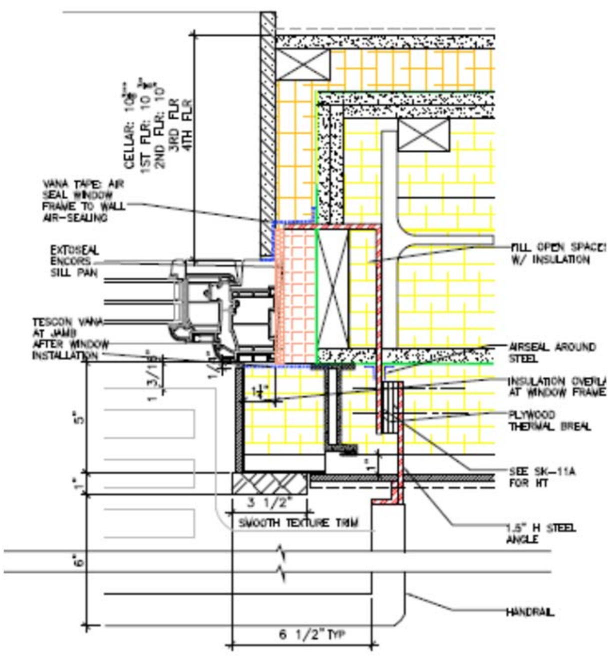
	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Roof U-value.pdf	0.131					1000
2.							
3.							
4.							
5.							
6.							
7.							
8.							
	Percentage of sec. 1	100%	Percentage of sec. 2		Percentage of sec. 3		Total 100.0 cm

U-value supplement: W/(m²K) **U-Value: 0.131** W/(m²K)

8. Window and Window Installation



TYP HEAD AND SILL DETAIL

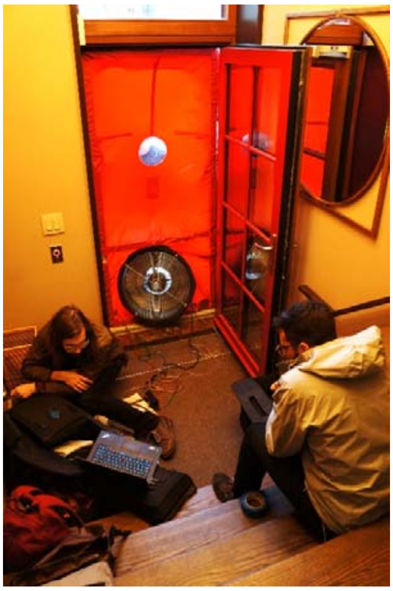


TYP JAMB DETAIL

	Window Installation
Description of the window (frame) construction, manufacturer Make window (frame; product name)	Munster Joinery, Eco Clad + Future Proof fixed and sash U $_w$-value = 0.79 W/(m²K) Average
Frame U-value Uf	EcoClad: 0,72 W/(m²K), Future Proof: 0,66 W/(m²K)
Type of glazing	St Gobain 52mm triple glazing VT 71%;
Glass U-value Ug	0,60 W/(m²K)
g-value of the glazing	0,61

9. Description of the Airtight Envelope

The first pressure test was done by Kevin Brennan on Dec 31, 2015 after the completion of the air-tight envelope. A second and final test were conducted by Nick Shaw, 475 Building Materials in 2017.


©ChoShieldsStudio

Measurement	50 Pa-Pressure test air change n_{50} h^{-1}
First test 12/31/15	1.08
2nd test	1.0
Final test 12/6/17	.99

Concept airtightness
Walls: liquid applied air tight membrane : Sto Emerald Coat
Base plate: concrete
Connection window: with bonding tapes: Pro-Clima Vana, Profil and Extoseal Encors
Roof: Exterior grade plywood taped at all seams.

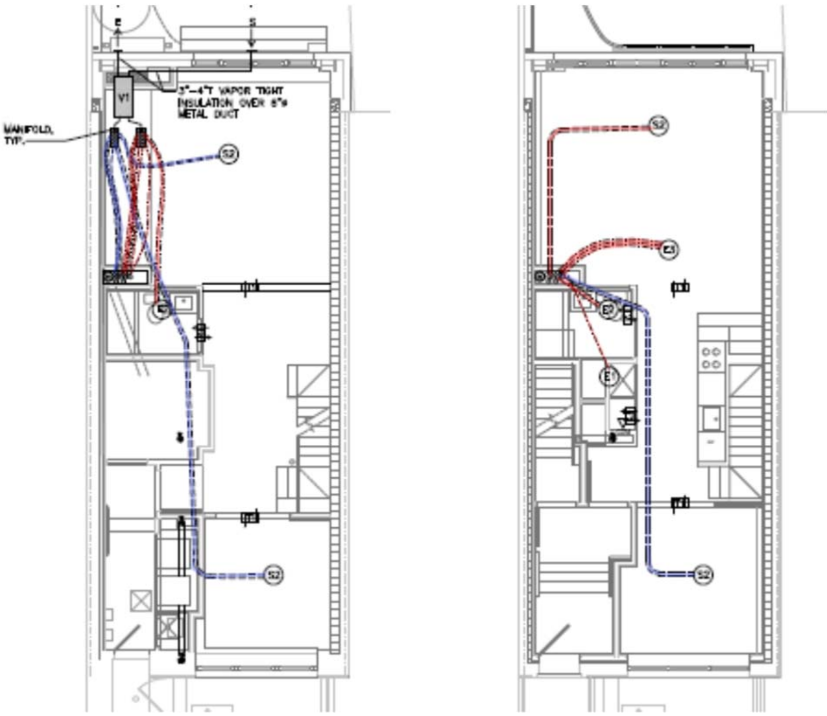
Of/from	Foundation	Wing frame	Window, door frame	Wall	Roof
Roof				Bonding tapes and spray foam	Bonding tapes (butyl rubber tapes)
Wall	Waterproof membrane joined to Sto Emerald Coat (on wall) with bonding tape		Window frame joined to wall with bonding tape (Tescon Vana)	Sto Emerald Coat	
Window, door frame	Bonding tapes and silicone grouted under threshold				

10. Ventilation Units

The project has 2 Zhender ventilation units. The Comfoair 200 serves the Unit 1 (cellar and 1st floor) and and Comfoair 550 serves Unit 2 (the 2nd, 3rd and 4th floors).

Manufacturer Ventilation System	**Zehnder**
Effective Heat Recovery Efficiency	85%
Power Consumption	

11. Ventilation System



Ventilation System Unit 1

Ventilation supply rooms are all main living /dining rooms and bedrooms. (blue: supply air ducts)

Exhaust air rooms are bathrooms, toilets and the kitchen. (red: exhaust air ducts).

Transfer Air is provided through a combination of custom transfer units, off-the-shelf transfer units (also used to transfer the conditioned air for heating and cooling), and door undercuts.

12. Heat/Cooling Supply

Domestic Hot Water Supply
The Domestic Hot water system serves the whole building it consists of :
1. Condensing gas boiler (roof) Manufacturer: Intellihot, Model: i250
2. Storage tank (roof) Manufacturer: Sanden, Model: SAN-83SSAQA
3. Circulation pump. (cellar) Manufacterer: Amtrol, Model:RP-25HP
4. Recirculation line

Heat/Cooling supply is from 2 Heat Pumps (Unit 1, Unit 2) with separate ducted air handlers serving 1 or 2 floors.
Cellar and 1st floor: HP 1, Manufacturer: Mitsubishi CUHP 1: SUZ-KA15NA, AH 1: SEZ-KD15NA4
2nd Floor, 3rd floor, 4th floor: Manufacturer: Mitsubishi, HP 2: MXZ-3B30NA-1, AH 1: SEZ-KD15NA4, AH 2: SEZ-KD12NA4, AH 3: SEZ-KD09NA4

Indoor Unit: SEZ-KD15NA4

Outdoor Unit: SUZ-KA15NA

FUNCTION	TYPE – ID	MODEL NUMBER	TOTAL QTY	REMARKS
HEAT PUMP	HP 1	MITSUBISHI : SUZ–KA15NA	1	(1) MOUNTED AT CELLAR LEVEL REAR EXTERIOR WALL FOR CELLAR AND FIRST FLOOR
HEAT PUMP	HP 2	MITSUBISHI : MXZ–3B30NA–1	1	(1) UNIT AT ROOF FOR 2ND, 3RD AND 4TH FLRS
INDOOR AIR HANDLER –DUCTED	AH 1	MITSUBISHI : SEZ–KD15NA4	1	CONCEALED IN DROPPED CLG W/ 40" x 31" ACCESS PANEL
INDOOR AIR HANDLER –DUCTED	AH 2	MITSUBISHI : SEZ–KD12NA	1	CONCEALED IN DROPPED CLG W/ 40" x 31" ACCESS PANEL
INDOOR AIR HANDLER –DUCTED	AH 3	MITSUBISHI : SEZ–KD09NA4	1	CONCEALED IN DROPPED CLG W/ 31.5" x 31.5" ACCESS PANEL
TRANSFER DUCT/GRILL	T1	TAMARACK	10	EITHER 12"x6" OR 14"x8", TBD

13. Building Costs

Our construction costs were somewhat higher than typical costs because this project was a custom renovation of a Manhattan townhouse (c1910) which required substantial structural remediation.
The construction cost was approximately $240.00 per square foot. The additional energy efficiency measures for Passive House EnerPHit construction came to approximately $40.00 per square foot.

14. Literature

[Cho 2018] Cho, In ; Shields, Timothy; Grammercy Park Enerphit Townhouse, New York, New York, From Small to Extra Large, Passive House Rising to New Heights, Low Carbon Productions,2018, p 106-7.
[Cho et Al. 2017] Cho, In ; Shields, Timothy; D'Silva, Karena; Shea, Maureen; A Passive House mosaic for A New York City urban infill residential retrofit and extension, Conference Proceedings International Passive House Conference 2017: Passive House For All, Passive House Institute and University of Innsbruck, Darmstadt/Innsbruck, 2017, p193-4.
[Cho 2017] Cho, In ; Shields, Timothy; Retrofitting with a Mosaic of Assemblies, Passive House Buildings, Low Carbon Productions, 2017, p29-30.

Certificate

30 Jericho Executive Plaza, Suite 300W
Jericho, NY 11753
USA

Authorised by:
Passive House Institute
Dr. Wolfgang Feist
Rheinstraße 44/46
64283 Darmstadt, Germany

Certificate ID: 17771-17773_MosArt_EP_20180313_TOL

Passive House Academy hereby awards the EnerPHit certificate to the following building:

206 E 20th St., New York, NY 10003

EnerPHit Certified Retrofit
Passive House Institute

Client:	Sudha & Anil Sahai, New York
Architecture:	Architect: ChoShields Studio, New York, NY PH Consultant: In Cho (ChoShields Studio) Brooklyn, NY
Building Services:	Diesel Contracting of NY, Astoria, NY Services: Cramer Silkworth, Baukraft Engineering, Brooklyn, NY

This building was designed to meet the Passive House component energy retrofit criteria as defined by the Passive House Institute Darmstadt. Given appropriate on-site implementation, this building has the following characteristics:

Building characteristics:	Achieved		Required	
Annual specific space heating demand	21 kWh/(m²a)	≤	25 kWh/(m²a)	✓
Annual specific primary energy demand[2] for heating, DHW, ventilation and all other electric appliances for	123 kWh/(m²a)	≤	128 kWh/(m²a)	✓
Airtightness of building envelope n_{50} as per test result	1.0 h⁻¹	≤	1.0 h⁻¹	✓
Mean value of individual building component thermal protection :				
Exterior insulation to ambient Thermal transmittance (U-value)	0.15 W/(m²K)	≤	0.15 W/(m²K)	-1
Exterior insulation to ground[2] Thermal transmittance (U-value)	N/A W/(m²K)	≤	0.19 W/(m²K)	-1
Interior insulation to ambient Thermal transmittance (U-value)	0.25 W/(m²K)	≤	0.35 W/(m²K)	-1
Interior insulation to ground Thermal transmittance (U-value)	0.20 W/(m²K)	≤	0.61 W/(m²K)	-1
Thermal bridges Δ_U Building envelope (window installation excluded)	N/A W/(m²K)		No limiting value	
Windows Thermal transmittance $U_{w,installed}$	0.79 W/(m²K)	≤	0.85 W/(m²K)	-1
Exterior doors Thermal transmittance $U_{w,installed}$	N/A W/(m²K)	≤	0.80 W/(m²K)	-1
Ventilation unit Effective efficiency of heat recovery	85 %	≥	75 %	-1

[1]Limiting value is not relevant [2]Limiting value differs for each building [3]The requirements can not be met (exception applies)

Certification criteria met?		
Selection of the evaluation method	Space heating demand	
	Component quality	✓

issued:
05/03/2018
30 Jericho Executive Plaza, Suite 300W Jericho, NY11753 USA

certifier:
Tomas O'Leary