Project Documentation
Gebäude-Dokumentation

1 Abstract / Zusammenfassung

Kaplarkey Passive House Retrofit, San Francisco, CA

1.1 Data of building / Gebäudedaten

Year of construction/ Baujahr	2015	**Space heating / Heizwärmebedarf**	**12 kWh/(m^2a)** **(3.91 kBTU/ft^2.yr)**
U-value external wall/ U-Wert Außenwand	0.321 W/(m^2K) (17.7 hr.ft^2.°F/BTU)		
U-value basement ceiling/ U-Wert Kellerdecke	0.627 W/(m^2K) (9.06 hr.ft^2.°F/BTU)	**Primary Energy Renewable (PER) / Erneuerbare Primärenergie (PER)**	35 kWh/(m^2a) (11.09 kBTU/ft^2.yr)
U-value roof/ U-Wert Dach	0.096 W/(m^2K) (60.1 hr.ft^2.°F/BTU)	**Generation of renewable energy / Erzeugung erneuerb. Energie**	17 kWh/(m^2a)
U-value window/ U-Wert Fenster	1.297 W/(m^2K) (4.38 hr.ft^2.°F/BTU)	**Non-renewable Primary Energy (PE) / Nicht erneuerbare Primärenergie (PE)**	44 kWh/(m^2a) (13.95 kBTU/ft^2.yr)
Heat recovery/ Wärmerückgewinnung	75 % (default)	Pressure test n_{50} / Drucktest n_{50}	0.6 h-1
Special features/ Besonderheiten	Solar collectors for hot water generation, photovoltaic panels, drain water heat recovery, on-demand hot water recirculation		

1.2 Brief Description ...

Kaplarkey Passive House, San Francisco

This single-family, two story, wood-framed house from the 1960s was expanded from 185 m2 (1,993 square feet) with 3 bedrooms and 2 bathrooms to 288 m2 (3,103 square feet) and 4 bedrooms and 3-½ bathrooms, including converting the unconditioned cellar into a finished and conditioned basement.

The lot line exterior wall was air-sealed from the interior and expanded into the living space to accommodate additional insulation. The other exterior walls were air-sealed on the exterior with new sheathing and additional insulation was added to the outside.

The glazing was expanded on both the front (south), and rear (north) elevations to improve daylighting and visual connection to the outdoors.

The formerly dark, cramped, and uncomfortable building is now bright, open, comfortable, and filled with fresh air, even during wildfire smoke events, thanks to a supplemental HEPA filter on the ventilation air supply.

https://www.essentialhabitat.com/kaplarkey-house

1.2 Kurzbeschreibung der Bauaufgabe

Kaplarkey Passivhaus San Francisco

Dieses zweistöckige Einfamilienhaus in Holzrahmenbauweise aus den 1960er Jahren wurde von 185 m² (1.993 Quadratfuß) mit 3 Schlafzimmern und 2 Bädern auf 288 m² (3.103 Quadratfuß) mit 4 Schlafzimmern und 3,5 Bädern erweitert. Der nicht klimatisierte Keller wurde dabei zu einem ausgebauten und klimatisierten Keller umgebaut.

Die Außenwand an der Grundstücksgrenze wurde von innen luftdicht abgeschlossen und in den Wohnraum hinein erweitert, um zusätzliche Dämmung zu ermöglichen. Die übrigen Außenwände wurden mit einer neuen Schalung luftdicht abgeschlossen, und die Außendämmung wurde zusätzlich angebracht.

Die Verglasung wurde sowohl an der Vorder- (Süd-) als auch an der Rückfassade (Nord-) erweitert, um die Tageslichtnutzung und den Blick nach außen zu verbessern.

Das ehemals dunkle, beengte und ungemütliche Gebäude ist nun hell, offen, komfortabel und dank eines zusätzlichen HEPA-Filters in der Lüftungszuluft auch bei Waldbrandrauch mit frischer Luft gefüllt.

1.3 Responsible project participants / Verantwortliche Projektbeteiligte

Architect/ Entwurfsverfasser	Graham Irwin, Essential Habitat Architecture https://www.essentialhabitat.com
Implementation planning/ Ausführungsplanung	Graham Irwin, Essential Habitat Architecture https://www.essentialhabitat.com
Building systems/ Haustechnik	Noel Fox, American Clover Construction/ Fox Brother's Construction Inc https://www.foxbrothersconstructioninc.com
Structural engineering/ Baustatik	Hom-Pisano Engineering, Inc https://hompisano.com
Building physics/ Bauphysik	Graham Irwin, Essential Habitat Architecture https://www.essentialhabitat.com
Passive House project planning/ Passivhaus-Projektierung	Graham Irwin, Essential Habitat Architecture https://www.essentialhabitat.com
Construction management/ Bauleitung	Noel Fox, American Clover Construction/ Fox Brother's Construction Inc

Certifying body/ Zertifizierungsstelle	CertiPHIers Cooperative https://www.certiphiers.com
Certification ID/ Zertifizierungs ID	Project-ID (www.passivehouse-database.org) Projekt-ID (www.passivehouse-database .org) 7925

Author of project documentation / Verfasser der Gebäude-Dokumentation	Graham Irwin, Essential Habitat Architecture https://www.essentialhabitat.com

Date, Signature/
Datum, Unterschrift

17 October, 2025

Graham Irwin, principal
Essential Habitat Architecture

2 PHOTOS

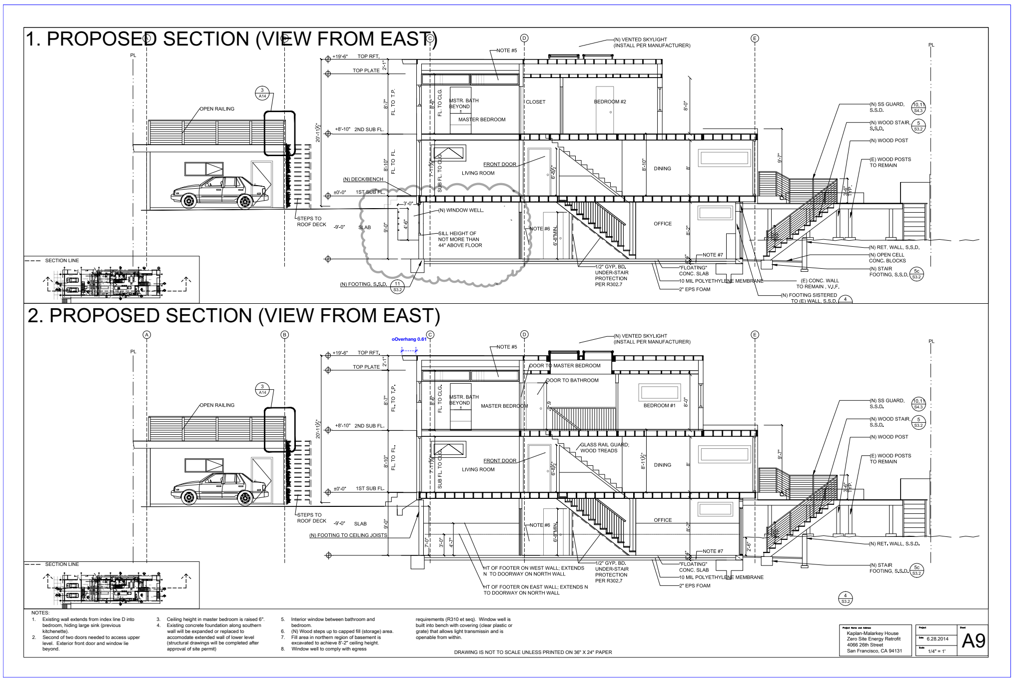
Front, South (Before & After)

Rear, North (After)

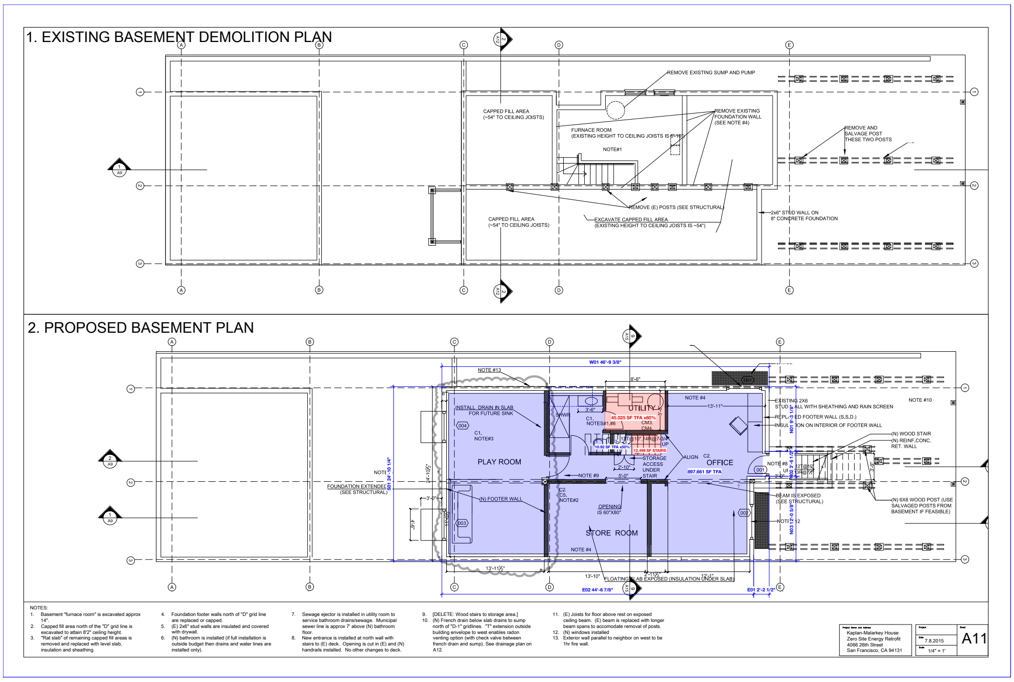
Side, East (In Progress)

Sample Interior (Kitchen)

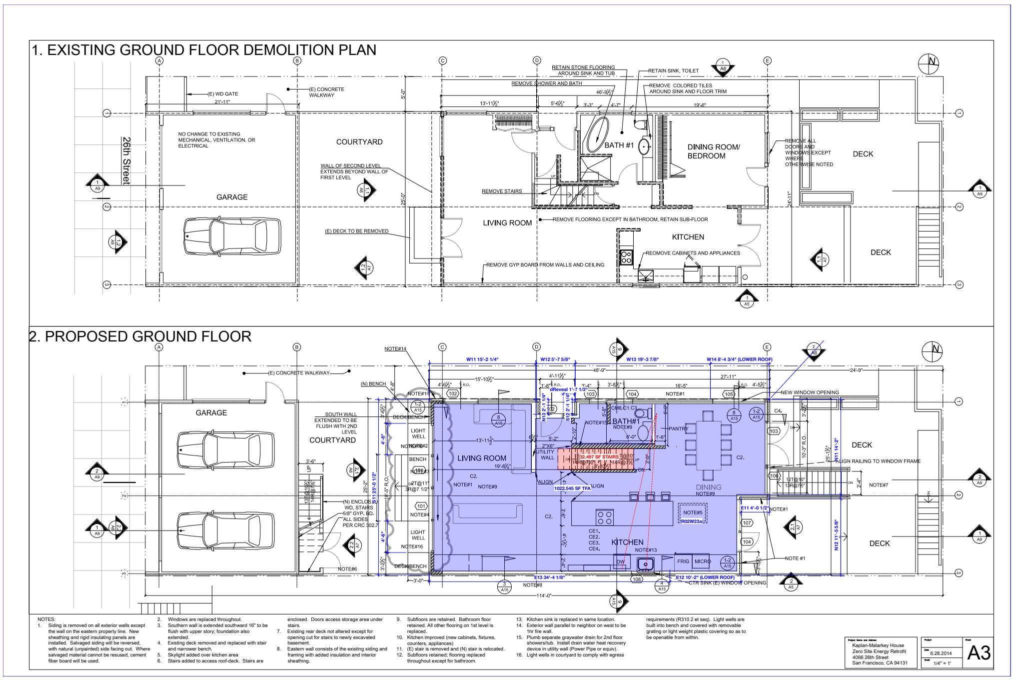
3 SECTIONAL DRAWING



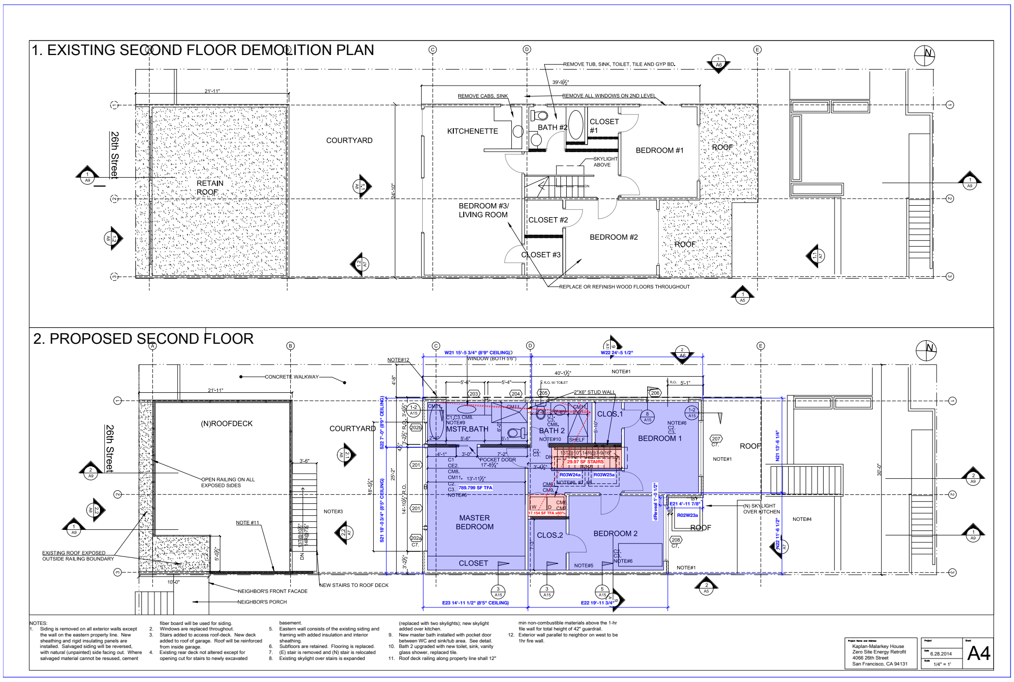
4 FLOOR PLANS



Basement (Before & After)



1st Floor (Before & After)

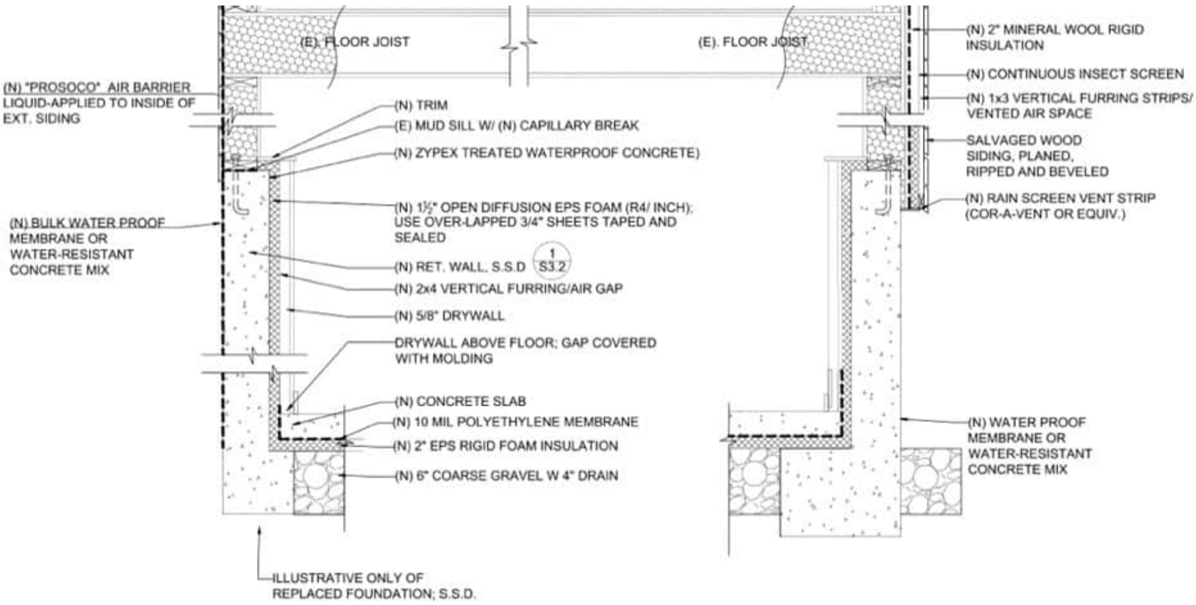


2nd Floor (Before & After)

5 CONSTRUCTION DETAILS

Construction – Foundation

The cellar was excavated and replaced with a conditioned basement. Basement walls consist of 203mm (8") reinforced concrete with 38mm (1.5") EPS to the interior. The basement floor consists of 102mm (4") reinforced concrete with 51mm (2") EPS beneath. The EPS insulation on the interior of the basement walls was extended to meet the EPS insulation below the slab.



Assembly no. 03ud — **Concrete Wall** — Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element: 2-Wall — interior R_{si}: 0.13

Adjacent to: 2-Ground — 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]
gypsum board	0.250					16
air gap	0.207	furring strips	0.130			38
EPS	0.036					38
concrete	2.100					203
Percentage of sec. 1	90%	Percentage of sec. 2	10.4%	Percentage of sec. 3		Total 29.5 cm

U-value supplement: W/(m²K)

U-value: 0.650 W/(m²K)

Assembly no.	Building assembly description	Interior insulation?
01ud	Finished Slab	

Heat transmission resistance [m²K/W]

Orientation of building element	3-Floor	interior R_{si}	0.13
Adjacent to	2-Ground	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]
concrete	2.100					102
EPS	0.036					51

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			15.3 cm

U-value supplement: W/(m²K)

U-value: 0.627 W/(m²K)

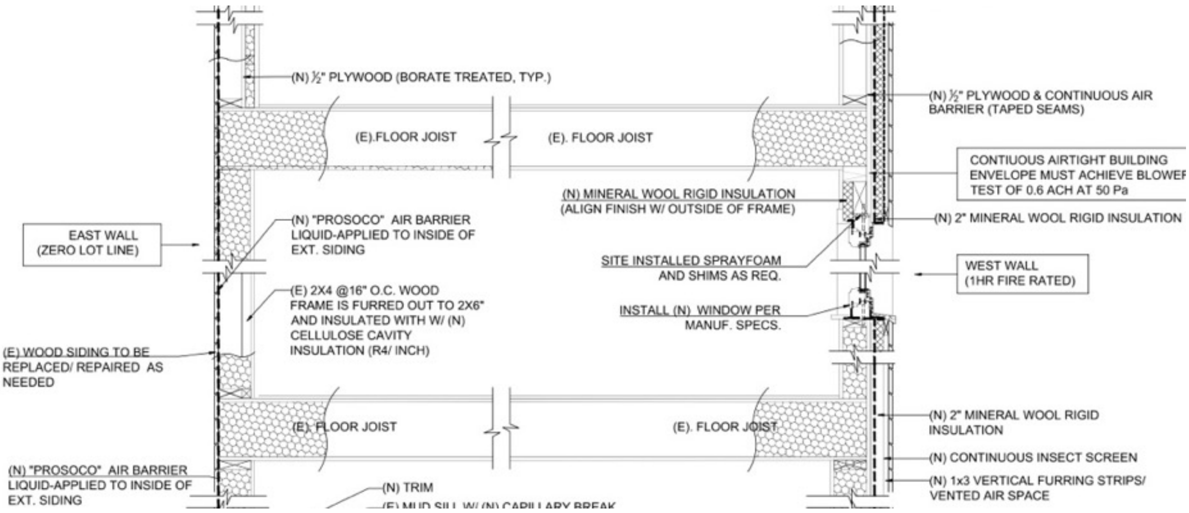
Photo of Basement Wall, Prior to Slab Insulation & Installation

Photo of Basement Slab Insulation, Prior to Concrete Placement

Construction – Exterior Walls

The east wall is only partially accessible from the outside, so the air sealing was performed on the interior of the existing siding and the wall framing was expanded to the interior to accommodate more cavity insulation, which was 140mm (5.5") dense-packed fiberglass.

The west wall was fully accessible from the exterior. The existing siding was removed and replaced with plywood, which was sealed at the seams to serve as the air barrier. The wall cavity was insulated with 89mm (3.5") dense-packed fiberglass and 51mm (2") of exterior EPS.



Assembly no.						Interior insulation?
05ud	Lot Line Wall					
		Heat transmission resistance [m²K/W]				
Orientation of building element	2-Wall	interior R_{si}	0.13			
Adjacent to	1-Outdoor air	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]
gypsum board	0.250					16
blown-in fiberglass	0.034	framing	0.130			51
plywood	0.000					13
blown-in fiberglass	0.034			framing	0.130	89
plywood	0.000					13
Percentage of sec. 1	50%	Percentage of sec. 2	25.0%	Percentage of sec. 3	25.0%	Total 18.1 cm
U-value supplement		W/(m²K)		U-value:	0.343	W/(m²K)

Assembly no. 04ud — Framed Wall

Interior insulation?

Heat transmission resistance [m^2K/W]

Orientation of building element: 2-Wall — interior R_{si}: 0.13

Adjacent to: 1-Outdoor air — 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]
gypsum board	0.250					16
blown-in fiberglass	0.034	framing	0.130			89
plywood	0.000					13
gypsum board	0.250					16
EPS	0.036					51
Percentage of sec. 1	75%	Percentage of sec. 2	25.0%	Percentage of sec. 3		Total 18.4 cm

U-value supplement: W/(m^2K)

U-value: 0.292 W/(m^2K)

Interior photo of framing, looking north.

Wall on right is the east exterior wall, with liquid-applied air barrier on the seams of the existing siding. The east wall is only partly accessible on the exterior due to neighboring building.

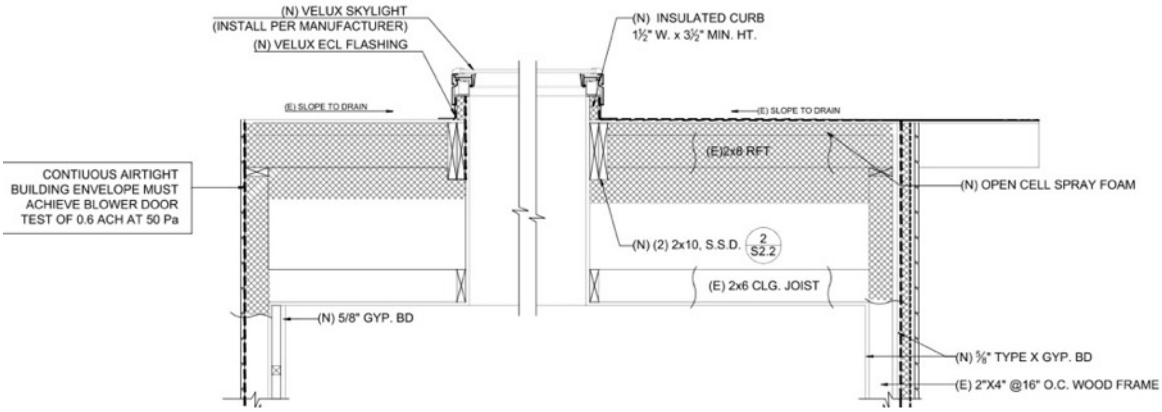
Photo of Exterior of South Wall

The new plywood sheathing was air sealed with liquid applied air barrier.

Photo of Exterior of South Wall, EPS Insulation Being Installed

Construction – Roof

The 2nd story roof was insulated with 229mm (9") open cell spray foam against the existing roof sheathing. Due to taller ceiling heights in the primary bedroom and bath 2.6m (8‘6“) vs. 2.4m (8‘0“) elsewhere on the second floor, and the slope of the roofing, the depth of the ceiling cavities varied. Above the primary bedroom and bathroom, an average of 187mm (7.38") of fiberglass batts were installed beneath the spray foam. This assembly is labeled as „Thin Roof“ in the PHPP file. Elsewhere on the 2nd floor, an average of 289mm (11.38") of fiberglass batts were installed beneath the spray foam. This assembly is labeled as „Thick Roof“ in the PHPP file.



Assembly no.						Interior insulation?
06ud	Thin Roof					

Heat transmission resistance [m²K/W]

Orientation of building element	1-Roof	interior R_{si}	0.13
Adjacent to	1-Outdoor air	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]
gypsum board	0.250					16
fiberglass batts	0.042	ceiling framing	0.130			140
fiberglass batts	0.042					48
fiberglass batts	0.042			roof framing	0.130	0
spray foam	0.043			roof framing	0.130	229
plywood	0.130					19
Percentage of sec. 1	86%	Percentage of sec. 2	9.4%	Percentage of sec. 3	4.7%	Total 45.1 cm

U-value supplement	W/(m²K)	U-value:	0.106 W/(m²K)

Assembly no.			Interior insulation?
07ud	Thick Roof		

Heat transmission resistance [m²K/W]

Orientation of building element	1-Roof	interior R_{si}:	0.13
Adjacent to	1-Outdoor air	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]
gypsum board	0.250					16
fiberglass batts	0.042	ceiling framing	0.130			140
fiberglass batts	0.042					149
fiberglass batts	0.042			roof framing	0.130	0
spray foam	0.043			roof framing	0.130	229
plywood	0.130					19
Percentage of sec. 1	86%	Percentage of sec. 2	0.094	Percentage of sec. 3	0.047	Total 55.2 cm

U-value supplement W/(m²K)

U-value: 0.084 W/(m²K)

The 1st floor roof was insulated with 229mm (9") of open cell spray foam filling the framing cavity.

Assembly no.			Interior insulation?
08ud	1st Floor Roof		

Heat transmission resistance [m²K/W]

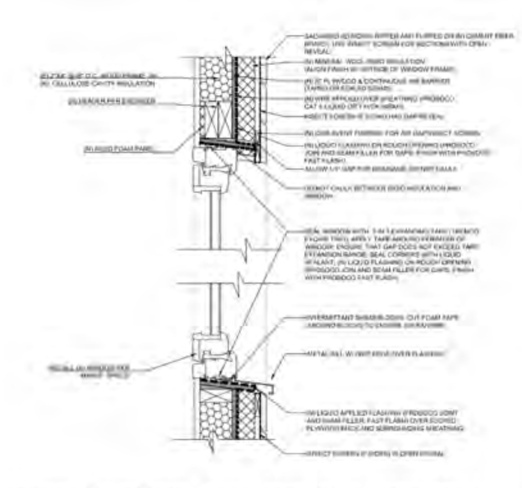
Orientation of building element	1-Roof	interior R_{si}:	0.13
Adjacent to	1-Outdoor air	exterior R_{se}:	0.04

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
gypsum board	0.250					16
fiberglass batts	0.042	roof framing	0.130			0
spray foam	0.043					229
plywood	0.130					19
Percentage of sec. 1	91%	Percentage of sec. 2	9.4%	Percentage of sec. 3		Total 26.4 cm

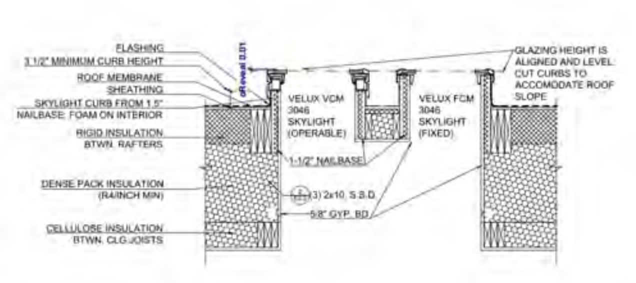
U-value supplement W/(m²K)

U-value: 0.176 W/(m²K)

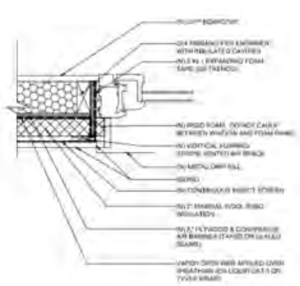
Construction – Window Installation



1. OPTION: WINDOW WITH PLYWOOD BUCK INSTALL



2. SKYLIGHT SECTION DETAIL



Window Installation Details
Windows are double-pane, uPVC frame, tilt-turn provided by Munster Joinery.

- Operable windows EcoClad 120+ Uf: 0.78 W/(m²K) (0.137 BTU/hr.ft².°F)
- Fixed windows EcoClad 120+ Uf: 0.78 W/(m²K) (0.137 BTU/hr.ft².°F)
- Glazed Doors EcoClad 120+ Uf: 0.78 W/(m²K) (0.137 BTU/hr.ft².°F)
- (Unclad Fixed) PassiV Futureproof Uf: 0.74 W/(m²K) (0.130 BTU/hr.ft².°F)
- (Unclad Glazed Door) PassiV Futureproof Uf: 0.97 W/(m²K) (0.171 BTU/hr.ft².°F)
- (Lift & Slide Door) EcoClad Futureproof Uf: 1.99 W/(m²K) (0.350 BTU/hr.ft².°F)

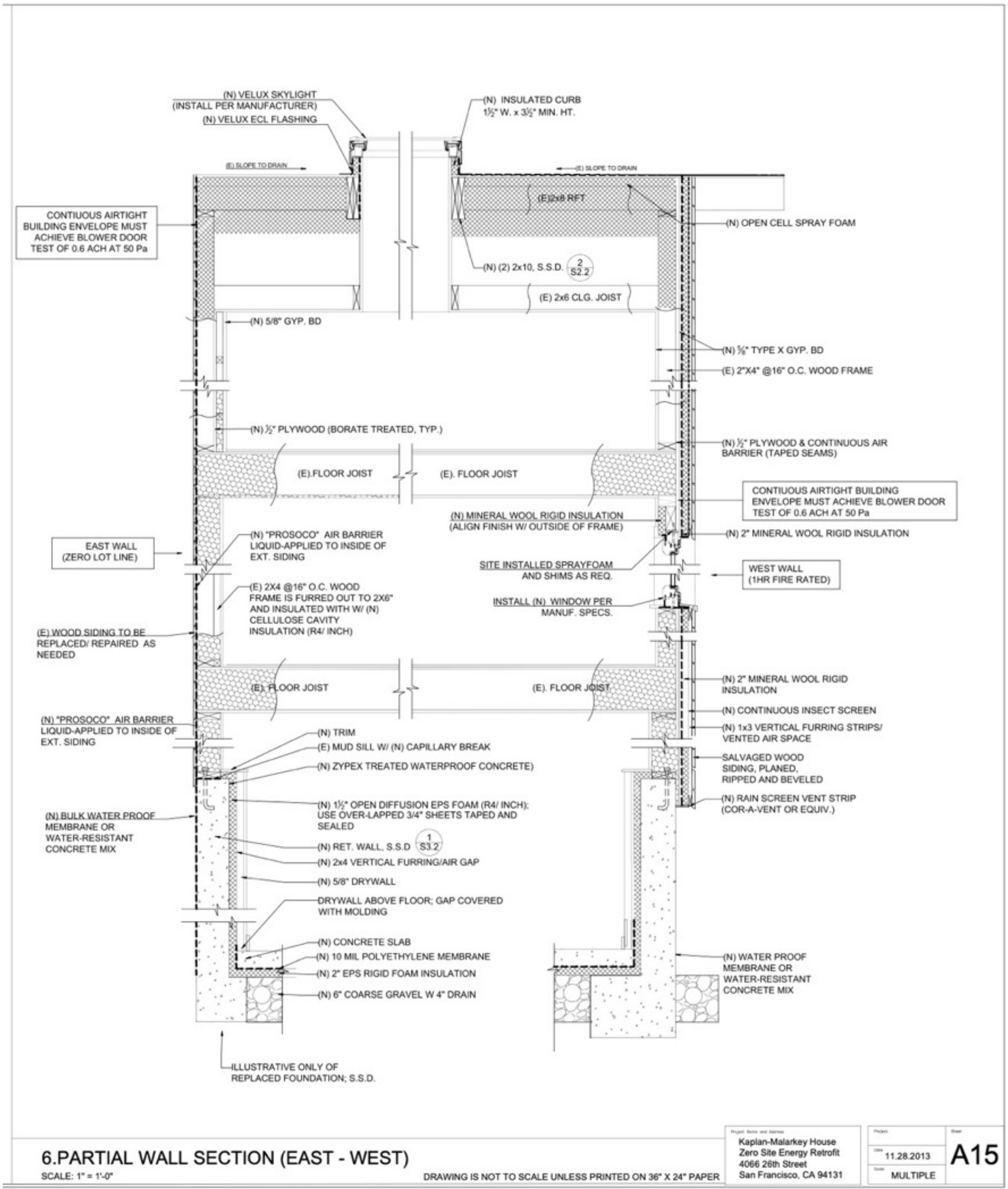
- IGU type: Saint-Gobain 24mm double-glazed, low-e coating, argon fill.
- Glazing g-value: 0.71
- U glazing 1.19 W/(m²K) (0.210 BTU/hr.ft².°F)

• Skylight (Roof Window) Velux VCM/FCM Uf: 1.60 W/(m²K)
(0.282 BTU/hr.ft².°F)
IGU Type: Double Pane LoE^3-366 (#2) / Clear) Air
• Glazing g-value: 0.27
• U glazing 1.65 W/(m²K)
(0.291 BTU/hr.ft².°F)

Photo of Window Rough Openings, West Wall, prepped with Liquid-Applied Air Sealant

6 DESCRIPTION OF THE AIRTIGHT ENVELOPE

The airtight envelope consists of 10mm polyethylene beneath the basement slab with the seams taped. This continues up onto the EPS on the interior of the basement walls with the seams taped. The capillary break beneath the framed walls was sealed to the concrete and to interior of the existing siding on the east exterior wall, and to the exterior of the new plywood sheathing on the other exterior walls, all with fluid-applied air sealant. The tops of the wall air barriers were likewise sealed to the underside of the existing roof sheathing. The leakage was reduced from 11 h^{-1} to 0.6 h^{-1}.



Building Section Ilustrating Airtight Layer

Air Leakage Test Report

In Compliance with European Norm EN13829 – European Union

Building Address: 4066 26th Street , San Francisco, CA 94131
Status: Construction completed
Performed for:

Performed by: Josh Young H.E.R.S. rater
Test date: 2015-03-05
Associated Test file: 4066 26th st door test

Summary

Test date: **2015-03-05**	By: **Josh Young H.E.R.S. rater**
Building address: **4066 26th Street , San Francisco, CA 94131**	

Building and Test Information	
Customer:	**Jonathan Kaplan**
Building volume:	**657.8 m^3**
Building Height (from ground to top):	**6 m**
Net Floor Area:	**265.2 m^2**
Envelope Area:	**n/a**
Building Exposure to wind	**Partially protected building**
Accuracy of measurements	**2%**
Test method	**EN13829**

Results Summary	
Air flow at 50 Pa, V_{50} [m^3/h]	**367.5**
Air changes at 50 Pa, n_{50} [/h]	**0.5585**
Permeability at 50 Pa, q_{50} [$m^3/h/m^2$]	**n/a**
Specific leakage at 50 Pa, w_{50} [$m^3/h/m^2$]	**1.385**

1st Page of Blower Door Test Report

Smoke Testing the Envelope for Leaks

7 DESCRIPTION OF THE VENTILATION SYSTEM

7.1 Description of the planning of the ventilation

Fresh air intake and extract air exhaust are located immediately outside the mechanical room on the west side of house. Interior supply air distribution ducts are insulated. Interior supply ducts run to each living space. Interior extract ducts run from the kitchen, bathrooms, and laundry.

Extract Air Ducts

7.2 Description of the planning for the central ventilation system

Air Pohoda Ultima 240E

94% effective heat recovery efficiency, 35-120 W power, 50-260 m^3/h, uncertified by PHI. Entered in PHPP as “default unit,” 75% effective heat recovery efficiency, 0.45 Wh/m^3.

Ventilation Unit, Adjacent to DHW Cylinder & Boiler

8 DESCRIPTION OF THE HEATING SYSTEM

Hydronically supplied by hot water from the DHW tank via a radiator within the supply duct heating ventilation air supplied to the living spaces. Additional heat supplied from the same source through PEX hydronic piping cast into the concrete basement floor slab.

Hydronic Heating Coil in Ventilation Air Supply

Distribution Manifold for Hydronic Slab Heating, Right Foreground

9 IMPORTANT PHPP RESULTS

Heating Demand: 12 kWh/m^2a

Heating Load: 9 W/m^2

Cooling Demand: 0 kWh/m^2a

Cooling Load: 0 W/m^2

Frequency of Overheating (>25ºC): 0%

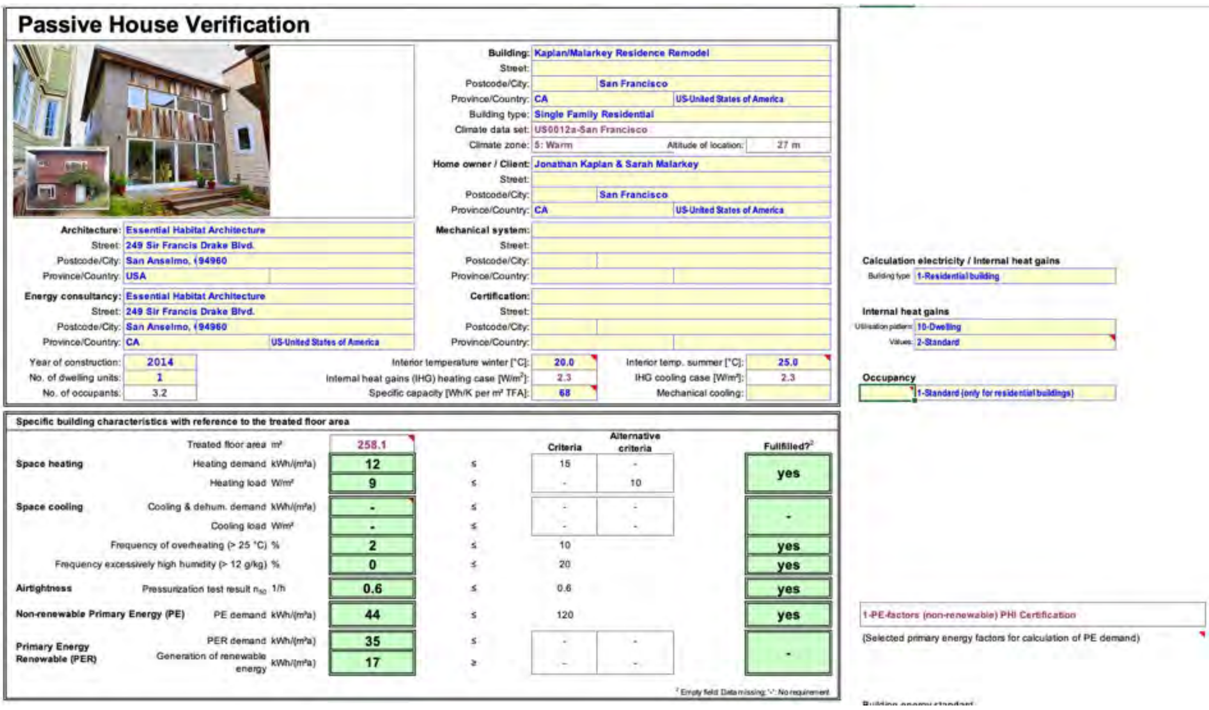
Frequency of excessively high humidity: 0%

Pressurization Test Result: 0.6 h^{-1}

PE Demand: 44 kWh/m^2a

PER Demand: 35 kWh/m^2a

Generation: 17 kWh/m^2a



Passive House Verification

Building: Kaplan/Malarkey Residence Remodel
Street:
Postcode/City: San Francisco
Province/Country: CA | US-United States of America
Building type: Single Family Residential
Climate data set: US0012a-San Francisco
Climate zone: 5: Warm | Altitude of location: 27 m

Home owner / Client: Jonathan Kaplan & Sarah Malarkey
Street:
Postcode/City: San Francisco
Province/Country: CA | US-United States of America

Architecture: Essential Habitat Architecture
Street: 249 Sir Francis Drake Blvd.
Postcode/City: San Anselmo, 94960
Province/Country: USA

Mechanical system:
Street:
Postcode/City:
Province/Country:

Energy consultancy: Essential Habitat Architecture
Street: 249 Sir Francis Drake Blvd.
Postcode/City: San Anselmo, 94960
Province/Country: CA | US-United States of America

Certification:
Street:
Postcode/City:
Province/Country:

Year of construction: 2014
No. of dwelling units: 1
No. of occupants: 3.2
Interior temperature winter [°C]: 20.0
Internal heat gains (IHG) heating case [W/m²]: 2.3
Specific capacity [Wh/K per m² TFA]: 68
Interior temp. summer [°C]: 25.0
IHG cooling case [W/m²]: 2.3
Mechanical cooling:

Calculation electricity / Internal heat gains
Building type: 1-Residential building

Internal heat gains
Utilisation pattern: 10-Dwelling
Values: 2-Standard

Occupancy
1-Standard (only for residential buildings)

Specific building characteristics with reference to the treated floor area

	Treated floor area	m²	258.1		Criteria	Alternative criteria	Fulfilled?[2]
Space heating	Heating demand	kWh/(m²a)	12	≤	15	-	yes
	Heating load	W/m²	9	≤	-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	-	≤	-	-	-
	Cooling load	W/m²	-	≤	-	-	
	Frequency of overheating (> 25 °C)	%	2	≤	10		yes
	Frequency excessively high humidity (> 12 g/kg)	%	0	≤	20		yes
Airtightness	Pressurization test result n_{50}	1/h	0.6	≤	0.6		yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	44	≤	120		yes
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	35	≤	-	-	-
	Generation of renewable energy	kWh/(m²a)	17	≥	-	-	

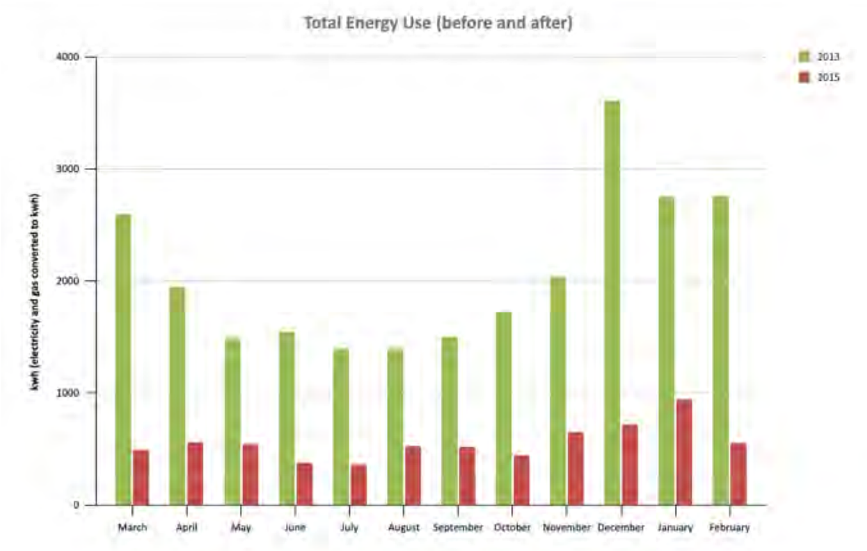
[2] Empty field: Data missing; '-': No requirement

1-PE-factors (non-renewable) PHI Certification
(Selected primary energy factors for calculation of PE demand)

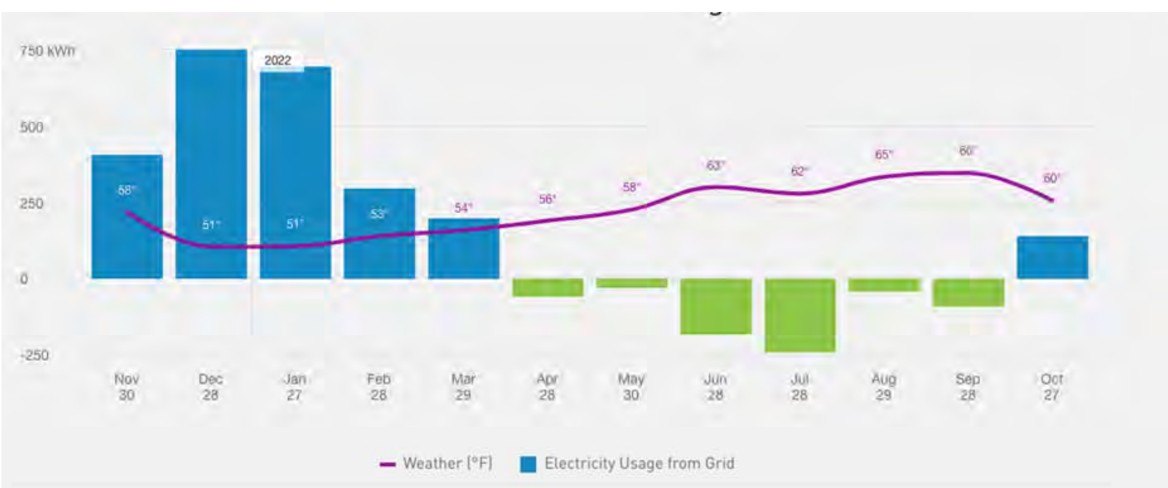
10 BUILDING COSTS

Withheld.

11 MEASURED RESULTS



Two EVs and solar: Dec 2021 to Oct 2022 (Electricity)



Graph above shows electrical use from December 2021 to October 2022. Blue bars are net monthly energy demand from grid, green bars are net monthly energy supply to grid from rooftop solar.

User Experiences

“I love our Passive House because it is so cozy, quiet, and peaceful—with a constant supply of clean, fresh air. It’s the best of all worlds!”

— Sarah M., homeowner

“We transformed a “lightly built” fixer-upper with little insulation, single pane metal windows, and a scary wall-mounted gas heater that we dared not use. Indoor temperatures weren’t much different from outside - we could lie in bed and see our breath most winter mornings. The conversion to Passive House took us to the far opposite end of the home performance spectrum. Super-insulated and airtight, we no longer hear cars and other city noises. Our house is comfortable year-round, with almost no additional heating, and no cooling. Drafts are a thing of the past. Our house uses so little energy that we’ve achieved net-zero energy use from our solar panels, including electric vehicle charging. The biggest problem with our home is that we’re never really 100% comfortable anywhere else.”

— Jonathan K., homeowner

Other References

https://www.passivehouseprojects.org/projects/kaplarkey-house/

https://www.essentialhabitat.com/kaplarkey-house