



North American
Passive House Conference Presentation

Case Study: VertDesign

QA/QC and Certification

Ryan Abendroth





At a Glance

- LEED Platinum
- Duplex
- 3 ½ to 4 stories
- Ottawa, Canada
- VertDesign
- CPHC: Homesol Building Solutions w/ PHIUS
- 1st PHIUS Certified? building in Canada



VertDesign Project





VertDesign Project





VertDesign Project





VertDesign Project





VertDesign Project





VertDesign Project





VertDesign Project





VertDesign Project





VertDesign Project





VertDesign Project





Part One: Initial Evaluation

Documents

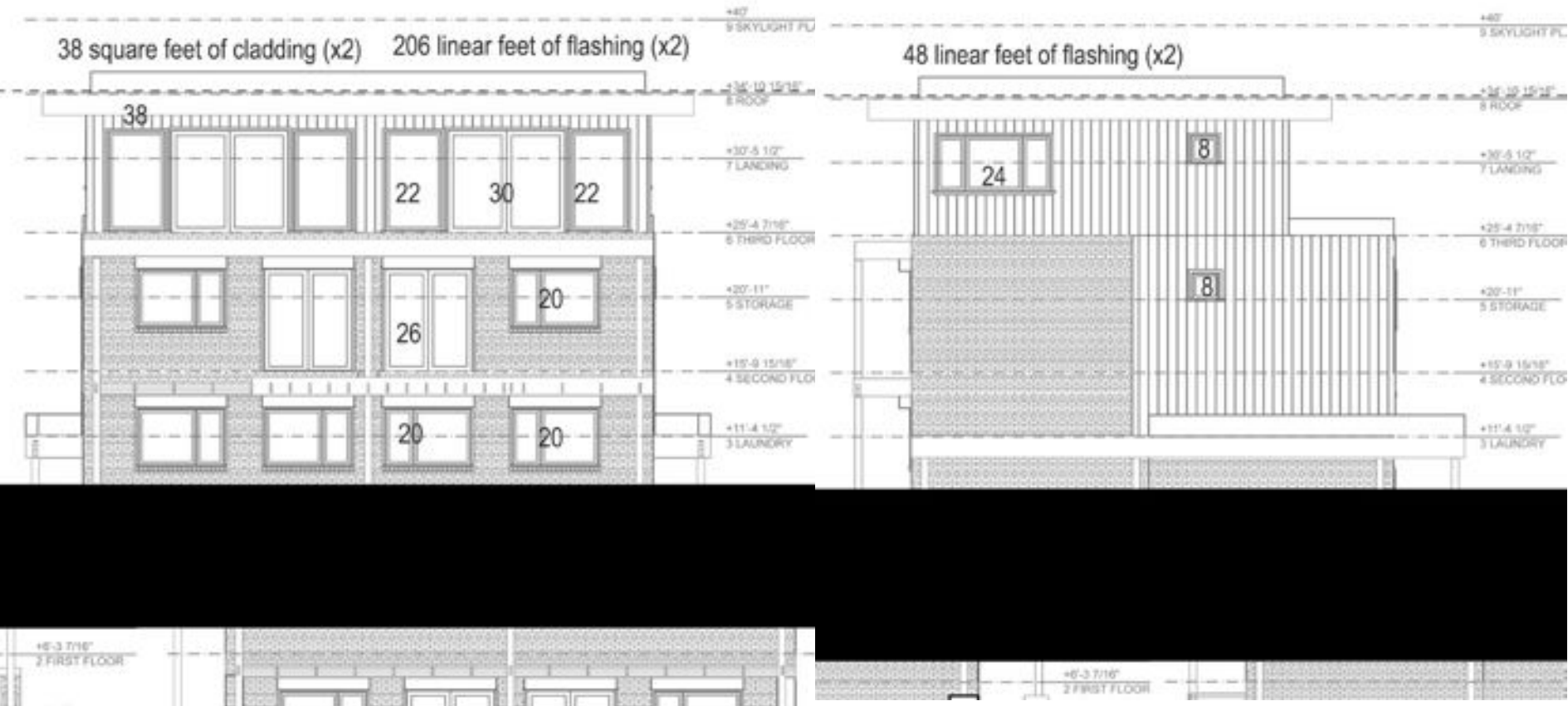


Initial Schematic



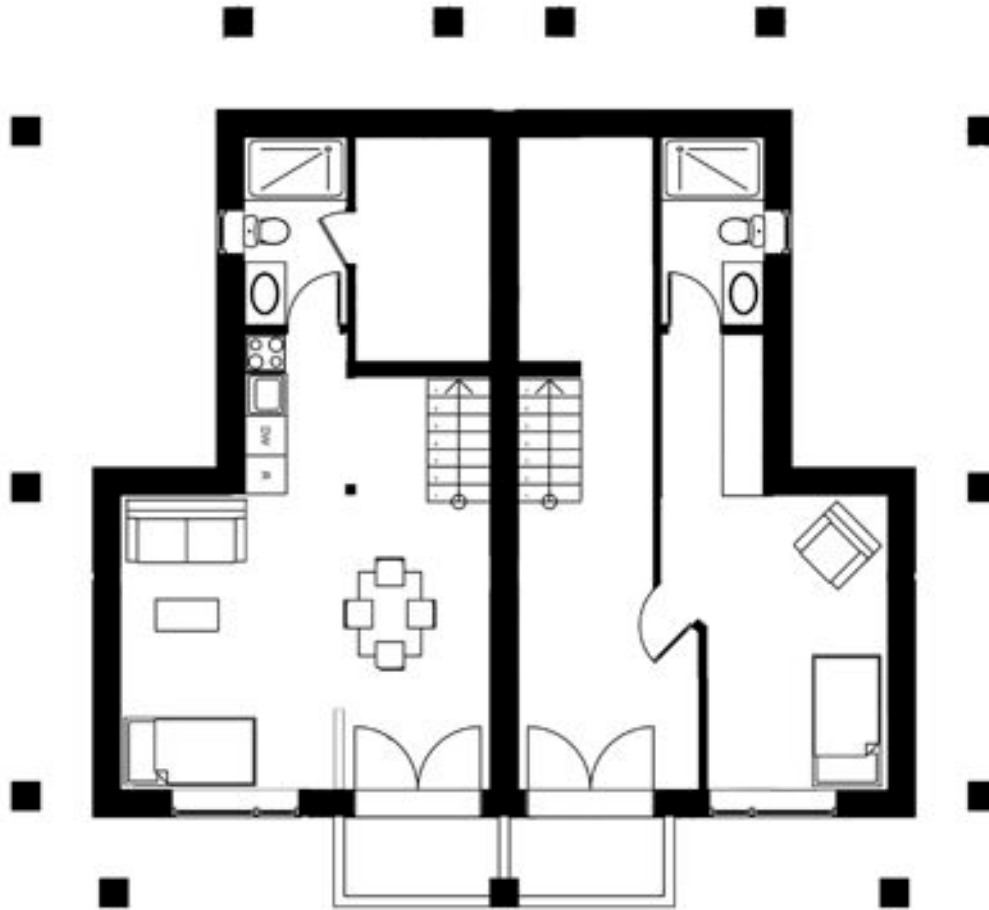


Final Schematic



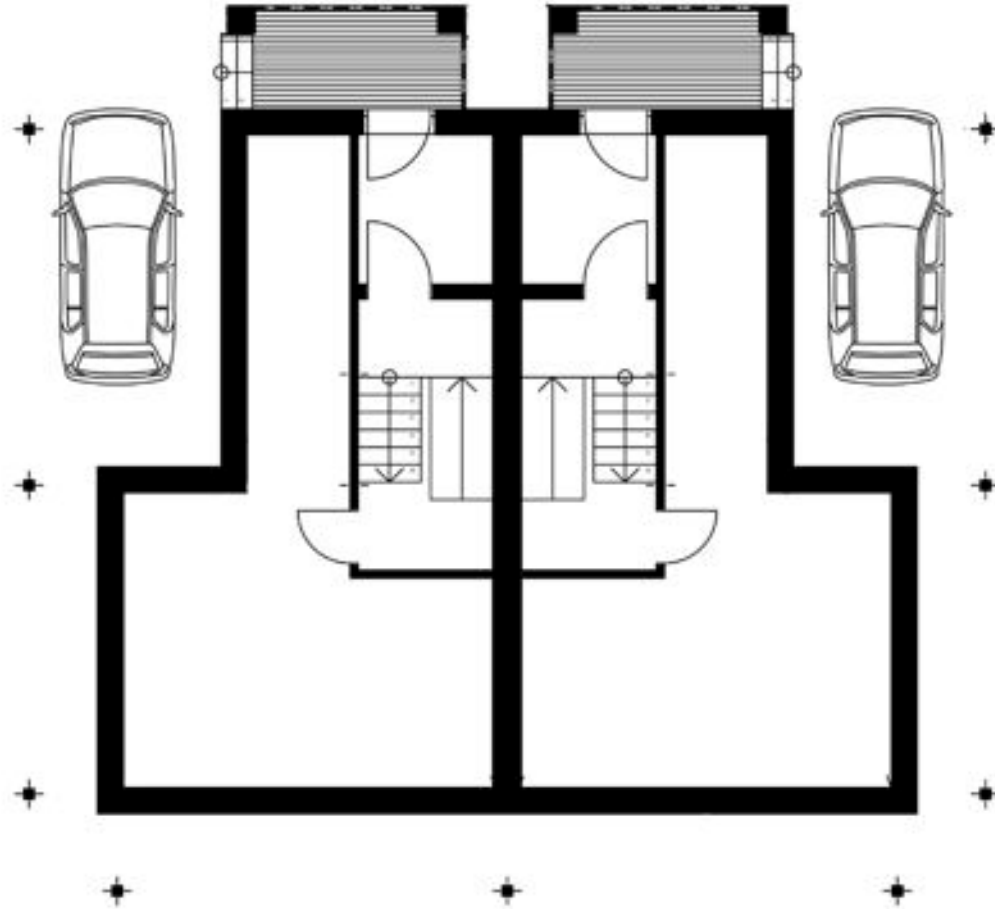


Plan



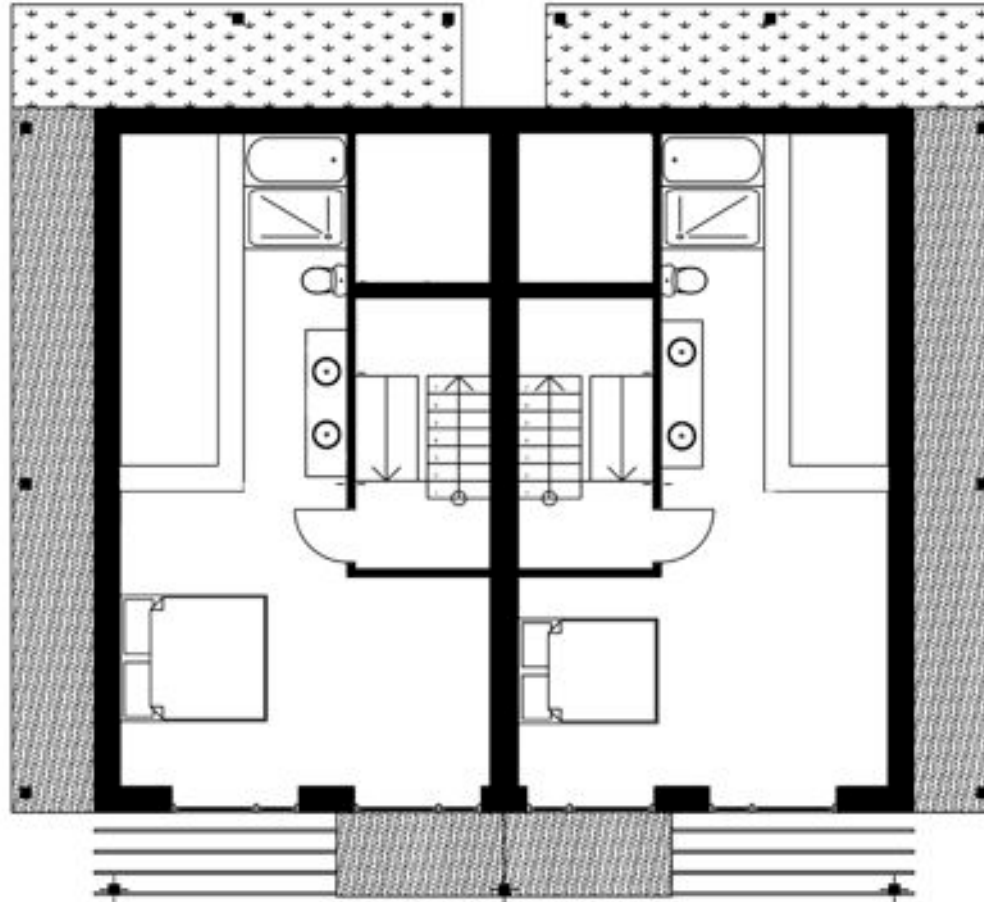


Plan



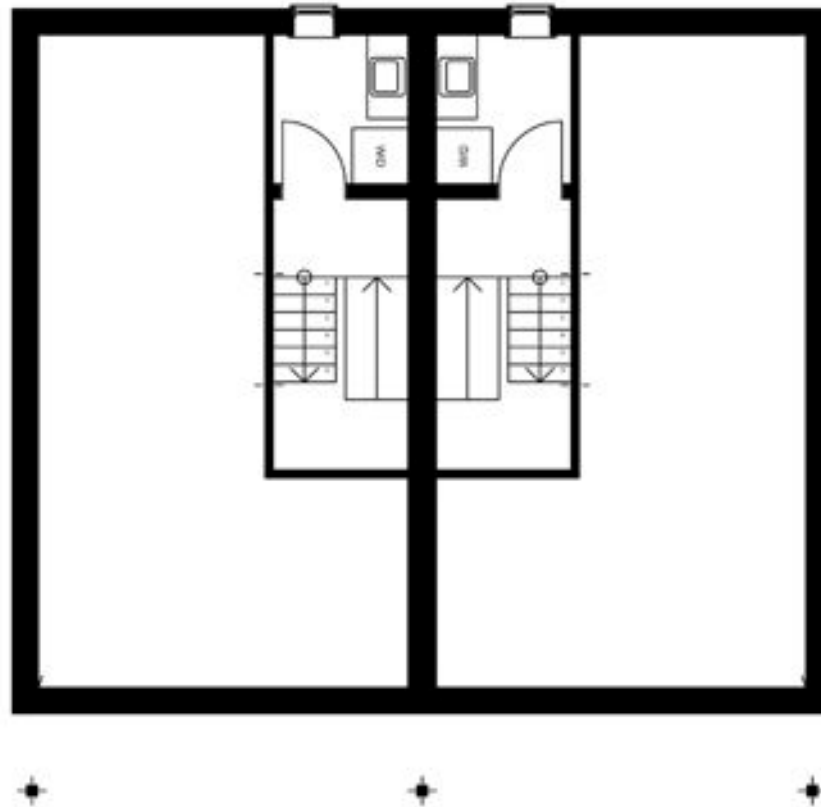


Plan



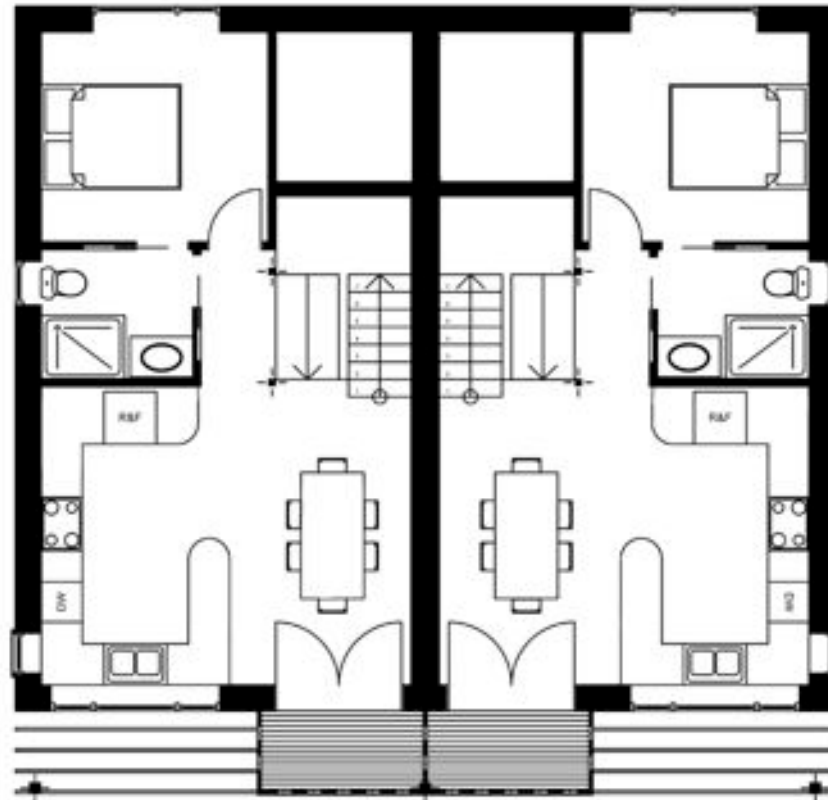


Plan





Plan



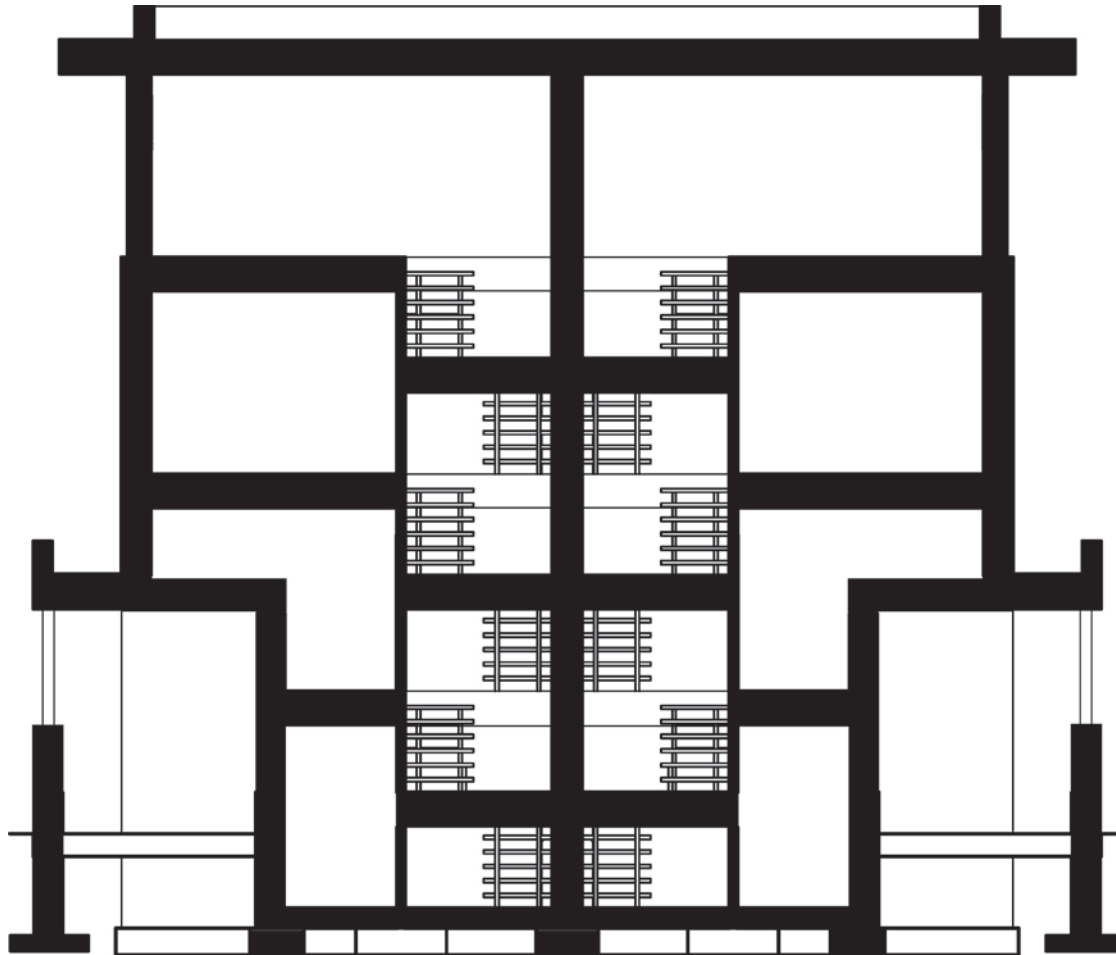


Plan



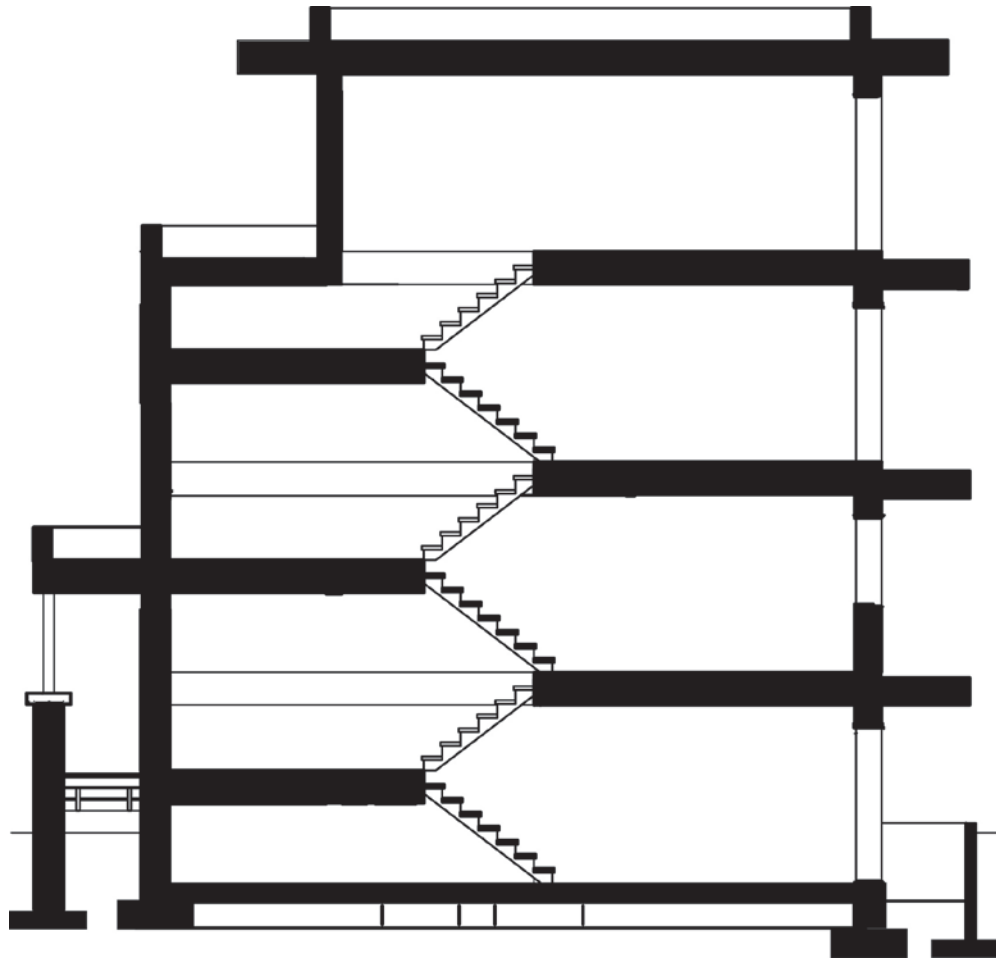


Section





Section





Part One: Initialed Evaluation

Modeled Results



Initial Results

Energy Demands with Reference to the Treated Floor Area				
Treated Floor Area	3536	ft ²		
	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	6.08	kBTU/(ft ² ·yr)	4.75 kBTU/(ft ² ·yr)	No
Pressurization Test Result:	0.60	ACH ₅₀	0.6 ACH ₅₀	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	35.4	kBTU/(ft ² ·yr)	38.0 kBTU/(ft ² ·yr)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	16.4	kBTU/(ft ² ·yr)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	0.0	kBTU/(ft ² ·yr)		
Heating Load:		BTU/(ft ² ·hr)		
Frequency of Overheating:	7	%	over 77.0 °F	
Specific Useful Cooling Energy Demand:		kBTU/(ft ² ·yr)	4.75 kBTU/(ft ² ·yr)	
Cooling Load:		BTU/(ft ² ·hr)		



Better Results

Energy Demands with Reference to the Treated Floor Area				
Treated Floor Area:	3536 ft ²		PH Certificate:	Fulfilled?
	Applied:	Monthly Method		
Specific Space Heat Demand:	4.75	kBTU/(ft ² yr)	4.75 kBTU/(ft ² yr)	Yes
Pressurization Test Result:	0.55	ACH ₅₀	0.6 ACH ₅₀	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	32.1	kBTU/(ft ² yr)	38.0 kBTU/(ft ² yr)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	14.7	kBTU/(ft ² yr)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	0.0	kBTU/(ft ² yr)		
Heating Load:	6.00	BTU/(ft ² hr)		
Frequency of Overheating:	6	%	over 77.0 °F	
Specific Useful Cooling Energy Demand:		kBTU/(ft ² yr)	4.75 kBTU/(ft ² yr)	
Cooling Load:	1.95	BTU/(ft ² hr)		

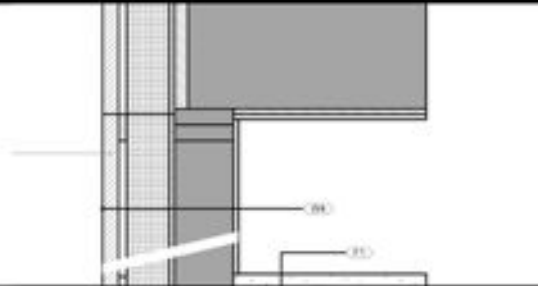
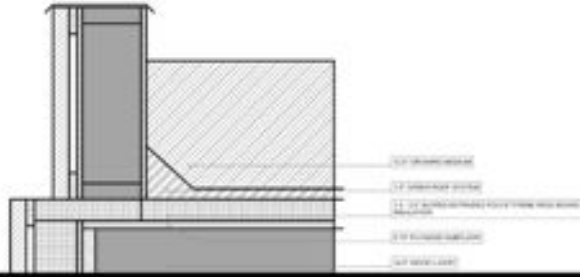


Part Two: Continued Evaluation

Thermal Bridging

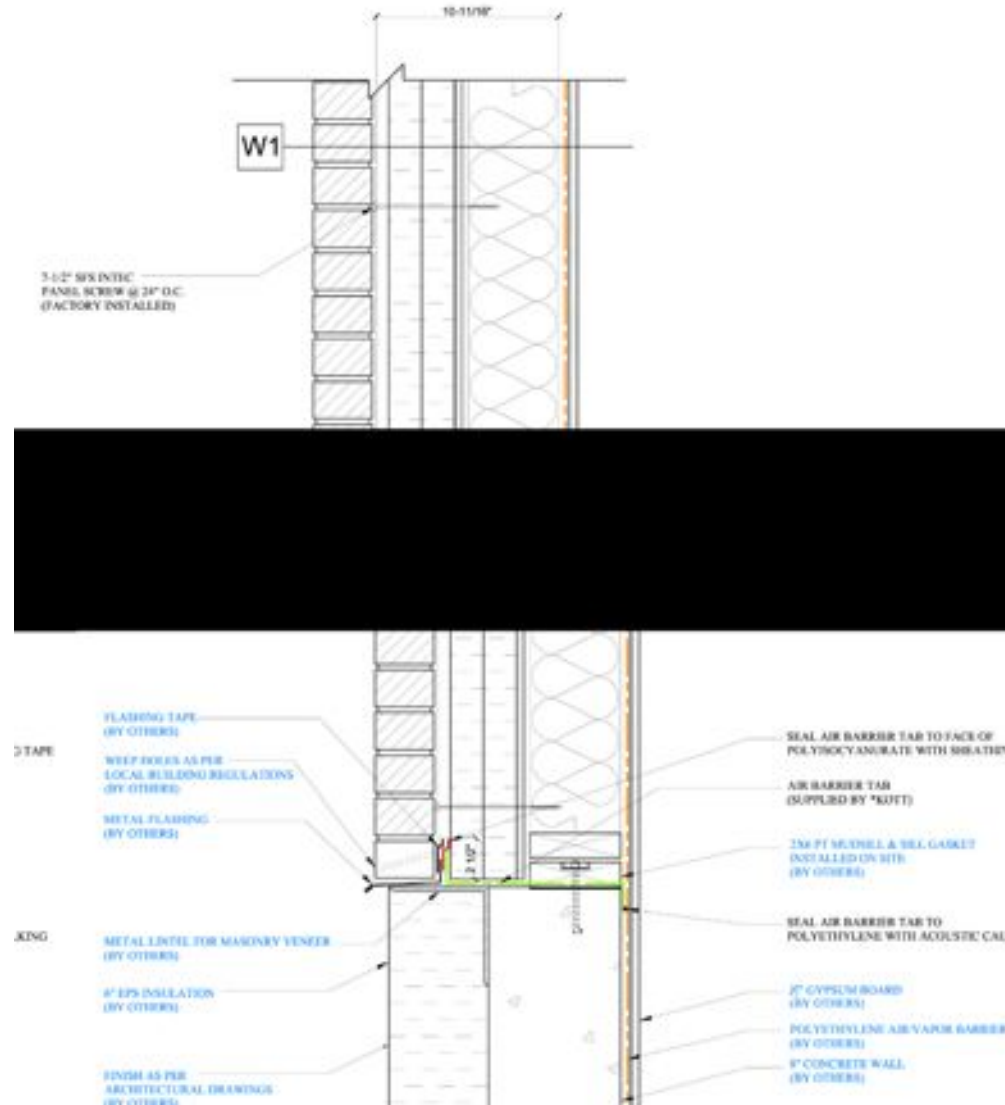


Section



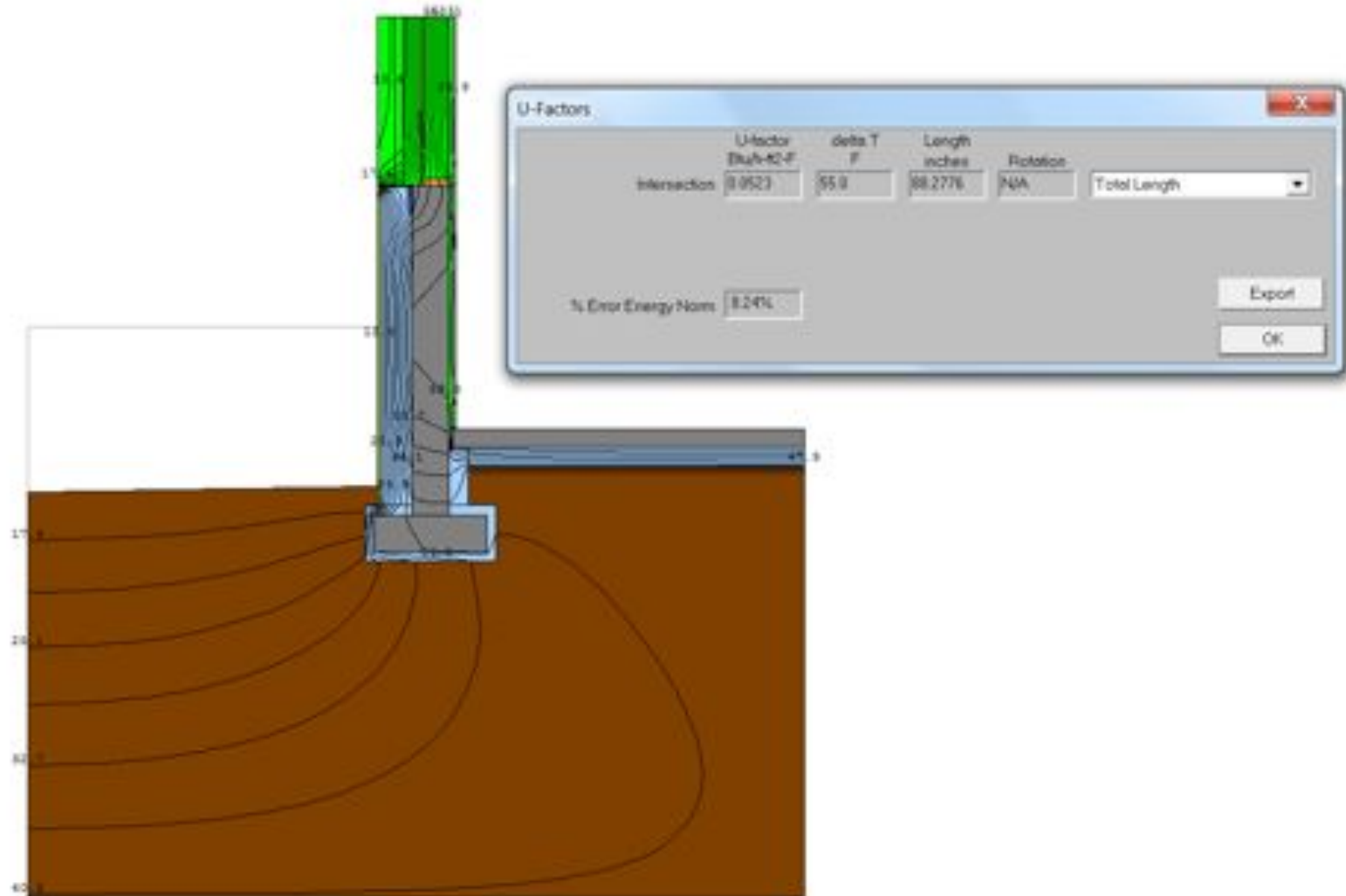


Section



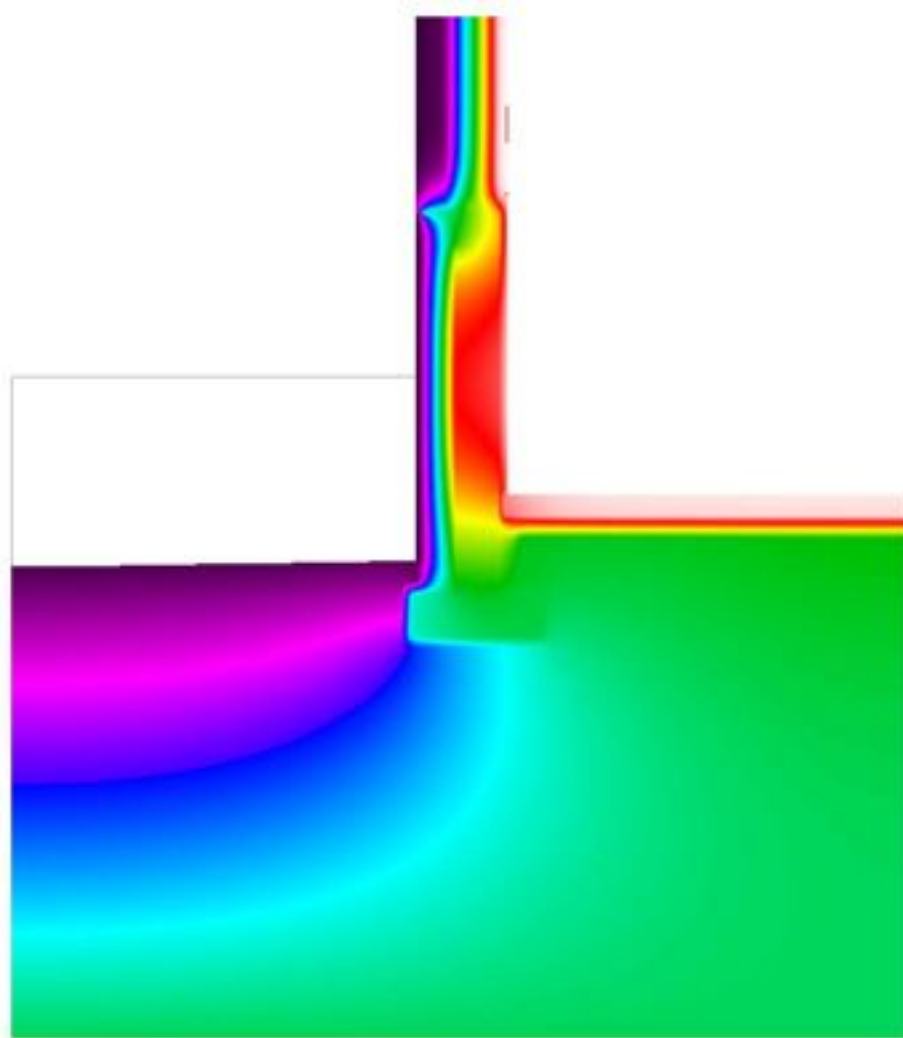


THERM Model





THERM Model





THERM Results

Energy Demands with Reference to the Treated Floor Area				
Treated Floor Area:	<input type="text" value="3536"/>	ft ²		
	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	5.57	kBTU/(ft ² yr)	4.75 kBTU/(ft ² yr)	No
Pressurization Test Result:	0.55	ACH ₅₀	0.6 ACH ₅₀	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	32.8	kBTU/(ft ² yr)	38.0 kBTU/(ft ² yr)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	15.4	kBTU/(ft ² yr)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	0.0	kBTU/(ft ² yr)		
Heating Load:	6.32	BTU/(ft ² hr)		
Frequency of Overheating:	6	%	over <input type="text" value="77.0"/>	<input type="text" value="°F"/>
Specific Useful Cooling Energy Demand:		kBTU/(ft ² yr)	4.75 kBTU/(ft ² yr)	<input type="text"/>
Cooling Load:	1.95	BTU/(ft ² hr)		



Part Two: Continued Evaluation

Shading



Shading – Iteration One

Additional Shading

- Top Floor None
- 3rd Floor Only on East/West
- 2nd Floor Only on East/West
- Bottom Floor None



Shading – Iteration Two

Additional Shading

- Top Floor 96%
- 3rd Floor 94%
- 2nd Floor 68%
- Bottom Floor 42%



Shading – Iteration Two





Shading – Iteration Two

Energy Demands with Reference to the Treated Floor Area				
Treated Floor Area:	3536 ft ²		PH Certificate:	Fulfilled?
	Applied:	Monthly Method		
Specific Space Heat Demand:	6.64	kBTU/(ft ² yr)	4.75 kBTU/(ft ² yr)	No
Pressurization Test Result:	0.55	ACH ₅₀	0.6 ACH ₅₀	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	33.5	kBTU/(ft ² yr)	38.0 kBTU/(ft ² yr)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	16.1	kBTU/(ft ² yr)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	0.0	kBTU/(ft ² yr)		
Heating Load:	6.19	BTU/(ft ² hr)		
Frequency of Overheating:	6	%	over 77.0 °F	
Specific Useful Cooling Energy Demand:		kBTU/(ft ² yr)	4.75 kBTU/(ft ² yr)	
Cooling Load:	1.95	BTU/(ft ² hr)		



Shading – Iteration Three

Energy Demands with Reference to the Treated Floor Area				
Treated Floor Area:	3536	ft ²		
	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	6.18	kBTU/(ft ² ·yr)	4.75 kBTU/(ft ² ·yr)	No
Pressurization Test Result:	0.55	ACH ₅₀	0.6 ACH ₅₀	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	33.1	kBTU/(ft ² ·yr)	38.0 kBTU/(ft ² ·yr)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	15.7	kBTU/(ft ² ·yr)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	0.0	kBTU/(ft ² ·yr)		
Heating Load:	6.14	BTU/(ft ² ·hr)		
Frequency of Overheating:	8	%	over 77.0 °F	
Specific Useful Cooling Energy Demand:		kBTU/(ft ² ·yr)	4.75 kBTU/(ft ² ·yr)	
Cooling Load:	2.07	BTU/(ft ² ·hr)		



Part Two: Continued Evaluation

Windows



Windows

	Type			
#	Glazing	SHGC	U _{cog} -Value	R _{cog} -Value
			BTU/hr.ft ² .F	hr.ft ² .F/BTU
1	INLINE	0.606	0.19	5.36
2				

	Type	U _f -Value	R _f -Value	Frame Dimensions				Thermal Bridge	Thermal Bridge
Assembly #	Frame	Frame	Frame	Width - Left	Width - Right	Width - Below	Width - Above	Ψ _{Spacer}	Ψ _{Installation}
		BTU/hr.ft ² .F	hr.ft ² .F/BTU	in	in	in	in	BTU/hr.ft. ² .F	BTU/hr.ft. ² .F
1	INLINE 300	0.28	3.57	2.375	2.375	2.375	2.375	0.020	0.025
2									



Windows

	Type			
#	Glazing	SHGC	U _{cog} -Value	R _{cog} -Value
			BTU/hr.ft ² .F	hr.ft ² .F/BTU
1	From Inline Specs	0.601	0.16	6.37
2				
3				

Assembly #	Type	U _f -Value	R _f -Value	Frame Dimensions				Thermal Bridge	Thermal Bridge
	Frame	Frame	Frame	Width - Left	Width - Right	Width - Below	Width - Above	Ψ _{Spacer}	Ψ _{Installation}
		BTU/hr.ft ² .F	hr.ft ² .F/BTU	in	in	in	in	BTU/hr.ft.*F	BTU/hr.ft.*F
1	Inline 700F	0.24	4.10	2.375	2.375	2.375	2.375	0.000	0.025
2	Inline 700C	0.55	1.83	2.375	2.375	2.375	2.375	0.000	0.025
3	Inline 300	0.52	1.92	2.375	2.375	2.375	2.375	0.000	0.025
4									
5									



Windows

Energy Demands with Reference to the Treated Floor Area				
Treated Floor Area:	3536 ft ²		PH Certificate:	Fulfilled?
	Applied:	Monthly Method		
Specific Space Heat Demand:	4.85	kBTU/(ft ² ·yr)	4.75 kBTU/(ft ² ·yr)	No
Pressurization Test Result:	0.58	ACH ₅₀	0.6 ACH ₅₀	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	32.2	kBTU/(ft ² ·yr)	38.0 kBTU/(ft ² ·yr)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	14.8	kBTU/(ft ² ·yr)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	0.0	kBTU/(ft ² ·yr)		
Heating Load:	5.88	BTU/(ft ² ·hr)		
Frequency of Overheating:	6	%	over 77.0 °F	
Specific Useful Cooling Energy Demand:		kBTU/(ft ² ·yr)	4.75 kBTU/(ft ² ·yr)	
Cooling Load:	1.89	BTU/(ft ² ·hr)		



Part Two: Continued Evaluation

Heat Recovery



Heat Recovery



Lifebreath unit
Rated at 88%
efficiency

76% was used in
the PHPP



Heat Recovery – 88%

Energy Demands with Reference to the Treated Floor Area					
	Treated Floor Area:	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	3536 ft ²	4.01	kBTU/(ft ² ·yr)	4.75 kBTU/(ft ² ·yr)	Yes
Pressurization Test Result:		0.55	ACH ₅₀	0.6 ACH ₅₀	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		31.6	kBTU/(ft ² ·yr)	38.0 kBTU/(ft ² ·yr)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		14.1	kBTU/(ft ² ·yr)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		0.0	kBTU/(ft ² ·yr)		
Heating Load:		5.68	BTU/(ft ² ·hr)		
Frequency of Overheating:		6	%	over 77.0 °F	
Specific Useful Cooling Energy Demand:			kBTU/(ft ² ·yr)	4.75 kBTU/(ft ² ·yr)	
Cooling Load:		1.95	BTU/(ft ² ·hr)		



Heat Recovery -83%

Energy Demands with Reference to the Treated Floor Area					
	Treated Floor Area:	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	3536	4.32	kBTU/(ft ² ·yr)	4.75 kBTU/(ft ² ·yr)	Yes
Pressurization Test Result:		0.55	ACH ₅₀	0.6 ACH ₅₀	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		31.8	kBTU/(ft ² ·yr)	38.0 kBTU/(ft ² ·yr)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		14.4	kBTU/(ft ² ·yr)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		0.0	kBTU/(ft ² ·yr)		
Heating Load:		5.81	BTU/(ft ² ·hr)		
Frequency of Overheating:		6	%	over 77.0 °F	
Specific Useful Cooling Energy Demand:			kBTU/(ft ² ·yr)	4.75 kBTU/(ft ² ·yr)	
Cooling Load:		1.95	BTU/(ft ² ·hr)		



Heat Recovery – 92%

Energy Demands with Reference to the Treated Floor Area				
Treated Floor Area:	3536 ft ²		PH Certificate:	Fulfilled?
	Applied:	Monthly Method		
Specific Space Heat Demand:	3.78	kBTU/(ft ² ·yr)	4.75 kBTU/(ft ² ·yr)	Yes
Pressurization Test Result:	0.55	ACH ₅₀	0.6 ACH ₅₀	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	31.4	kBTU/(ft ² ·yr)	38.0 kBTU/(ft ² ·yr)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	13.9	kBTU/(ft ² ·yr)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	0.0	kBTU/(ft ² ·yr)		
Heating Load:	5.58	BTU/(ft ² ·hr)		
Frequency of Overheating:	6	%	over 77.0 °F	
Specific Useful Cooling Energy Demand:		kBTU/(ft ² ·yr)	4.75 kBTU/(ft ² ·yr)	
Cooling Load:	1.95	BTU/(ft ² ·hr)		



Upon Further Review - Results

Worst Case: HR@76%, Lots of Shading, TB's

Energy Demands with Reference to the Treated Floor Area					
	Treated Floor Area:	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	3536 ft ²	7.28	kBTU/(ft ² ·yr)	4.75 kBTU/(ft ² ·yr)	No
Pressurization Test Result:		0.58	ACH ₅₀	0.6 ACH ₅₀	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		34.0	kBTU/(ft ² ·yr)	38.0 kBTU/(ft ² ·yr)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		16.6	kBTU/(ft ² ·yr)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		0.0	kBTU/(ft ² ·yr)		
Heating Load:		6.24	BTU/(ft ² ·hr)		
Frequency of Overheating:		6	%	over 77.0 °F	
Specific Useful Cooling Energy Demand:			kBTU/(ft ² ·yr)	4.75 kBTU/(ft ² ·yr)	
Cooling Load:		1.91	BTU/(ft ² ·hr)		



Upon Further Review - Results

Median Case: HR@ 88%, No Shading Reveals or overhangs

Energy Demands with Reference to the Treated Floor Area				
	Treated Floor Area:	Applied:	Monthly Method	Fulfilled?
Specific Space Heat Demand:	3536	5.99	kBTU/(ft ² ·yr)	No
Pressurization Test Result:		0.58	ACH ₅₀	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		32.9	kBTU/(ft ² ·yr)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		15.5	kBTU/(ft ² ·yr)	
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		0.0	kBTU/(ft ² ·yr)	
Heating Load:		5.89	BTU/(ft ² ·hr)	
Frequency of Overheating:		7	%	
Specific Useful Cooling Energy Demand:			kBTU/(ft ² ·yr)	
Cooling Load:		2.06	BTU/(ft ² ·hr)	

PH Certificate: 4.75 kBTU/(ft²·yr)
0.6 ACH₅₀
38.0 kBTU/(ft²·yr)

over 77.0 °F
4.75 kBTU/(ft²·yr)



Upon Further Review - Results

Better Case: HR@ 88%, No Shading Reveals or overhangs, 6% bonus for negative TB's

Energy Demands with Reference to the Treated Floor Area				
Treated Floor Area:	3536	ft ²		
	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	4.90	kBTU/(ft ² yr)	4.75 kBTU/(ft ² yr)	No
Pressurization Test Result:	0.58	ACH ₅₀	0.6 ACH ₅₀	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	32.1	kBTU/(ft ² yr)	38.0 kBTU/(ft ² yr)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	14.6	kBTU/(ft ² yr)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	0.0	kBTU/(ft ² yr)		
Heating Load:	5.91	BTU/(ft ² hr)		
Frequency of Overheating:	7	%	over 77.0 °F	
Specific Useful Cooling Energy Demand:		kBTU/(ft ² yr)	4.75 kBTU/(ft ² yr)	
Cooling Load:	2.54	BTU/(ft ² hr)		



Upon Further Review - Results

Best Case: HR@ 92%, No Shading Reveals or overhangs, 6% bonus for negative TB's

Energy Demands with Reference to the Treated Floor Area				
Treated Floor Area:	3536	ft ²		
	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	4.65	kBTU/(ft ² yr)	4.75 kBTU/(ft ² yr)	Yes
Pressurization Test Result:	0.58	ACH ₅₀	0.6 ACH ₅₀	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	31.9	kBTU/(ft ² yr)	38.0 kBTU/(ft ² yr)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	14.4	kBTU/(ft ² yr)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	0.0	kBTU/(ft ² yr)		
Heating Load:	5.81	BTU/(ft ² hr)		
Frequency of Overheating:	7	%	over 77.0 °F	
Specific Useful Cooling Energy Demand:		kBTU/(ft ² yr)	4.75 kBTU/(ft ² yr)	
Cooling Load:	2.54	BTU/(ft ² hr)		



Part Three: Performance

Quality Assurance and Control



Conclusions

- Important:
 - Verify Details
 - Know your climate
 - There are still things we need to work on
 - **Quality Assurance** of details is **Important**
 - May or may not be a “Passive House” but is still an excellent project where a few key details made a huge amount of difference