

Passive Without Compromise

Alan Barlis, BarlisWedlick Architects

Jordan Dentz, Levy Partnership

NAPHC, Philadelphia, September 24, 2016



Hudson Passive Project, BarlisWedlick + Levy Partnership, 2010



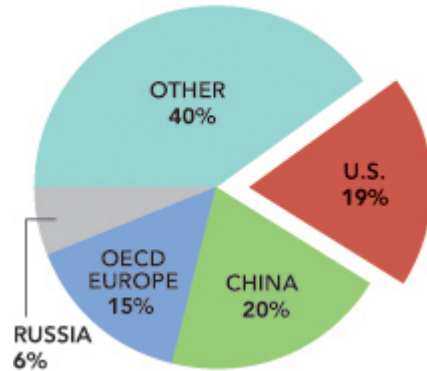
Photo by Peter Aaron

Certified Passive House Projects, BarlisWedlick + Levy Partnership

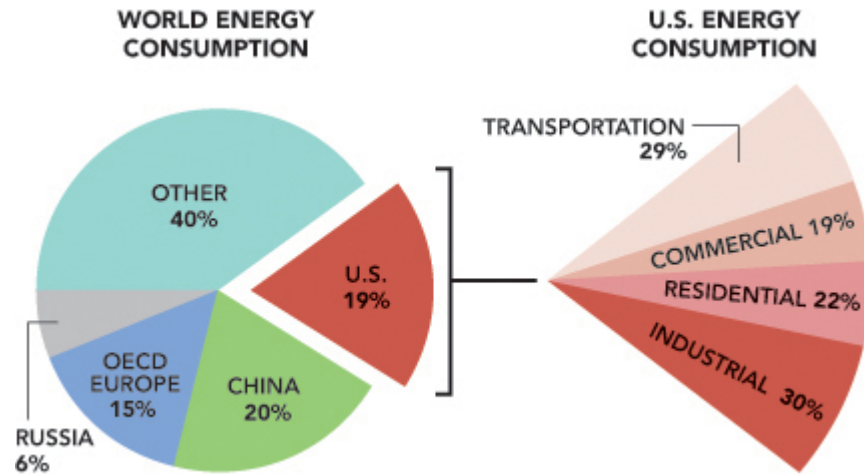


Photos by Peter Aaron, Jonny Valiant, Reto Guntli

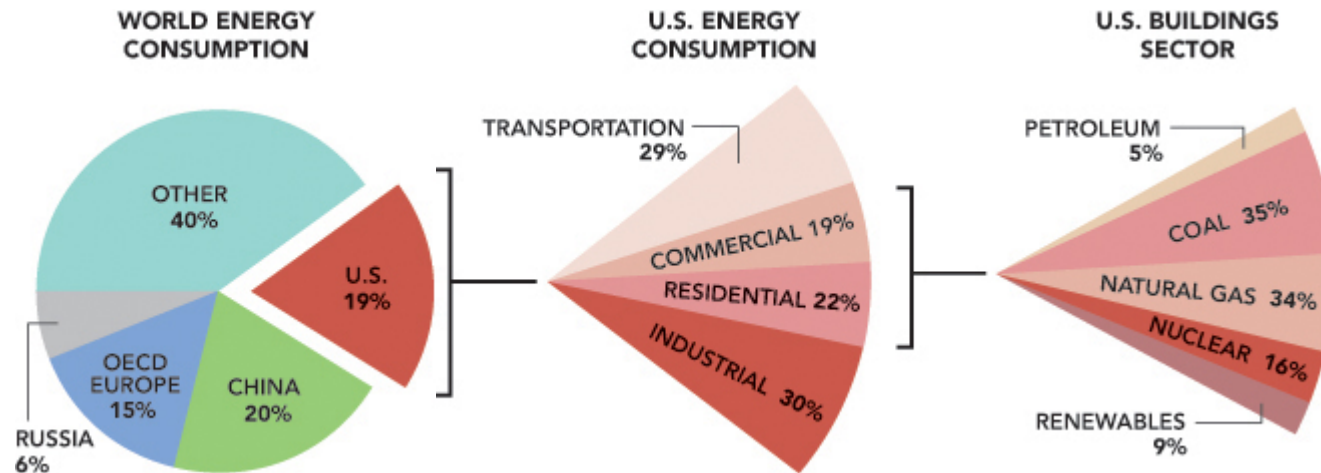
WORLD ENERGY CONSUMPTION



US Residential Architecture offers unique and important opportunities for the exploration of innovation in energy conservation.



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US Residential Architecture offers unique and important opportunities for the exploration of innovation in energy conservation.

How Passive House affects our Practice

Q1. Does pursuing Passive House force the client to compromise on design?

Q2. How does pursuing Passive House affect the architect/client relationship?

Q3. How does using a Passive House consultant as the lead impact the design/building process and how does staff training figure in to the process?



Photos by Peter Aaron, Jonny Valiant

Case studies in Passive House Architecture

Three Case Study Passive House Projects



Project	HPP	SDAK	Fox Hall
Client	Developer	Congregation	Private
Year Built	2010	2015	2014
Stories	2	1	2
Building Type	Single Family	Church	Single Family
Construction Type	Timber Frame with SIP Curtain Wall	Timber Frame with SIP Curtain Wall (sanctuary)	Timber Frame with SIP Curtain Wall
Builder/Contractor	Bill Stratton Building Co.	Hills Construction	Bill Stratton Building Co.
Climate	Zone 5	Zone 5	Zone 5
Floor Area (sf)	1,650	6,500	1,800
Form Factor (SA/V)	0.69	0.16	0.81

Design

Q1. Does pursuing passive house force the client to compromise on design?

Case Study 1: Hudson Passive Project, BarlisWedlick + Levy Partnership, 2010



Photo by Elliot Kaufman

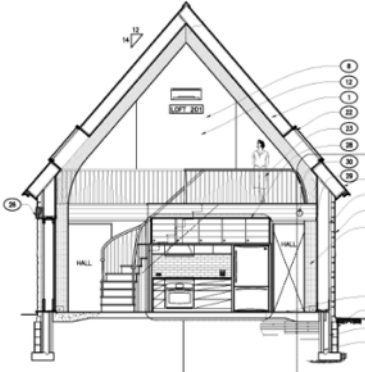
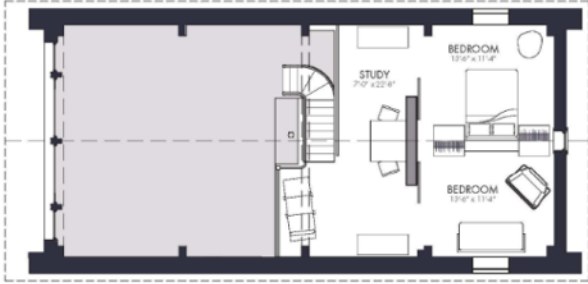
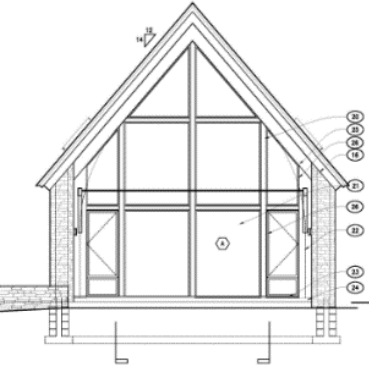
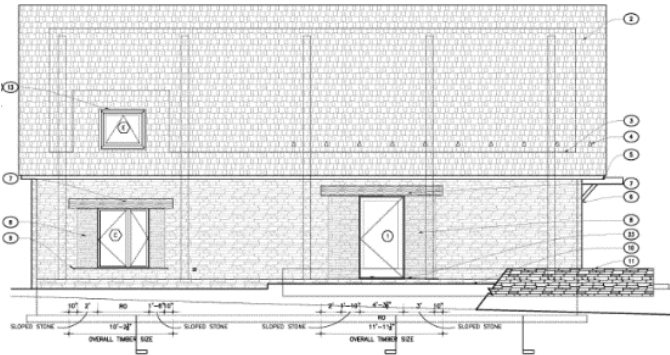
Hudson Passive Project



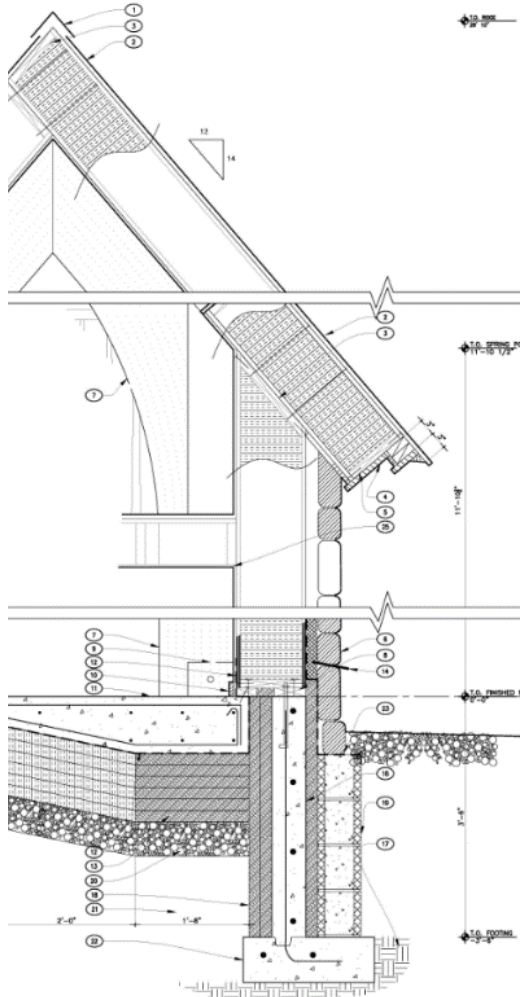
Project	HPP
Client	Developer
Year Built	2010
Stories	2
Building Type	Single Family
Construction Type	Timber Frame with SIP Curtain Wall
Builder/Contractor	Bill Stratton Building Co.
Climate	Zone 5
Floor Area (sf)	1,650
Form Factor (SA/V)	0.69



Hudson Passive Project



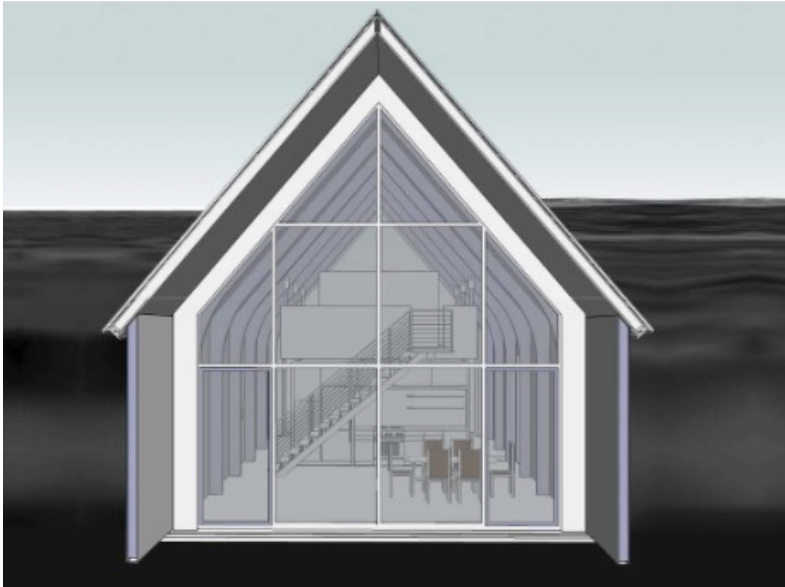
Hudson Passive Project



TOPIC	HPP	
BW Project Number	1003	
Year Built	2010	
Square Footage	1568	
Stories	1.5	
Construction Cost		
Cost/SF	\$225-\$250	
Building Type	Detached Single Family House	
Construction Type	Timber Frame with SIP Curtain Wall	
Builder	Bill Stratton Building	
Developer	N/A	
Building Scientist	The Levy Partnership	
MEP Engineer	X	
PHIUS Certification	YES	
PHIUS Certification Date	2010	
PHIUS Pre-Certification		
PHIUS Pre-Certification Date		
PHI Certification	YES	
PHI Certification Date	2010	
PHI Pre-Certification		
PHI Pre-Certification Date		
The Role of Form - PH technique #1 – compact form, understanding form, intro to PHPP software	Archetypal Form	
Compactness Ratio	Low surface area to volume ratio	
	?	
The Role of the Sun - PH technique #2 – orientation, understanding windows	Glazed façade	
Latitude (effective)	Utilizing passive solar shading concepts	
Azimuth of Primary Southern Façade	Sun driven orientation	
Windows (VERT) Type	42	
Windows (VERT) Company	?	
Windows (VERT) Product	Triple Glazed	
Windows (VERT) SHGC (South)	Serious Windows	
Windows (VERT) SHGC (West)	725 Series	
Windows (VERT) SHGC (North)	0.56	
Windows (VERT) SHGC (East)	0.3	
Windows (ROOF) Type	X	
Windows (ROOF) Company	X	
Windows (ROOF) Product	Triple Glazed	
Windows (ROOF) SHGC (South)	Fakro	
Windows (ROOF) SHGC (West)	FPL Preselect	
Windows (ROOF) SHGC (North)	X	
Windows (ROOF) SHGC (East)	0.3	
The Role of the Blanket - PH technique #3 – insulation, understanding materials, Intro to WUFI software	SIPS methodology	
Windows (ROOF) R-Value	GluLam Super-structure	
Windows (VERT) R-Value	Slab insulation	
Wall Type	R-5.	
Wall Supplier	R-7.	
Wall Thickness (pre-finish)	SIP (EPS)	
Wall R-Value	Vermont Timber Frames	
Roof Type	12.25in	
Roof Supplier	R-50.	
Roof Thickness (pre-finish)	SIP (BASF Neopor EPS)	
Roof R-Value	Vermont Timber Frames	
Slab Type	12.25in	
Slab Supplier	R-55.	
Slab Thickness	6" Concrete over XPS insulation on gravel bed	
Slab Insulation Thickness	Bill Stratton Building	
Slab R-Value	6.in	
Foundation Wall Type	12.in	
Foundation Wall Supplier	R-60.	
Foundation Wall Insulation Thickness (Interior)	Concrete between XPS Insulation	
Foundation Wall Insulation Thickness (Exterior)	Bill Stratton Building	
Foundation Wall R-Value	4.in	
	2.in	
	Incl. w/ slab R-Value	
The Role of Air & Water - PH technique #4 – air tightness, understanding details		Blower door test
Depressurization Test		Tape and Caulk
Pressure		.15 ACH
Test Date		50. Pa
		10/7/2010
The Role of Systems - PH technique #5 – ventilation systems, understanding monitoring/use/systems...		Heat recovery units
Heating Degree Days		Mini-splits
Cooling degree Days		Monitored - kWh tracking over 1st year
Annual Heating Demand (Btu/(ft ² -a))		6900
Annual Heating Demand (kWh/(m ² 2a))		500
Useful Cooling Demand (Btu/(ft ² -a))		3,841 Btu/(ft ² -a)
Useful Cooling Demand (kWh/(m ² 2a))		12,113 kWh/(m ² 2a)
Specific Primary Energy Demand (Btu/(ft ² -a))		1,084 Btu/(ft ² -a)
Specific Primary Energy Demand (kWh/(m ² 2a))		3.42 kWh/(m ² 2a)
Ventilation Type		\$4,514 Btu/(ft ² -a)
Ventilation Company		108.9 kWh/(m ² 2a)
Ventilation Product		HRV
Heat Recovery Efficiency		Zehnder
Climate Control: Unit 1 Type		ComfoAir 200
Unit 1 Company		92.00%
Unit 1 Product		Heat Pump
Unit 1 Heating Capacity		Mitsubishi
Unit 1 HSPF (IV)		Mr. Slim, MS2-FE12NA and MUZ12NA
Unit 1 Cooling Capacity		13,600 Btu/h
SEER (Energy Efficiency)		47 deg. F
Climate Control: Unit 2 Type		10 Btu/h/W
Unit 2 Company		12,000 Btu/h
Unit 2 Product		23
Unit 2 Heating Capacity		Heat Pump
Unit 2 HSPF (IV)		Mitsubishi
Unit 2 Cooling Capacity		Mr. Slim, MS2-RE09NA and MUZ12NA
SEER (Energy Efficiency)		10,900 Btu/h
Climate Control: Unit 3 Type		47 deg. F
Unit 3 Company		10 Btu/h/W
Unit 3 Product		9,000 Btu/h
Unit 3 Length		SEER (Energy Efficiency)
Unit 3 Power		baseboard Heater
Domestic Hot Water Company		Caslet
Domestic Hot Water Product		Electric Baseboard Heat
Efficiency		36.in
		750 w
		Stiebel Eltron Electric Tankless Water Heater
		Tempra 29 Plus
		99.00%

Hudson Passive Project



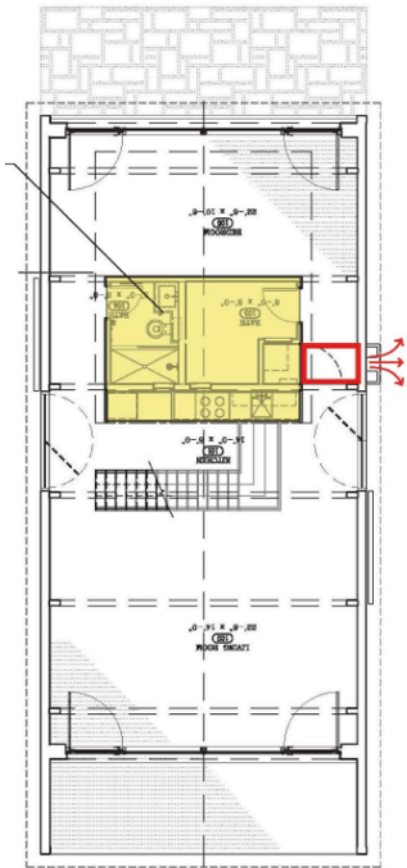


Original Passive Solar Design

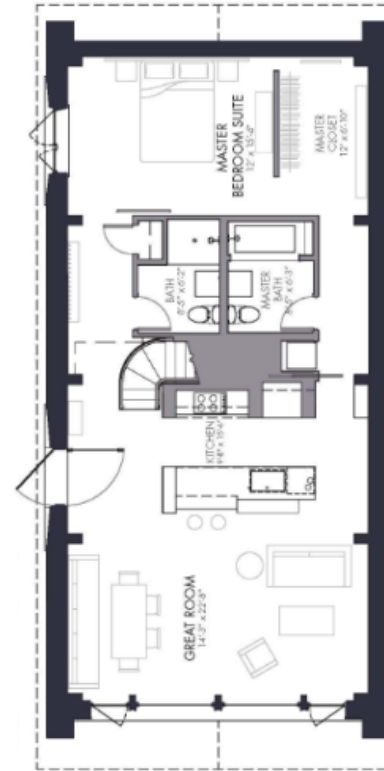


Passive House Design

A1.1. HPP was completely redesigned to meet the Passive House standard and saw insignificant changes to its design and design intent.



Original Passive Solar Design



Passive House Design

**Case Study 2:
SDAKinderhook Church, BarlisWedlick + Levy Partnership, 2015**



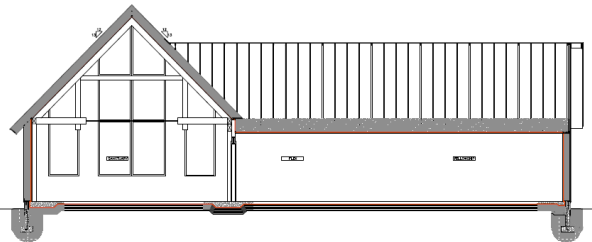
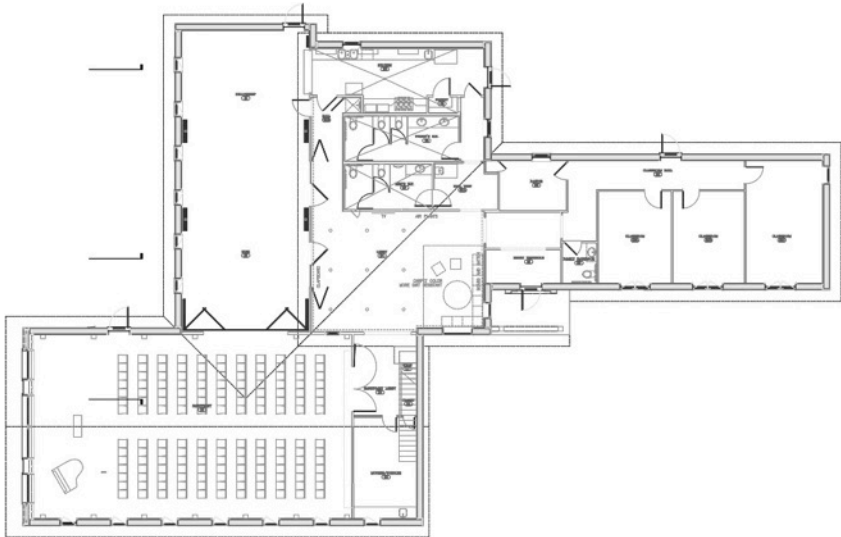
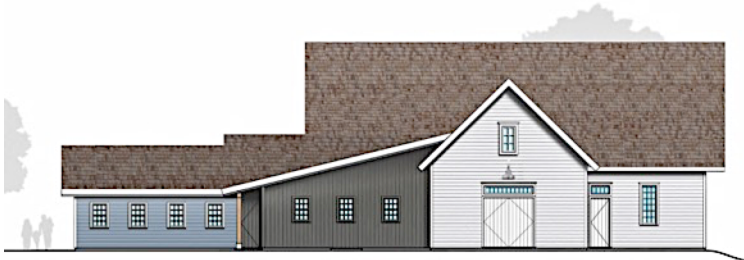
SDAKinderhook Church



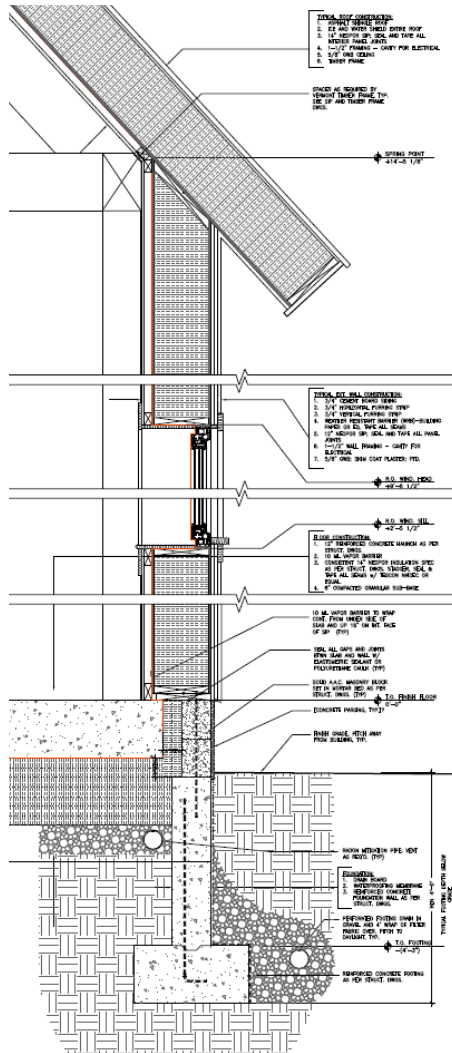
Project	SDAK
Client	Congregation
Year Built	2015
Stories	1
Building Type	Church
Construction Type	Timber Construction with SIP Curtain Wall (sanctuary)
Builder/Contractor	Hills Construction
Climate	Zone 5
Floor Area (sf)	6,500
Form Factor (SA/V)	0.16



SDAKinderhook Church

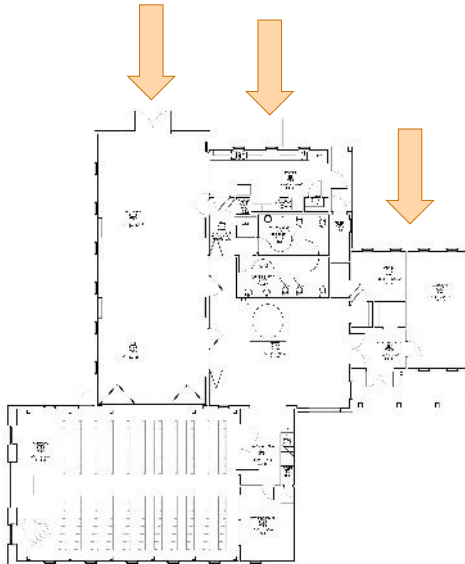


SDAKinderhook Church

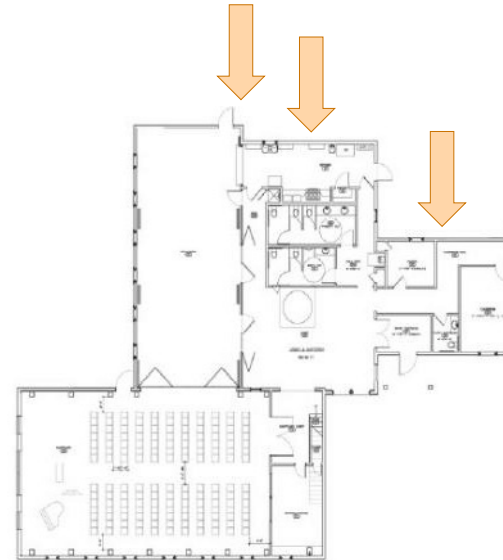


TOPIC	KSDA
BW Project Number	1217
Year Built	2014
Square Footage	6538
Stories	1 w/ loft
Construction Cost	
Cost/SF	
Building Type	Public Building / Church
Construction Type	Timber Construction w/ SIP walls & roof
Builder	Hills Construction Management Inc, Don
Developer	X
Building Scientist	The Levy Partnership
MEP Engineer	X
PHIUS Certification	YES
PHIUS Certification Date	2016
PHIUS Pre-Certification	YES
PHIUS Pre-Certification Date	2014
PHI Certification	X
PHI Certification Date	X
PHI Pre-Certification	X
PHI Pre-Certification Date	X
The Role of Form - PH technique #1 - compact form, understanding form, intro to PHPP software	
Compactness Ratio	?
The Role of the Sun - PH technique #2 - orientation, understanding windows	
Latitude (effective)	42.4
Azimuth of Primary Southern Façade	?
Windows (VERT) Type	Triple Glazed Intus Windows
Windows (VERT) Company	EFORTE
Windows (VERT) Product	0.62
Windows (VERT) SHGC (South)	0.494
Windows (VERT) SHGC (West)	0.494
Windows (VERT) SHGC (North)	0.494
Windows (VERT) SHGC (East)	0.494 / 0.62
Windows (ROOF) Type	X
Windows (ROOF) Company	X
Windows (ROOF) Product	X
Windows (ROOF) SHGC (South)	X
Windows (ROOF) SHGC (West)	X
Windows (ROOF) SHGC (North)	X
Windows (ROOF) SHGC (East)	X
The Role of the Blanket - PH technique #3 - insulation, understanding materials, intro to WUFI software	
Windows (ROOF) R-Value	X
Windows (VERT) R-Value	R-5.9
Wall Type	SIP and Double Wall Framing
Wall Supplier	Vermont Timber Framing
Wall Thickness (pre-finish)	12.25'
Wall R-Value	R-67.8
Roof Type	SIP
Roof Supplier	Vermont Timber Frames
Roof Thickness (pre-finish)	14.25
Roof R-Value	63
Slab Type	Concrete, EPS Neopor Insulation
Slab Supplier	Hills Construction Management Inc
Slab Thickness	5.in Reinforced Concrete
Slab Insulation Thickness	14.in
Slab R-Value	R-64
Foundation Wall Type	Reinforced Concrete
Foundation Wall Supplier	Hills Construction Management Inc
Foundation Wall Insulation Thickness (Interior)	1/4.in?
Foundation Wall Insulation Thickness (Exterior)	2.in
Foundation Wall R-Value	?

The Role of Air & Water - PH technique #4 - air tightness, understanding details	Blower door test Tape and Caulk
Depressurization Test	0.60 ACH
Pressure	51.7 Pa
Test Date	8/14/2015
The Role of Systems - PH technique #5 - ventilation systems, understanding monitoring/use/systems...	System sized to manage a congregation - lots of latent
Heating Degree Days	10896
Cooling degree Days	48?
Annual Heating Demand (Btu/(ft ² -a))	27,787 kWh/yr
Annual Heating Demand (kWh/(m ² -a))	12,945 kWh/yr
Useful Cooling Demand (Btu/(ft ² -a))	184,372 kWh/yr
Specific Primary Energy Demand (Btu/(ft ² -a))	ERV
Specific Primary Energy Demand (kWh/(m ² -a))	Ultimate Air
Ventilation Type	Recoup Aerator 2000DX
Ventilation Company	0.83
Ventilation Product	Ductless Heat Pump
Heat Recovery Efficiency	Mitsubishi
Climate Control: Unit 1 Type	Unit 1 Company
Unit 1 Product	Unit 1 Heating Capacity
Unit 1 Heating Capacity @ Temperature	Unit 1 Heating Capacity @ Temperature
Unit 1 HSPF (IV)	Unit 1 Cooling Capacity
Unit 1 Cooling Capacity	SEER (Energy Efficiency)
SEER (Energy Efficiency)	Climate Control: Unit 2 Type
Climate Control: Unit 2 Type	Unit 2 Company
Unit 2 Product	Unit 2 Heating Capacity
Unit 2 Heating Capacity	Unit 2 Heating Capacity @ Temperature
Unit 2 HSPF (IV)	Unit 2 Cooling Capacity
Unit 2 Cooling Capacity	SEER (Energy Efficiency)
SEER (Energy Efficiency)	Climate Control: Unit 3 Type
Climate Control: Unit 3 Type	Unit 3 Company
Unit 3 Product	Unit 3 Length
Unit 3 Length	Unit 3 Power
Unit 3 Power	Domestic Hot Water Company
Domestic Hot Water Company	Domestic Hot Water Product
Domestic Hot Water Product	Electric point source and tankless water heaters



Original Passive Solar Design



Passive House Design

A1.2. SDAK was completely redesigned to meet the Passive House standard and saw insignificant changes to its design and design intent.

Case Study 3: Fox Hall, BarlisWedlick + Levy Partnership, 2014

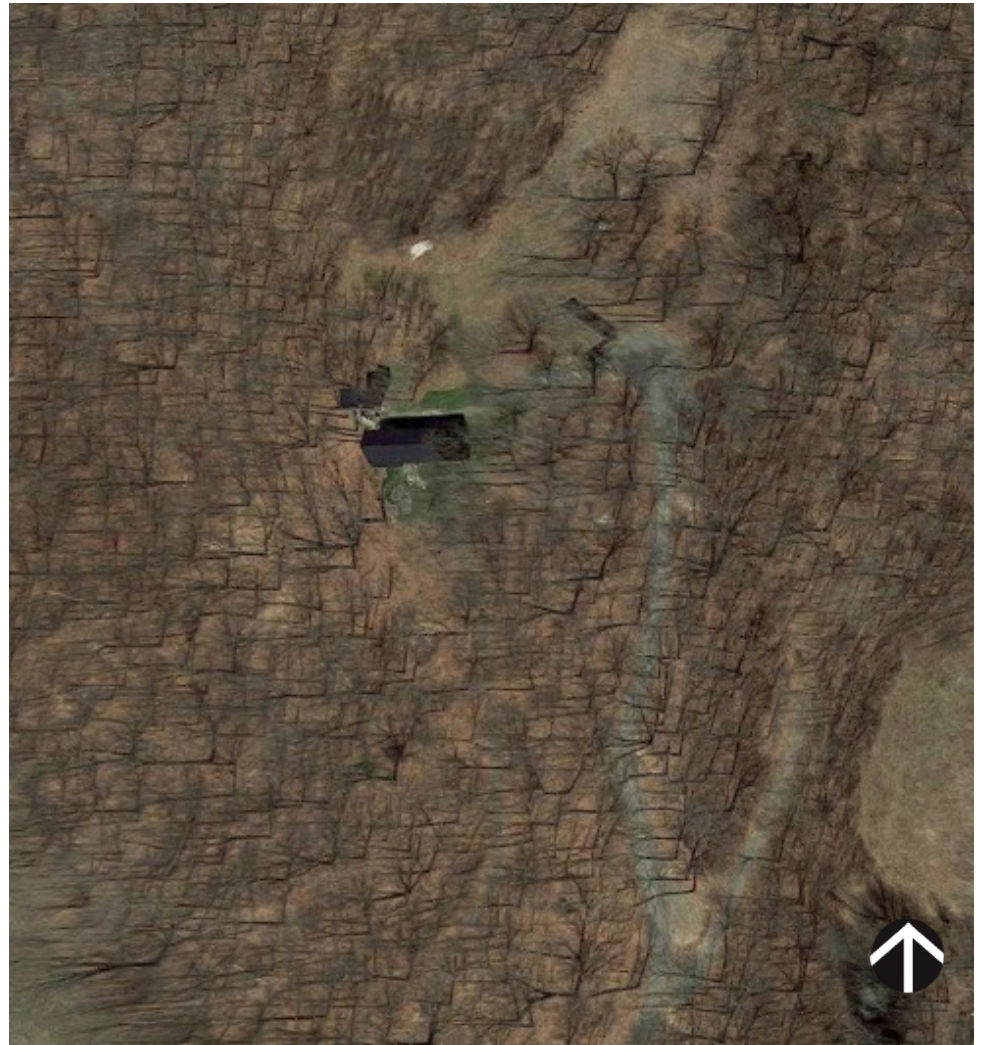


Photo by Jonny Valiant

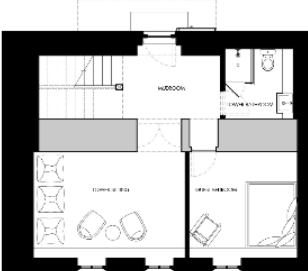
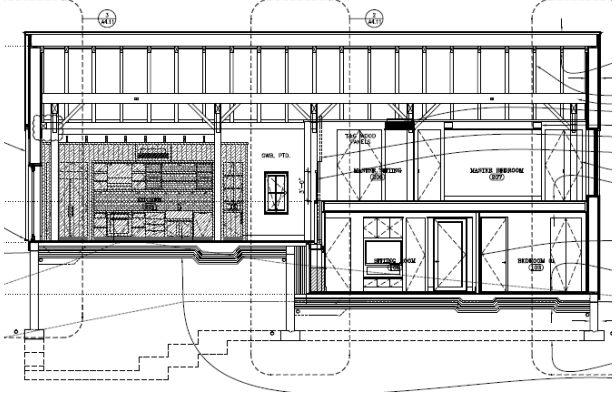
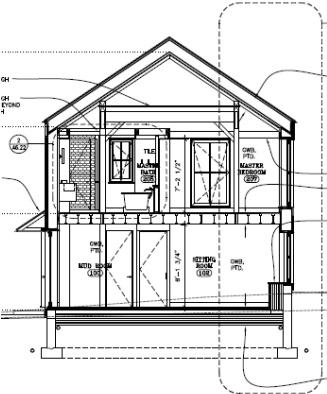
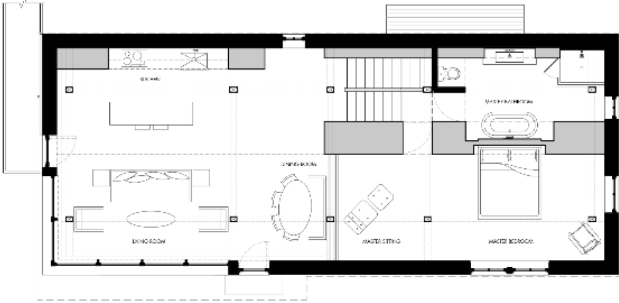
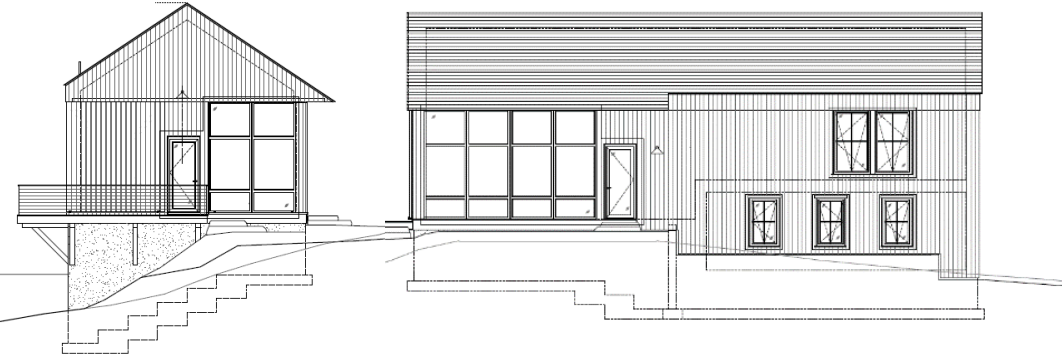
Fox Hall



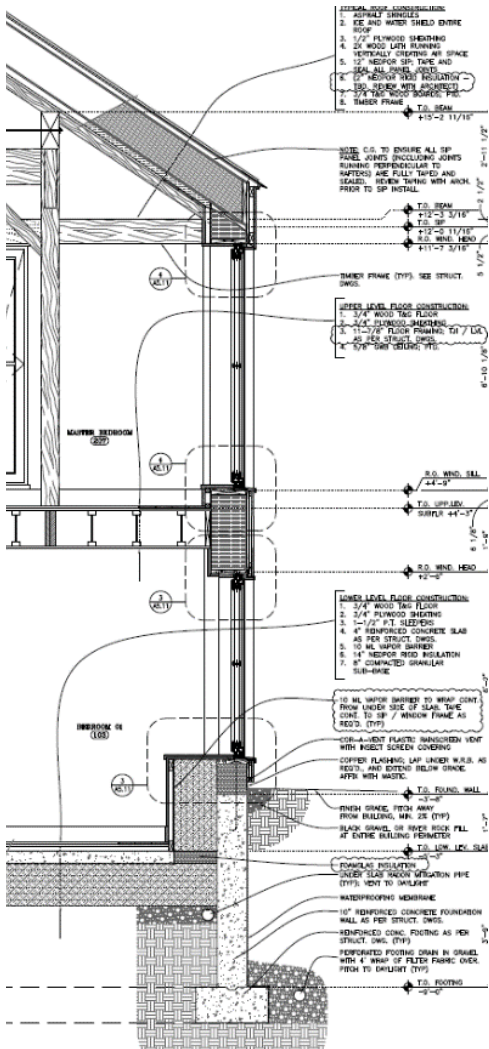
Project	Fox Hall
Client	Private
Year Built	2014
Stories	2
Building Type	Single Family
Construction Type	Timber Frame with SIP Curtain Wall
Builder/Contractor	Bill Stratton Building Co.
Climate	Zone 5
Floor Area (sf)	1,800
Form Factor (SA/V)	0.81



Fox Hall



Fox Hall



TOPIC	HALL HILL
BW Project Number	1210
Year Built	2014
Square Footage	1602 SF
Stories	2
Construction Cost	\$897,454 w.o upgrades
Cost/SF	\$411 w.o upgrades
Building Type	Detached Single Family House
Construction Type	Timber Frame with SIP Curtain Wall
Builder	Bill Stratton Building Company
Developer	N/A
Building Scientist	The Levy Partnership
MEP Engineer	X
PHIUS Certification	X
PHIUS Certification Date	X
PHIUS Pre-Certification	X
PHIUS Pre-Certification Date	X
PHI Certification	Yes
PHI Certification Date	1/7/2015
PHI Pre-Certification	Yes
PHI Pre-Certification Date	12/18/2013
The Role of Form - PH technique #1 - compact form, understanding form, intro to PHPP software	Split level plan approach Sectional space interactions
Compactness Ratio	?
The Role of the Sun - PH technique #2 - orientation, understanding windows	Site plan approach and tree clearing Curtain wall eve solar diagrams
Latitude (effective)	42
Azimuth of Primary Southern Façade	?
Windows (VERT) Type	Triple Glazed
Windows (VERT) Company	Intus Windows
Windows (VERT) Product	EFORTE
Windows (VERT) SHGC (South)	0.483 & 0.494 & 0.62
Windows (VERT) SHGC (West)	0.483
Windows (VERT) SHGC (North)	0.373
Windows (VERT) SHGC (East)	0.373 & 0.494
Windows (ROOF) Type	X
Windows (ROOF) Company	X
Windows (ROOF) Product	X
Windows (ROOF) SHGC (South)	X
Windows (ROOF) SHGC (West)	X
Windows (ROOF) SHGC (North)	X
Windows (ROOF) SHGC (East)	X
The Role of the Blanket - PH technique #3 - insulation, understanding materials, intro to WUFI software	SIPS construction over heavy timber Partially earth bermed
Windows (ROOF) R-Value	X
Windows (VERT) R-Value	R- 5.99
Wall Type	SIP
Wall Supplier	Vermont Timber Framing
Wall Thickness (pre-finish)	11.375 in core with Neopor
Wall R-Value	R-57
Roof Type	SIP (Neopor)
Roof Supplier	Vermont Timber Framing
Roof Thickness (pre-finish)	11.375in Core, plus 2.in Neopor on top of SIP
Roof R-Value	R-57
Slab Type	Concrete, Neopor EPS 256mm
Slab Supplier	Bill Stratton Building
Slab Thickness	4in. Reinforced Concrete
Slab Insulation Thickness	14.in Neopor Insulation
Slab R-Value	R-67
Foundation Wall Type	10 in. Reinforced Concrete with Neopor Insulation
Foundation Wall Supplier	Bill Stratton Building
Foundation Wall Insulation Thickness (Interior)	Total thickness 14 in. of Neopor?
Foundation Wall Insulation Thickness (Exterior)	Total thickness 14 in. of Neopor?
Foundation Wall R-Value	incl. w/ slab R-value

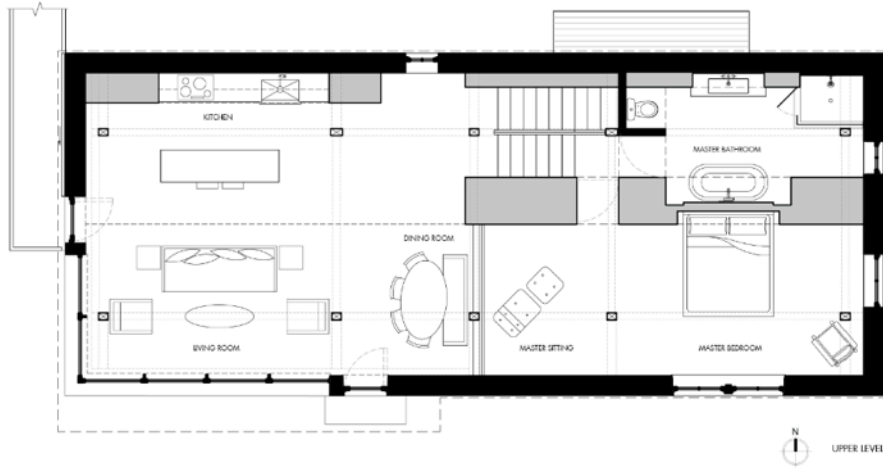
The Role of Air & Water - PH technique #4 - air tightness, understanding details	Blower door test Tape and Caulk
Depressurization Test	38 ACH
Pressure	50 Pa
Test Date	7/31/2014

The Role of Systems - PH technique #5 - ventilation systems, understanding monitoring/use/systems...	Comparing with expected energy performance Understanding client behavioral patterns
Heating Degree Days	
Cooling degree Days	
Annual Heating Demand (Btu/(ft²-a))	
Annual Heating Demand (kWh/(m²-a))	996 kWh
Useful Cooling Demand (Btu/(ft²-a))	
Useful Cooling Demand (kWh/(m²-a))	579 kWh
Specific Primary Energy Demand (Btu/(ft²-a))	
Specific Primary Energy Demand (kWh/(m²-a))	58,364 kBtu/yr.
Ventilation Type	HRV
Ventilation Company	Zehnder
Ventilation Product	ComfoAir 200
Heat Recovery Efficiency	92.00%
Climate Control: Unit 1 Type	Heat Pump
Unit 1 Company	Fujitsu
Unit 1 Product	ARJUSLF
Unit 1 Heating Capacity	10,200 Btu/h
Unit 1 Heating Capacity @ Temperature	47 deg. F
Unit 1 HSPF (IV)	9 Btu/h/W
Unit 1 Cooling Capacity	9,000 Btu/h
SEER (Energy Efficiency)	14.7 (Ducted)
Climate Control: Unit 2 Type	Heat Pump
Unit 2 Company	Fujitsu
Unit 2 Product	ACU12RLS2H, ASU12RLS2
Unit 2 Heating Capacity	16,000 Btu/h
Unit 2 Heating Capacity @ Temperature	47 deg. F
Unit 2 HSPF (IV)	9 Btu/h/W
Unit 2 Cooling Capacity	12,000 Btu/h
SEER (Energy Efficiency)	25
Climate Control: Unit 3 Type	X
Unit 3 Company	X
Unit 3 Product	X
Unit 3 Length	X
Unit 3 Power	X
Domestic Hot Water Company	Bosch Electric Tankless Water Heater
Domestic Hot Water Product	Bosch AE 125
Efficiency	95.00%

Fox Hall



Photos by Jonny Valiant, Reto Guntli, Bryan Ferry



A1.3. Fox Hall was designed from the start to meet the Passive House standard and benefitted from employing that as the design intent.





Client Relationship

Q2. How does pursuing passive house affect the architect/client relationship?

Case Study 1: Hudson Passive Project, 2010



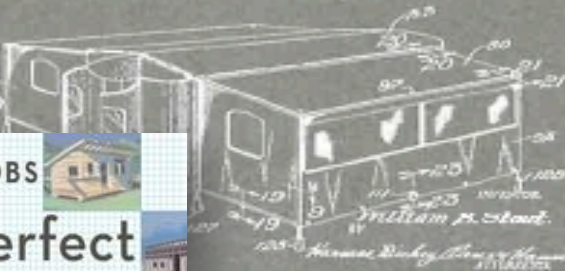
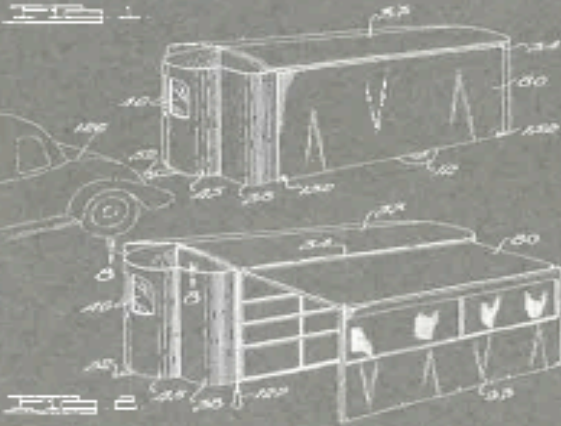
Photo by Elliott Kaufman

April 25, 1939.

W. B. STOUT
FOLDABLE BUILDING STRUCTURE
Filed Nov. 12, 1935

2,155,876

8 Sheets-Sheet 1

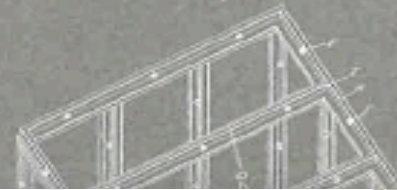


Aug. 8, 1944.

N. L. WACHSMANN ET AL.
METEORICALLY COLLAPSE
PLATE May 20, 1942
Fig. 3

2,356,192

7 Sheets-Sheet 2



HOME DELIVERY

FABRICATING
THE MODERN DWELLING

THE MUSEUM OF MODERN ART

KARRIE JACOBS

The Perfect \$100,000 House



A TRIP ACROSS AMERICA AND BACK
IN PURSUIT OF A PLACE TO CALL HOME



WITH ILLUSTRATIONS BY GARY PANTER

R. B. FULLER
DESIGNED THIS



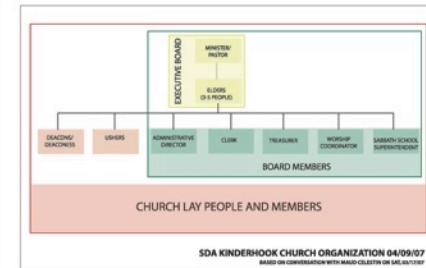
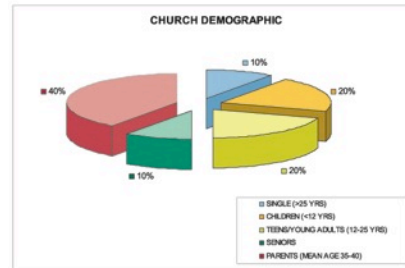
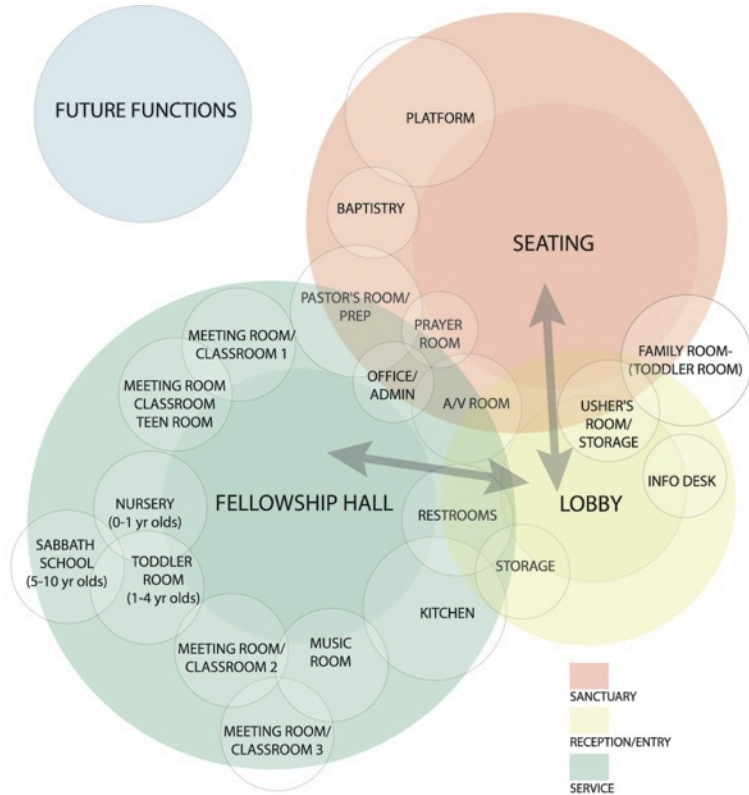






Case Study 2: SDA Kinderhook Church, 2015

Space	Area (ft ²)	Notes
Entry		
Lobby	500	20-40 people; Primary Access; handicap accessibility
Information Desk	100	For visitor access and wayfinding
Coat Storage	100	100-200 coats
Usher's Room	150	To also provide storage for Communion services; auxiliary storage for info desk
Bathrooms/Custodial Services	200	accessible bathrooms
Total	700	
Sanctuary		
Worship Center	1400	200 seats; non-hierarchical
Fixed Seats (space for)	800	125 seats
Moveable Seats (space for)	600	75 seats
Platform	300	Viewable by everyone; able to be multi-use
Baptistry	200	Full immersions; accessed by prep areas
Dressing Rooms	200	For both genders
Loft	300	For choir or A/V purposes or extra seating
Audio-Visual/Production Room	170	Integrated technology throughout church including
Lighting	30	Projectors, multiple lighting options, speakers through
Sound	40	multiple rooms of structure
Broadcast	100	Closed-circuit TV; possibility of future broadcasts to local cable channel
Mother's Room	250	Acoustically segregated; interactive with main space
Total	2820	
Service Spaces		
Administrative Offices	350	
Pastor's Room/Prep room	100	Pastor's room to be accessible to main sanctuary
Prayer Room	100	To be accessible to Pastor's room
Offices	150	Administration area; photocopying and storage
Fellowship Hall	1600	
Gathering space	900	May also be partitioned into meeting rooms (75-90 people)
Kitchen	300	Small efficient commercial kitchen
Bathrooms	300	main bathrooms for building
Storage	100	auxiliary storage
Classrooms (Education)	1670	
Nursery	150	For nursing mothers as well as for young babies who need it to be quiet
Primary Ed-Sabbath School	250	Main teaching space for young kids
Toddler Room	250	Can double as Mother's room
Adult Learning/Teen Room	870	May also be turned into meeting rooms (4 rooms maybe integrated into fellowship hall)
Music/Rehearsal Room Storage	150	Rehearsal space can also double as classroom
Total	3620	
Grand Total	7140	
Auxiliary Spaces		
Library	500	
Bookstore	200	
Fitness Center	300	
Locker Rooms	100	
Counseling/Community Center	300	
Exterior		
Outdoor Worship Services		
Trails		
Pavilion		
Gardens		
Parking		
Dropoff		
		For approximately 100 - 125 cars



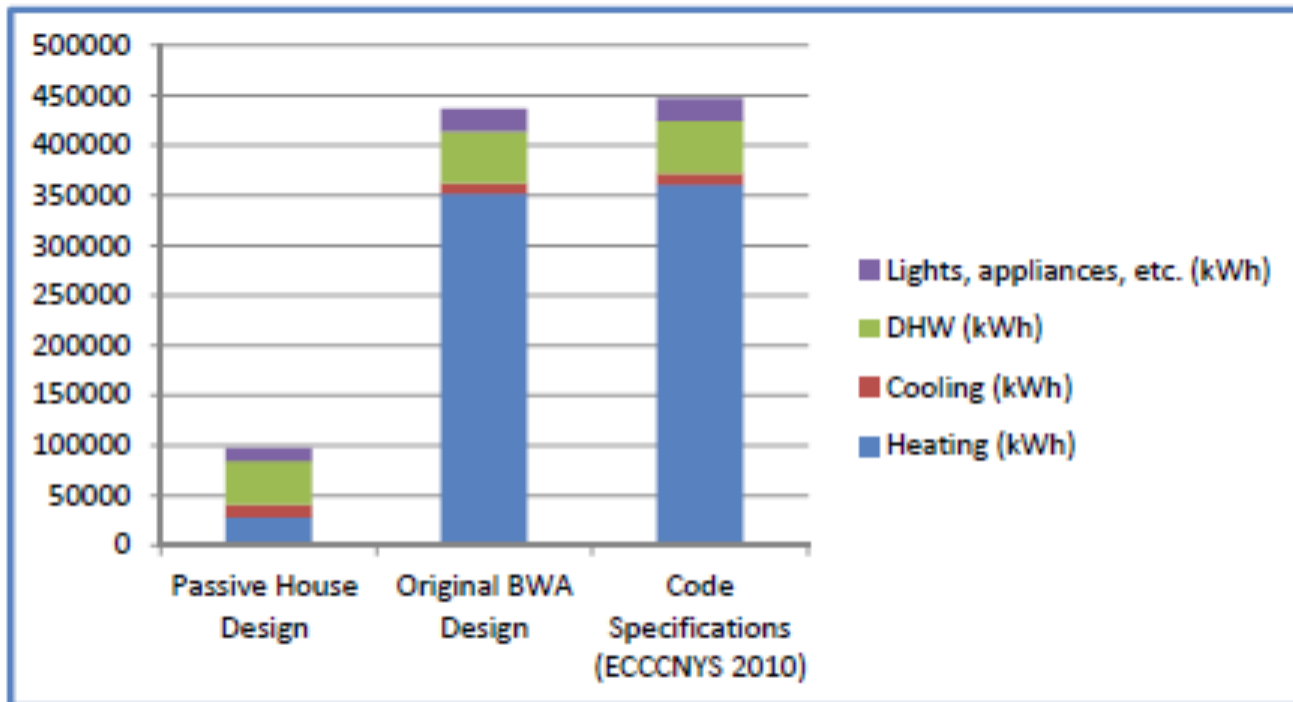
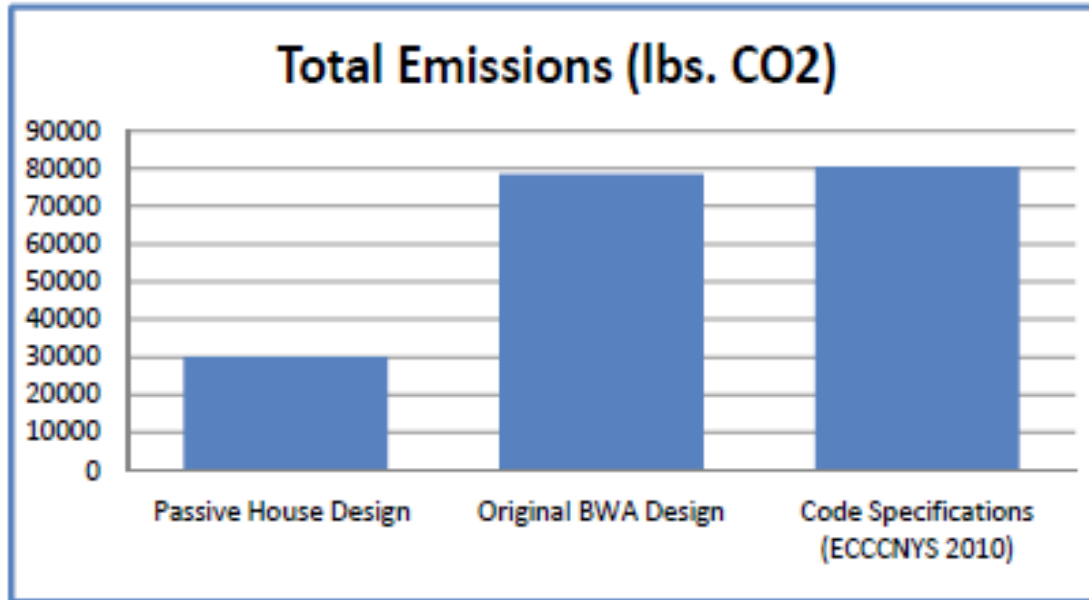


Figure 2. Predicted annual energy consumption by major end use – site energy



A2.2. Our Passive House design for SDAK Church proved to be a dramatic reduction in CO2 per year over our original Passive Solar design.





Case Study 3: Fox Hall, 2014









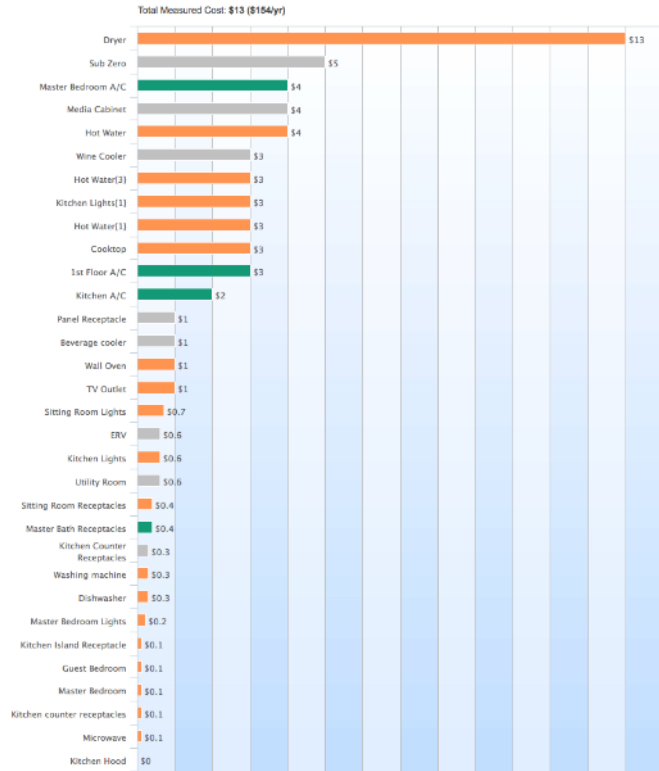


A2.3. As a 'part-fab' Passive House, Fox Hall fully satisfied the client's intent, and gave us goals and successes to monitor to enhance our relationship.

My Energy Report Card

	Past 30 Days	Past 90 Days	Same 30 Days Last Year	
Electricity:	Daily Usage Cost	\$0	\$0	N/A
	Average Daily Usage	3 kWh	2 kWh	N/A
CO2:	Average Daily Emissions	2 lbs	1 lbs	N/A

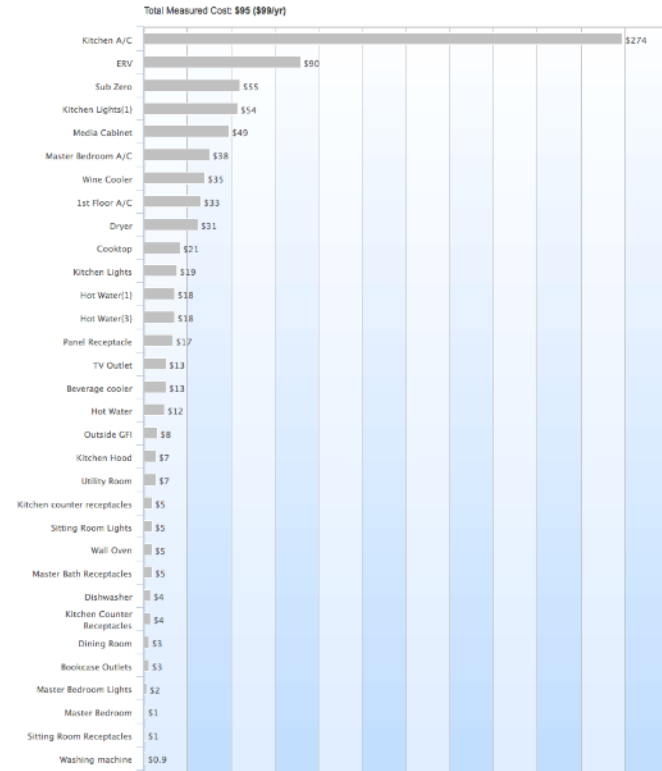
Estimated Cost By Circuit, Past 30 Days [®] [Select Date Range](#)



My Energy Report Card

	Past 30 Days	Past 90 Days	Same 30 Days Last Year	
Electricity:	Daily Usage Cost	\$0	\$0	N/A
	Average Daily Usage	3 kWh	2 kWh	N/A
CO2:	Average Daily Emissions	2 lbs	1 lbs	N/A

Estimated Cost By Circuit, Past 352 Days [®] [Select Date Range](#)



Process

Q3. How does using a passive house consultant as the lead impact the design/building process and how does staff training figure in to the process?

Case Study 1: Hudson Passive Project, 2010



Case Study 2: SDA Kinderhook Church, 2015



Case Study 3: Fox Hall, 2014

NOTE: FOR RELATIVE COMPARISON ONLY - NOT FOR COMPARISON WITH EXTERNAL DATA OR CERTIFICATION REQUIREMENTS

Depth of overhang from edge of wall (add 9.75 to glass)	Specific heat demand	Specific cooling demand	Frequency of overheating	Specific Space Conditioning Demand	Primary Energy demand
ft	kBTU/(ft ² yr)	kBTU/(ft ² yr)	%	kBTU/(ft ² yr)	kBTU/(ft ² yr)
0	4.04	2.04	7.0%	6.08	38.1
1	4.35	1.69	6.6%	6.04	38.1
2	4.51	1.47	6.4%	5.98	38.1
3	4.67	1.31	6.1%	5.98	38.2
4	4.82	1.18	5.9%	6.00	38.2
5	4.97	1.08	5.7%	6.05	38.3
6	5.11	1.01	5.5%	6.12	38.4



Case Study 3: Fox Hall, 2014





Conclusions

Q1. Does pursuing passive house force the client to compromise on design?

A1. PH influence had minor impact, and techniques can be used to drive design in a positive way

Q2. How does pursuing passive house affect the architect/client relationship?

A2. PH influence had positive impact in setting goals, working together to reach them, measuring and verifying accomplishments.

Q3. How does pursuing passive house affect the architect/client relationship?

A3. Using a passive house consultant as the lead improved the design process while staff training enhanced employee satisfaction and client good-will.

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