BUILDINGENERGY BOSTON

Creating Harmony: Overcoming Challenges in Passive House Multifamily Design

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Curated by Jean Carroon

Northeast Sustainable Energy Association (NESEA) | March 21, 2025

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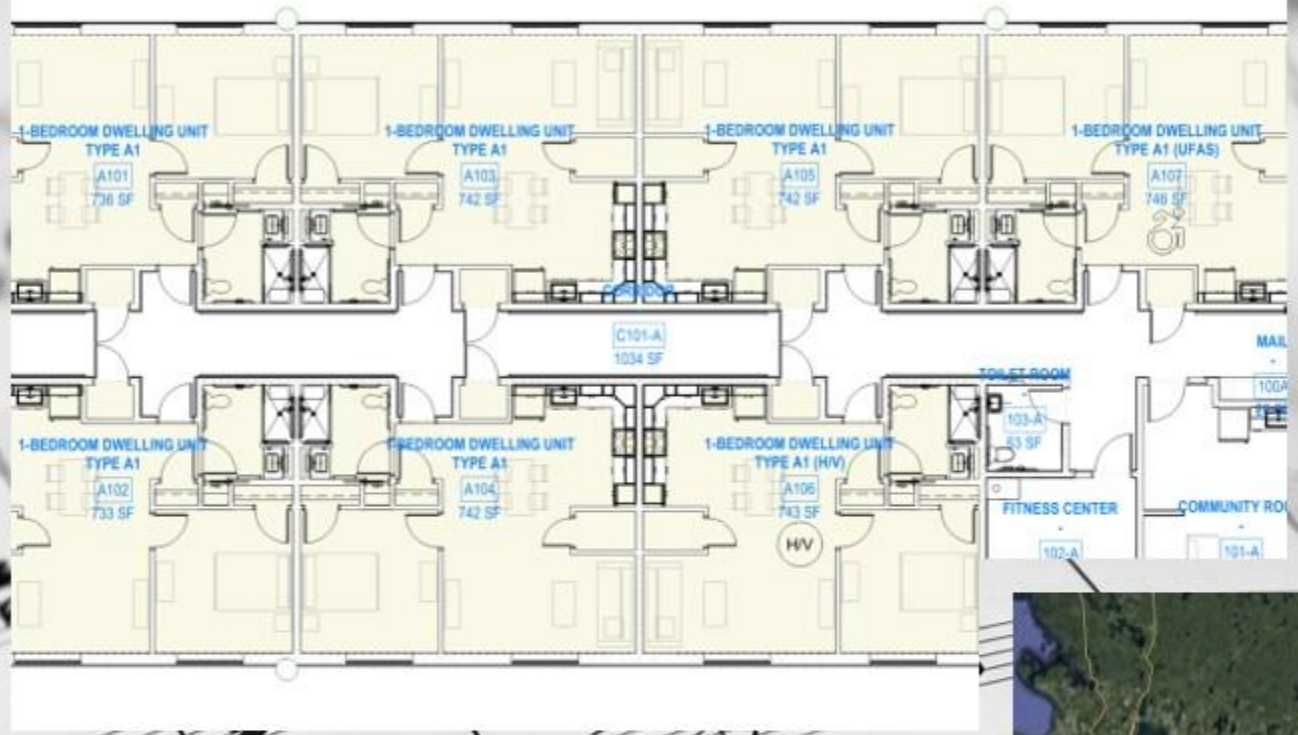
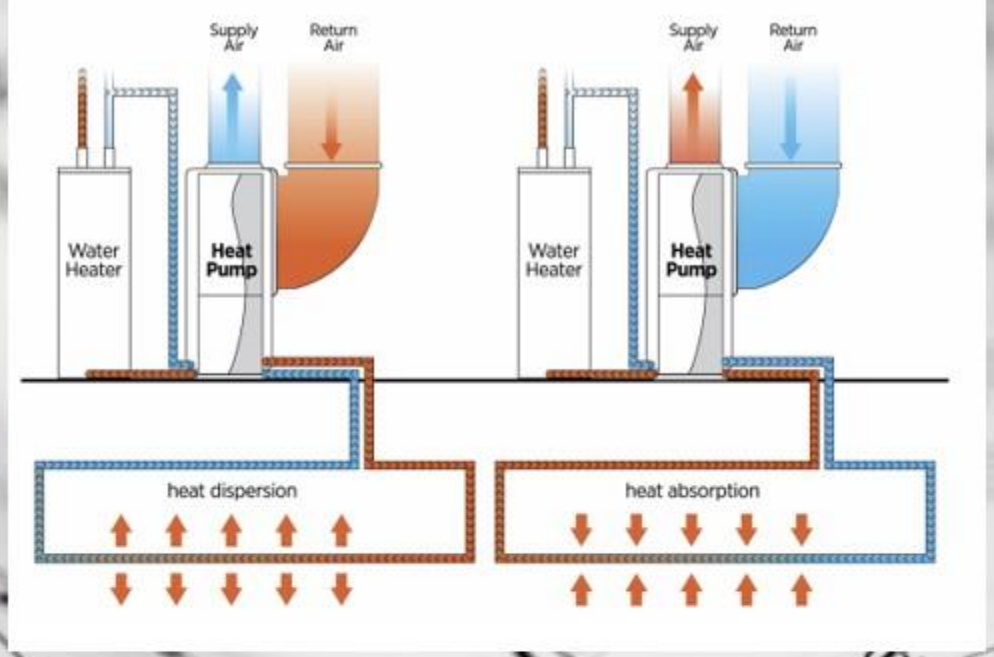
ASHLEY MCGRAW ARCHITECTS

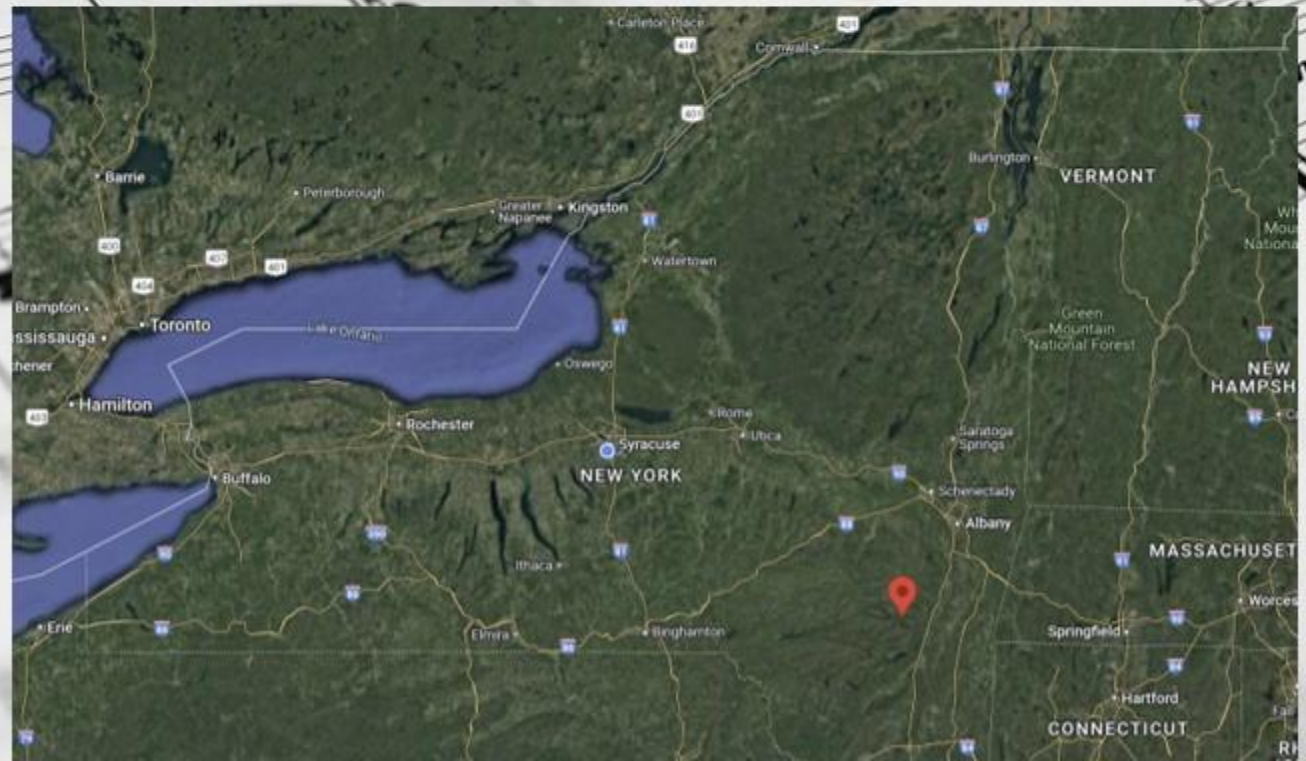
POSITIVE TRACE

phius certified consultant





phius 2021	
Custom Performance Criteria Calculator v3.3	
BUILDING FUNCTION	RESIDENTIAL
Climate Location	TANNERSVILLE, NY | 5A
Envelope Area (sf)	27,858
iCFA (sf)	16,167
Dwelling Units (Count)	15
Total Bedrooms (Count)	15
Space Conditioning Criteria	



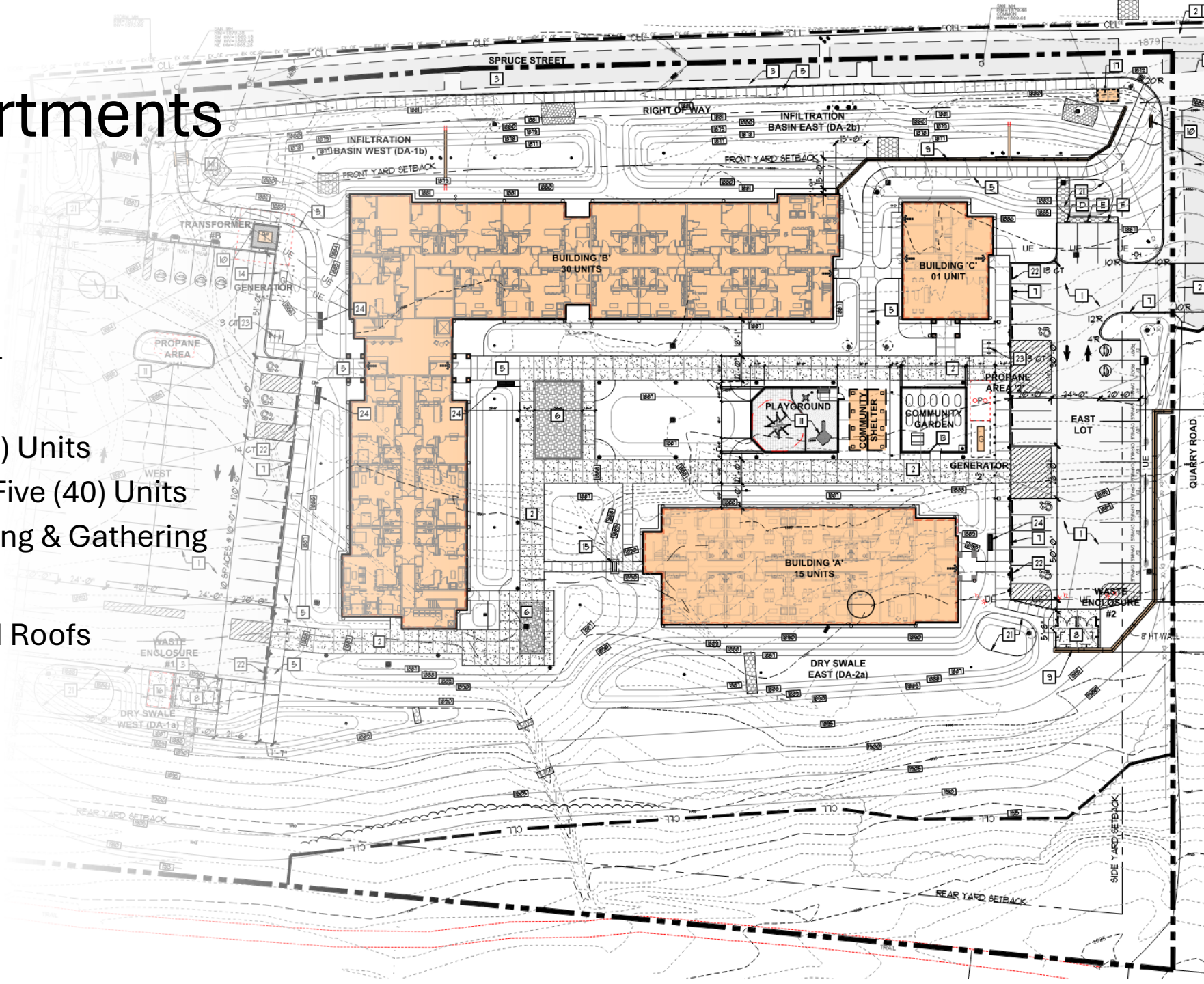
Cold Spring Apartments

Tannersville, New York

Cold Spring Apartments

Tannersville, New York

- 5.1 Acre Site
- 63,000 Gross Square Feet, Total
- Three (3) Buildings
  - Senior Housing: Fifteen (15) Units
  - Workforce Housing: Forty-Five (40) Units
  - Community Building: Leasing & Gathering
- Construction:
  - Two (2) Stories with Gabled Roofs
  - Double Loaded Corridors
  - Slab-on-Grade
  - Wood Framed



The Audience

Regulatory Agencies

NEW YORK STATE | Homes and Community Renewal

NEW YORK STATE | Department of Environmental Conservation

NYC Environmental Protection

PROGRAMS

Downtown Revitalization Initiative

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

phius

ENERGY STAR

EPA Indoor airPLUS

ZERO ENERGY READY HOME
U.S. DEPARTMENT OF ENERGY

LEED® FOR HOMES

The Band

Project Team

RUPCO

ASHLEY MCGRAW ARCHITECTS

POSITIVE TRACE

KGA

RYAN BIGGS CLARK DAVIS ENGINEERING & SURVEYING

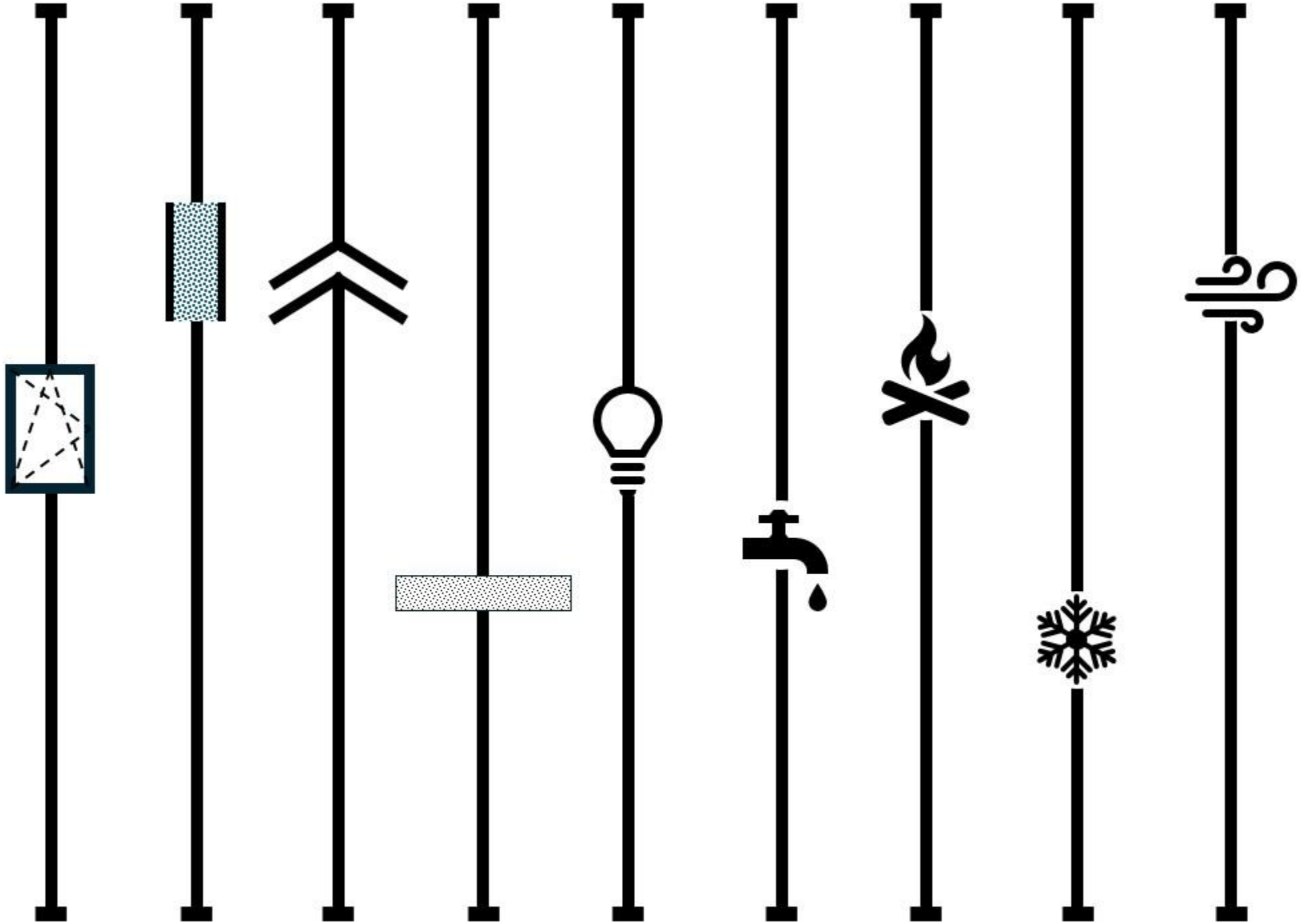
BUFFALO GEOTHERMAL HEATING™ www.BuffaloGeoThermal.com

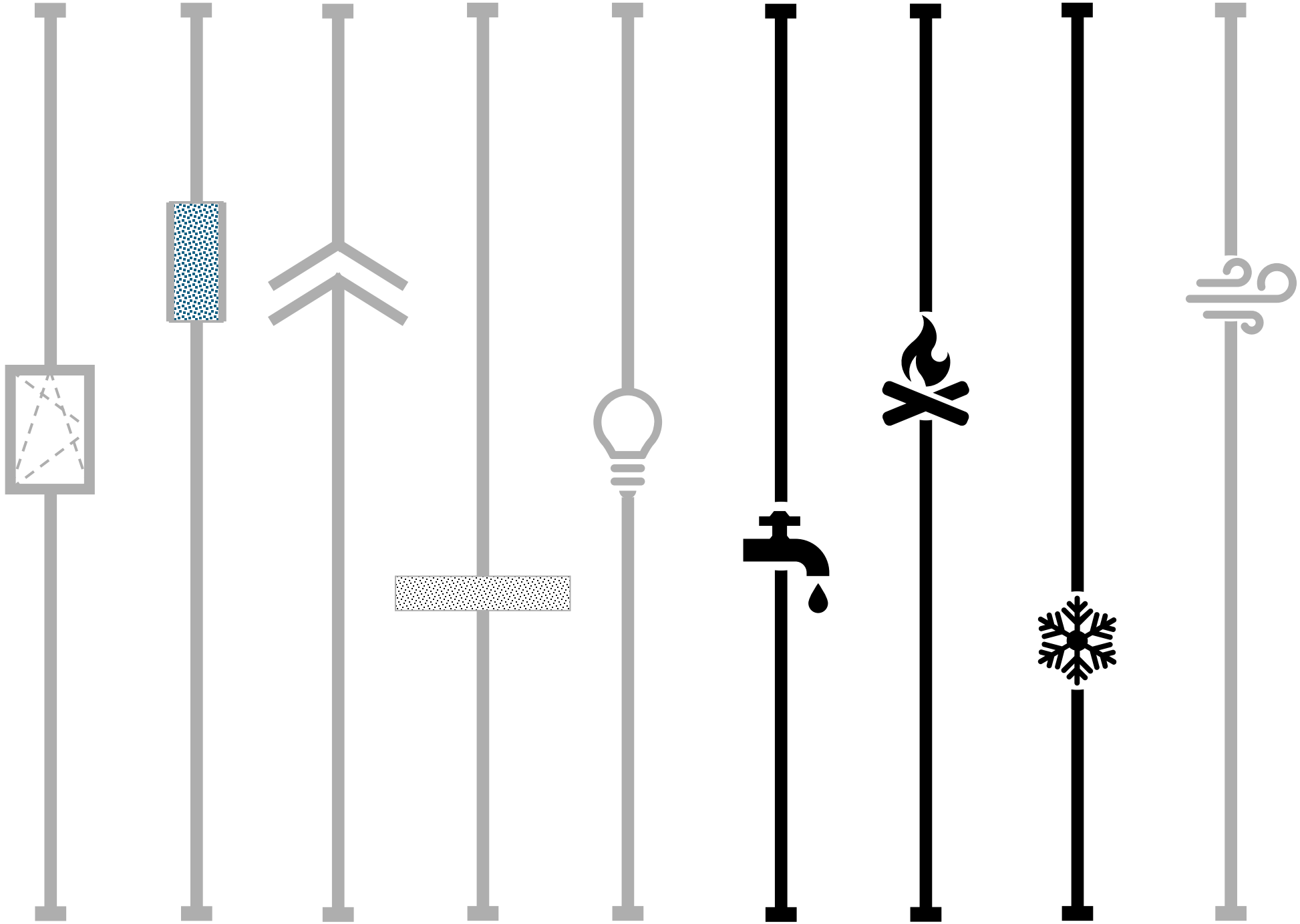
IPD

INTEGRAL BUILDING + DESIGN

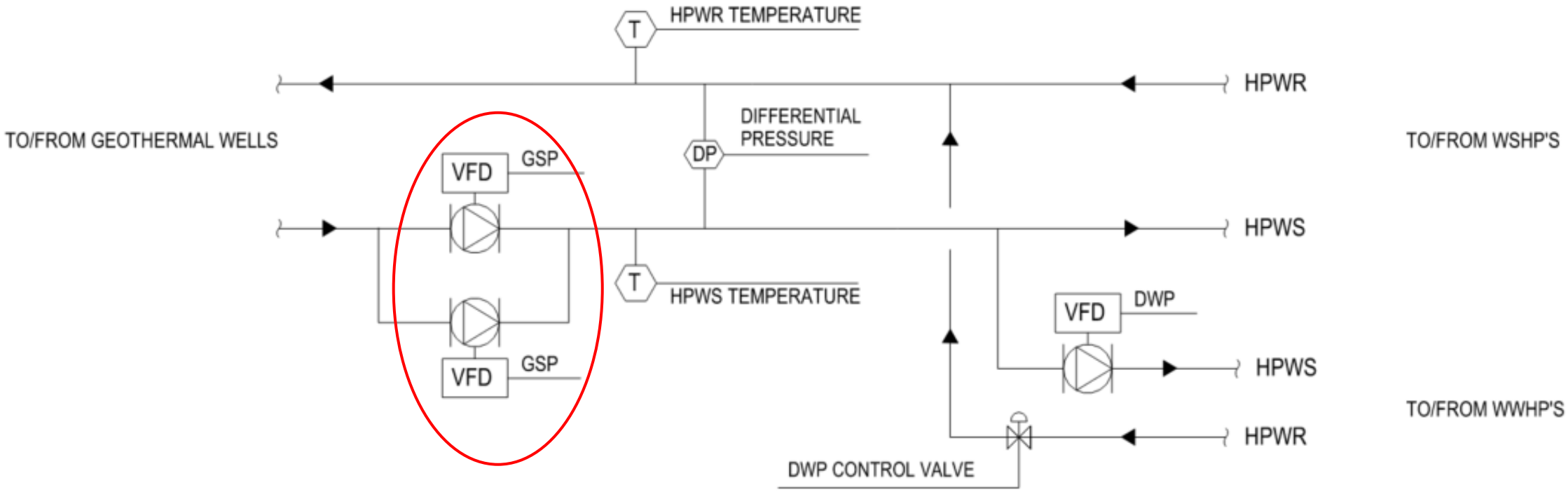

Who are You?


MUTE
MUTE
SOLO
MUTE

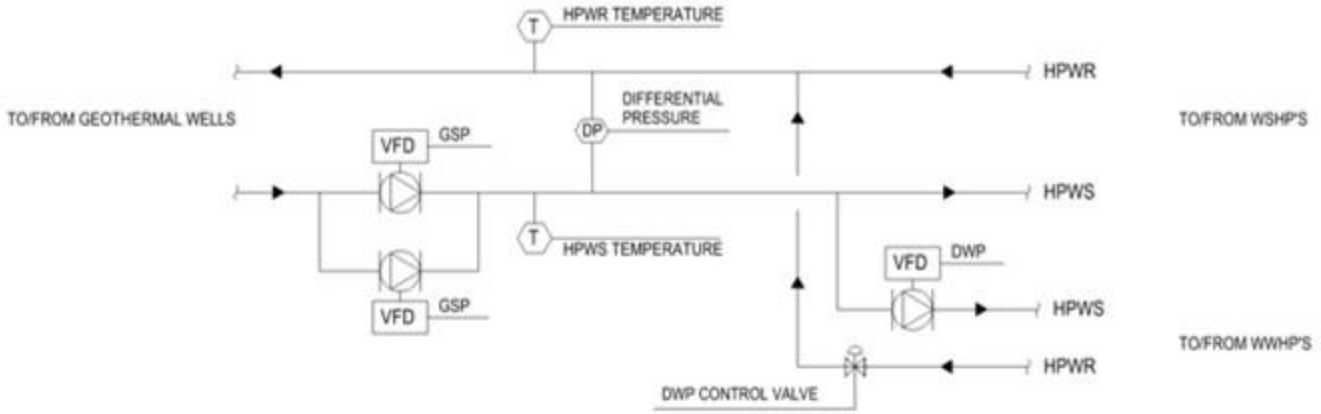




Pumps


T
HPWR TEMPERATURE
HPWR
TO/FROM GEOTHERMAL WELLS
DIFFERENTIAL
PRESSURE
DP
TO/FROM WSHP'S
VFD
GSP
HPWS
T
HPWS TEMPERATURE
VFD
DWP
HPWS
VFD
GSP
TO/FROM WWHP'S
HPWR
DWP CONTROL VALVE

Pumps


HPWR TEMPERATURE
HPWR
TO/FROM GEOTHERMAL WELLS
DIFFERENTIAL PRESSURE
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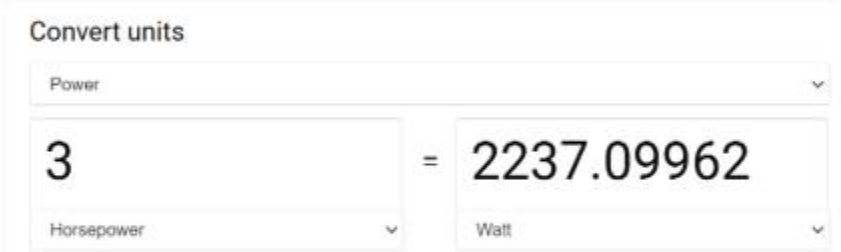
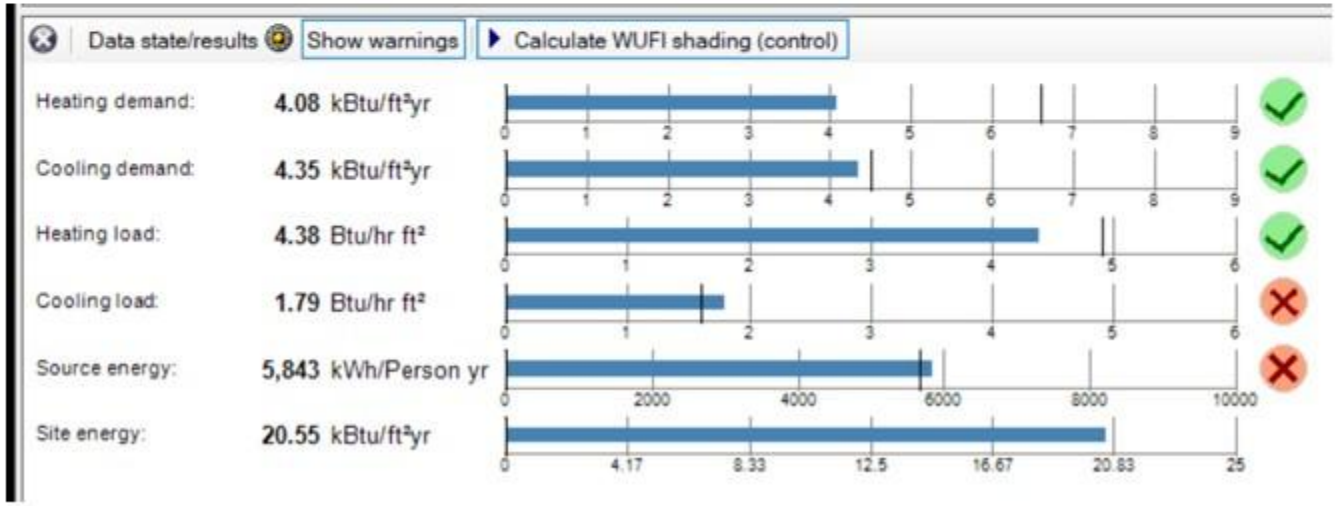
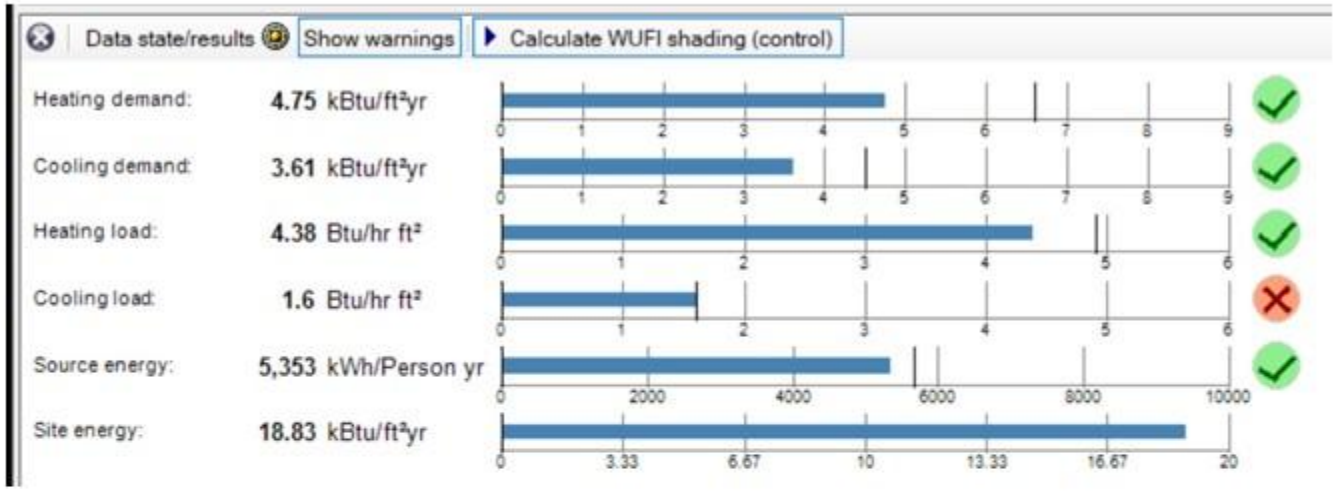
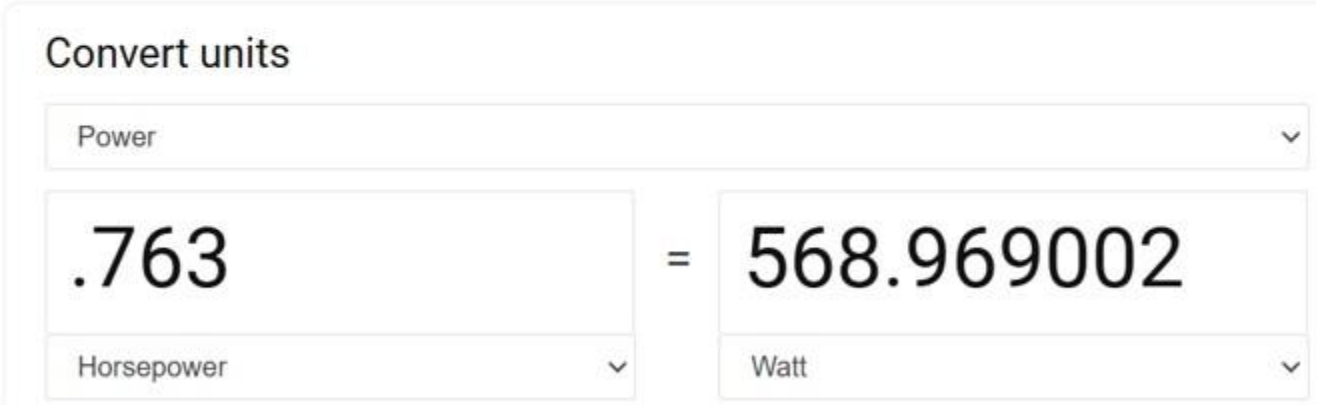
TO/FROM WSHP'S
VFD
GSP
HPWS
HPWS TEMPERATURE
VFD
DWP
VFD
GSP
HPWS
TO/FROM WWHP'S
HPWR
DWP CONTROL VALVE


Convert units
Power
3
Horsepower
=
2237.09962
Watt


Data state/results
Show warnings
Calculate WUFI shading (control)
Heating demand: 4.08 kBtu/ft²yr
Cooling demand: 4.35 kBtu/ft²yr
Heating load: 4.38 Btu/hr ft²
Cooling load: 1.79 Btu/hr ft²
Source energy: 5,843 kWh/Person yr
Site energy: 20.55 kBtu/ft²yr

Smaller Pumps





v24.0.2 - 2024.11

Phius Ground Source Heat Pump Calculator

Required inputs | Calculated cells

Required dropdown menu inputs | Instructions

Device(s)	Qty:	Power [W]		Power [kBtu/hr]		Total Power [kBtu/hr]		Effective Total Power [kBtu/hr]	
		Heating	Cooling	Heating	Cooling	Heating	Cooling	Heating	Cooling
P-SP1	1	569.0	569.0	1.94	1.94	1.94	1.94	0.69	0.49
				-	-				
				-	-			**Complete '*Fan and Pump Run-Time Estimator*' tab to update value above.**	
				-	-				
				-	-				

Phius Heat Pump Calculator

Ground Source Heat Pump Performance Data

Include line items for each unique device type. Only include outdoor compressors and condensing units. Do not include interior heads or air handling units.

Performance data should be provided from the manufacturer or a third party rating like NEEP (https://ashp.neep.org/#!/) or AHRI (https://www.ahridirectory.org/Search/SearchHome?ReturnUrl=%2f). Input data at the design conditions noted below.

Device(s)	Qty:	Heating Data				Cooling Data				
		Capacity [kBtu/hr]	Part Load COP	AND / OR	Full Load COP	Delivery Method	Capacity [kBtu/hr]	Part Load EER	AND / OR	Full Load EER
HP-1: Versatec 500 NB009	3	6.7		AND / OR	3.2	**Recirculation Air**	9.0		AND / OR	12.5
HP-2: Versatec 500 NB012	1	8.1		AND / OR	3.2	**Recirculation Air**	12.4		AND / OR	14.5
HP-3: Versatec 500 NB015	15	10.7		AND / OR	3.8	**Recirculation Air**	14.2		AND / OR	12.2
				AND / OR		**Select**			AND / OR	
				AND / OR		**Select**			AND / OR	
HP6: Versatec 500NC012	4	9.4		AND / OR	3.5	**Recirculation Air**	10.3		AND / OR	11.3

v24.0.2 - 2024.11

Phius Heat Pump Calculator

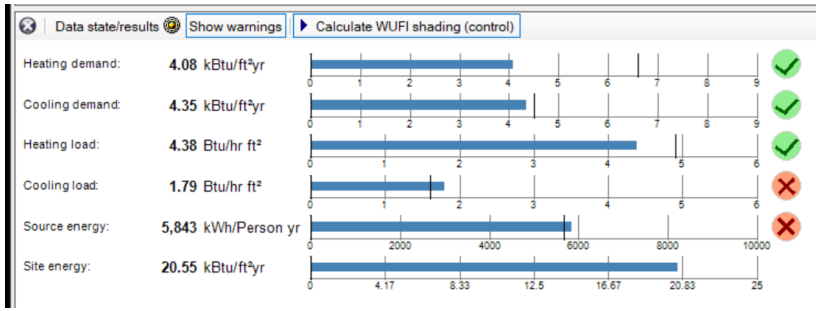
Required inputs	Calculated cells	Results
Required dropdown menu inputs	**Calculated cells from another sheet**	Instructions

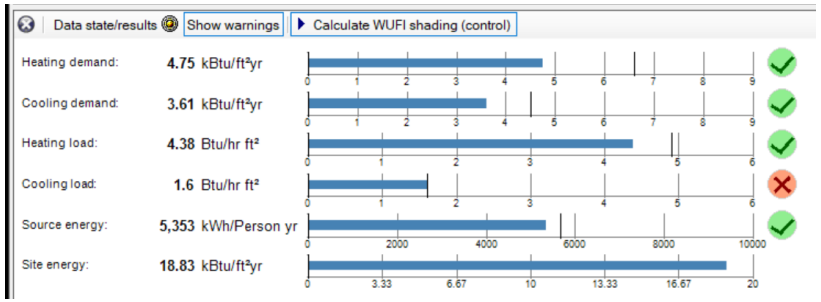
Enter 'System Performance Data' below to attain Results for WUFI Passive.

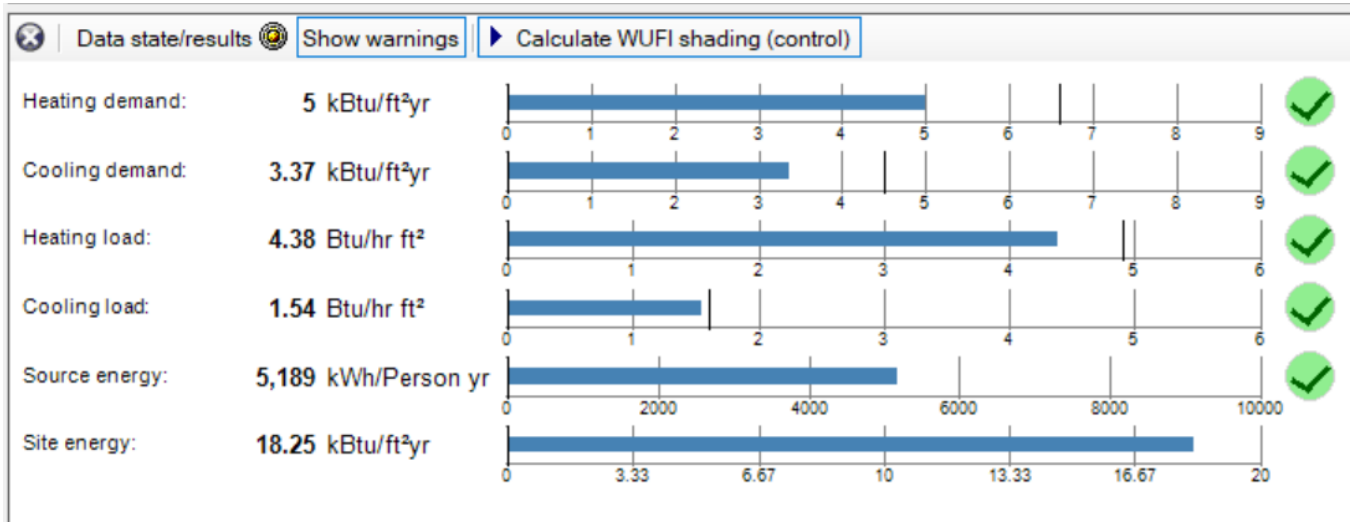
Cooling via Recirculation Air		Units	System > Distribution > Cooling: Check the box for 'Cooling via air recirculation'.
Number of Systems Needed	1		Under Systems > Create the number of systems noted to the left and add a heat pump device to each system.
Space Cooling Coverage	1.00		Assign coverage to each new device created. If coverage is 0.33 (or similar), one input should be adjusted so the coverage sums to 1.
Total Recirculation Air Flow Rate	7316	cfm	Phius assumes 300 cfm of airflow per ton of cooling capacity.
ASHP Cooling Capacity	0	kBtu/hr	Informs the total capacity of the cooling via recirculation ventilation air.
GSHP Cooling Capacity	293		
Total Recirculation Air Cooling Capacity	293		Input the cooling capacity calculated to the left. A ton of cooling is equivalent to 12 kBtu/hr.
Weighted ASHP Cooling COP	0.00		
Weighted GSHP Cooling COP	3.62		
Weighted Recirculation Cooling COP	3.62		The value calculated to the left is the weighted average COP for the cooling system as a whole.

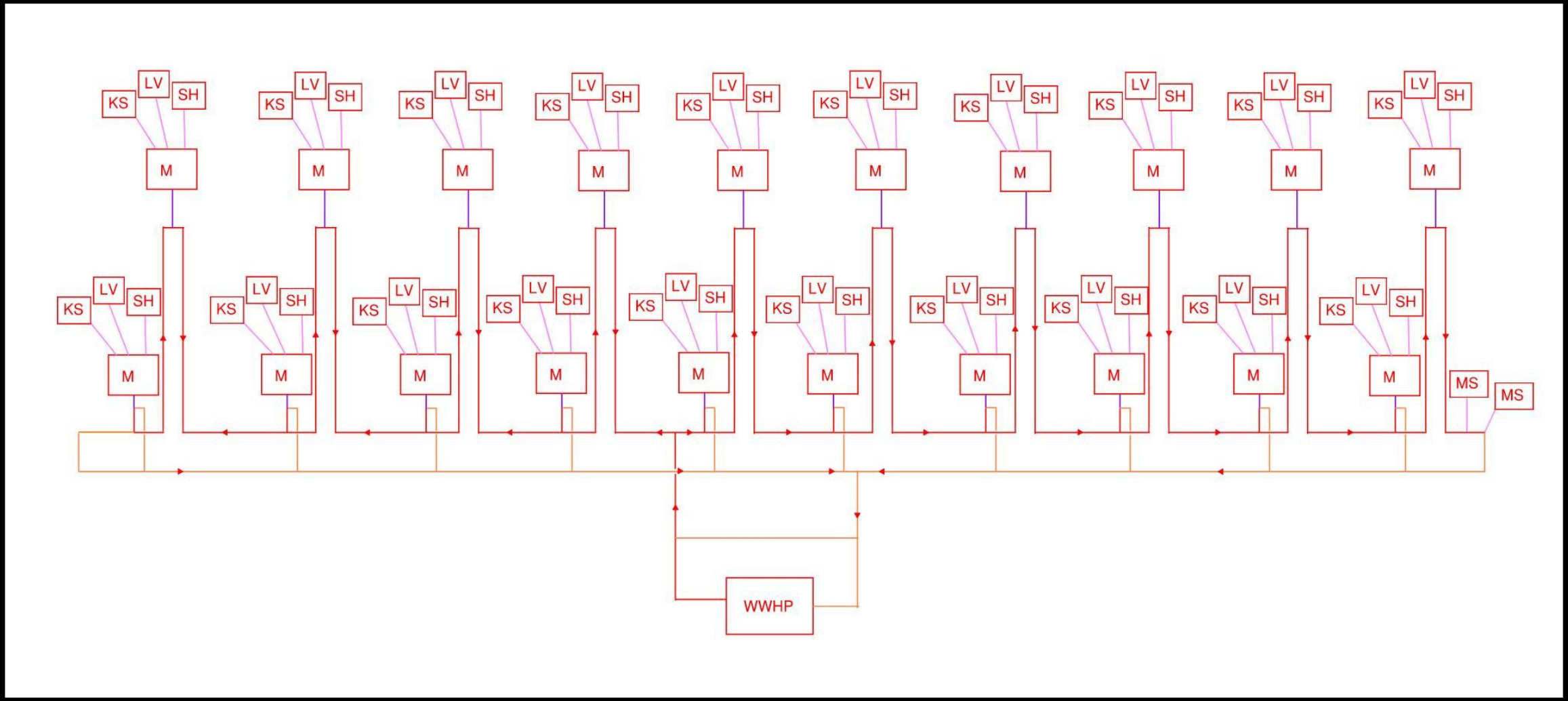
Heat Pump - rated monthly COP: ASHP		Units	If no heating provided via heat pump, no inputs required.
Space Heating Coverage:	0.00		
Weighted ASHP Heating COP 1	-		-
Ambient Temperature 1	17	°F	
Weighted ASHP Heating COP 2	-		
Ambient Temperature 2	47	°F	

Heat Pump: GSHP		Units	If no heating provided via heat pump, no inputs required.
Space Heating Coverage:	1.00		
Weighted GSHP Heating COP	3.71		Under the heat pump device device noted above, set the Type to 'Heat Pump' and input values calculated to the left.
Total System performance ratio of heat generator	0.27		


Data state/results
Show warnings
Calculate WUFI shading (control)
Heating demand: 4.08 kBtu/ft²yr
Cooling demand: 4.35 kBtu/ft²yr
Heating load: 4.38 Btu/hr ft²
Cooling load: 1.79 Btu/hr ft²
Source energy: 5,843 kWh/Person yr
Site energy: 20.55 kBtu/ft²yr


Data state/results
Show warnings
Calculate WUFI shading (control)
Heating demand: 4.75 kBtu/ft²yr
Cooling demand: 3.61 kBtu/ft²yr
Heating load: 4.38 Btu/hr ft²
Cooling load: 1.6 Btu/hr ft²
Source energy: 5,353 kWh/Person yr
Site energy: 18.83 kBtu/ft²yr

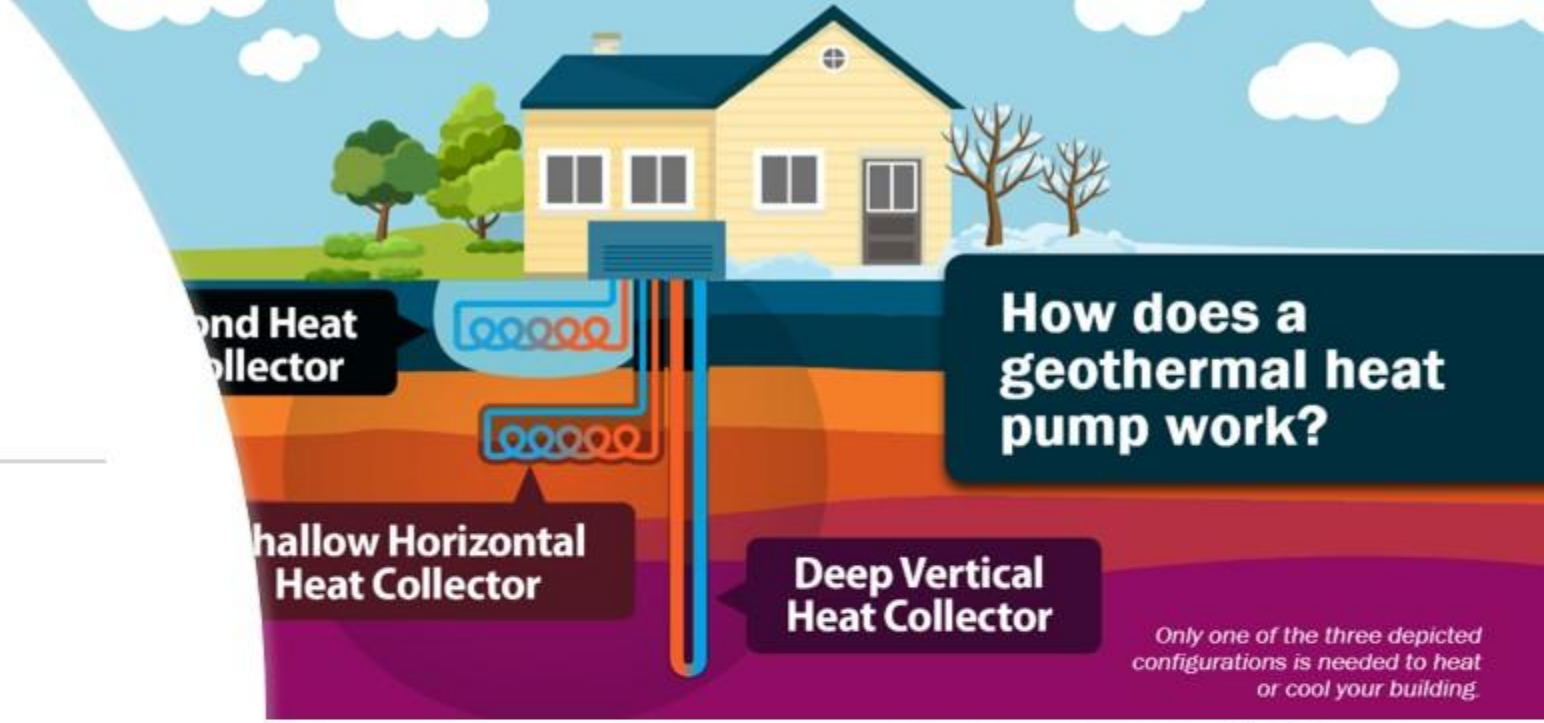

Data state/results
Show warnings
Calculate WUFI shading (control)
Heating demand: 5 kBtu/ft²yr
Cooling demand: 3.37 kBtu/ft²yr
Heating load: 4.38 Btu/hr ft²
Cooling load: 1.54 Btu/hr ft²
Source energy: 5,189 kWh/Person yr
Site energy: 18.25 kBtu/ft²yr

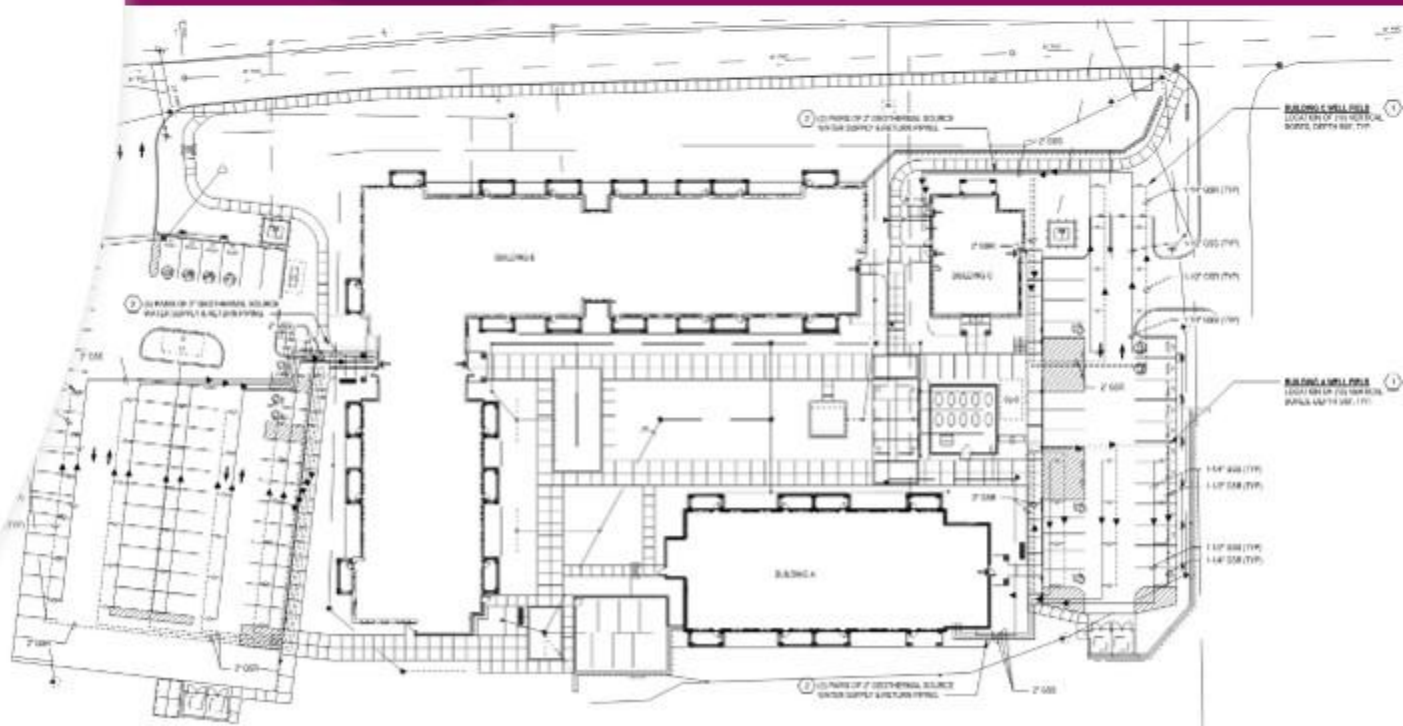


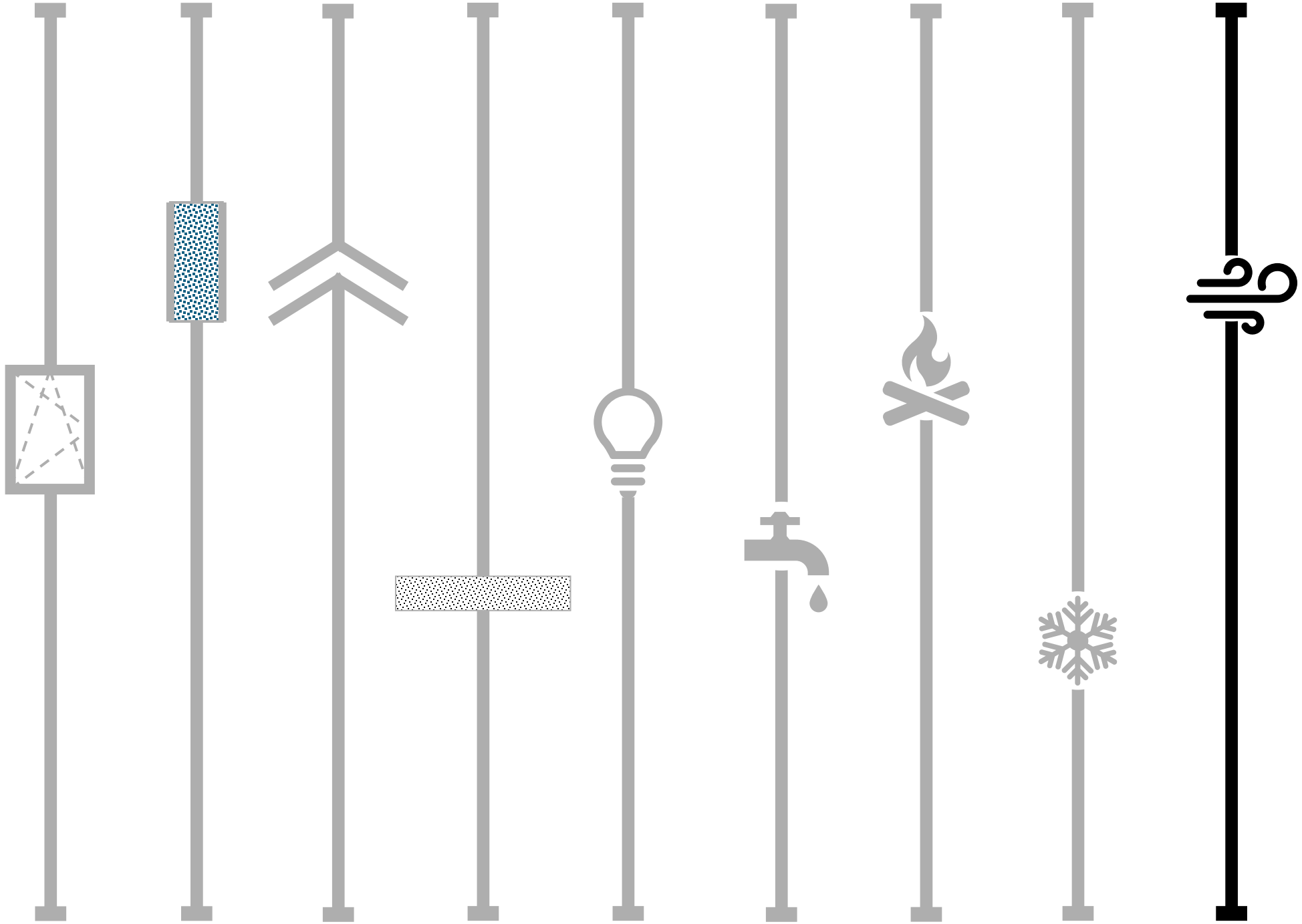
GSHPs - DHW

Theory vs Practice

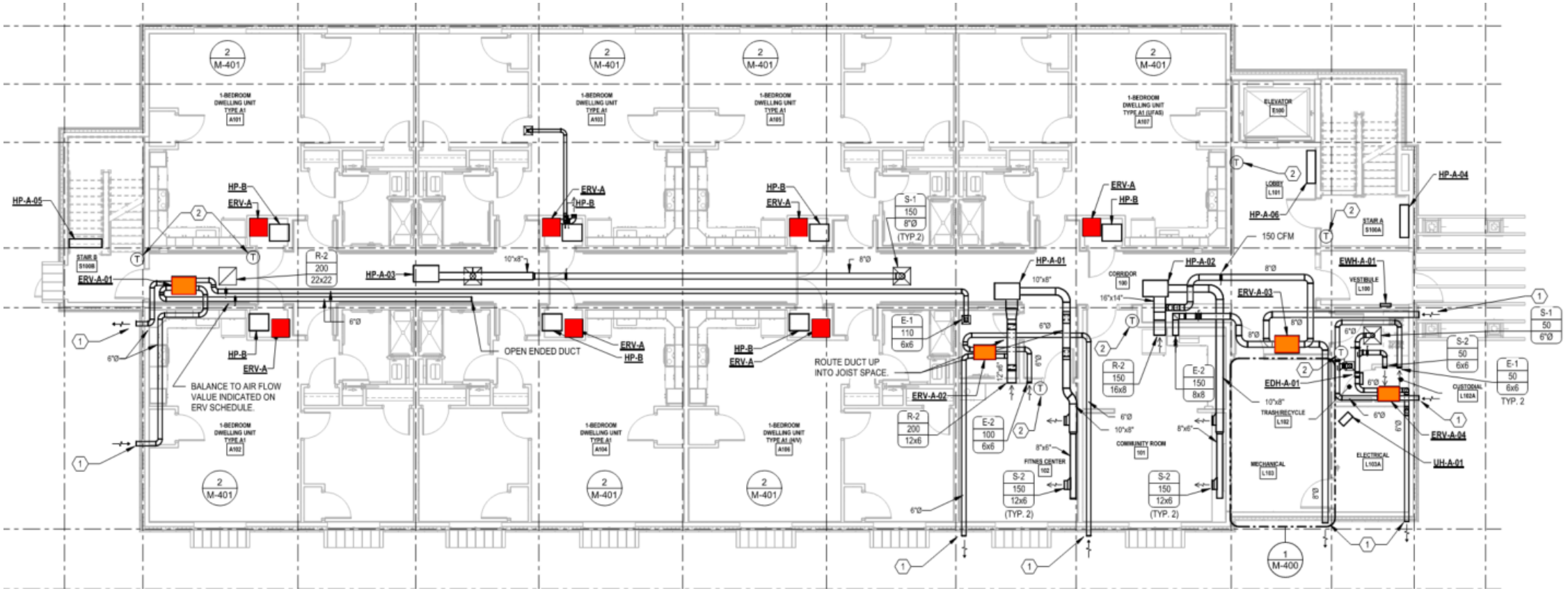
- Ground Source Closed Loop Systems (Exterior vs Interior)
- Measured Design vs Installer Experience
  - Quantity, Depth, & Location of Wells
  - NYS DEC Regulatory Requirements
  - Pipe Size
  - Glycol & Methanol
- Reduce Pumping Power Required







As Designed


HP-A-05
HP-B
ERV-A
ERV-A-01
HP-A-03
R-2
200
22x22
10"x8"
6"Ø
BALANCE TO AIR FLOW VALUE INDICATED ON ERV SCHEDULE.
OPEN ENDED DUCT
ROUTE DUCT UP INTO JOIST SPACE.
S-1
150
8"Ø
(TYP.2)
E-1
110
6x6
HP-A-01
10"x8"
ERV-A-02
R-2
200
12x6
E-2
100
6x6
S-2
150
12x6
(TYP. 2)
HP-A-02
150 CFM
16"x14"
R-2
150
16x8
E-2
150
8x8
ERV-A-03
EDH-A-01
10"x8"
HP-A-04
HP-A-06
EWH-A-01
ERV-A-04
UH-A-01
S-2
50
6x6
E-1
50
6x6
TYP. 2
S-1
50
6"Ø
1-BEDROOM DWELLING UNIT TYPE A1
1-BEDROOM DWELLING UNIT TYPE A1 (UFAS)
1-BEDROOM DWELLING UNIT TYPE A1 (MIR)
ELEVATOR
LOBBY
STAIR A
STAIR B
CORRIDOR
VESTIBULE
COMMUNITY ROOM
FITNESS CENTER
TRASH/RECYCLE
MECHANICAL
ELECTRICAL
CUSTODIAL
2
M-401
1
M-400

ERVs – Equipment Efficiency - Units

EV Premium LH/EV Premium L – Energy Performance							
Supply Temperature		Net Airflow		Average Power Watts	Sensible Recovery Efficiency %	Adjusted Sensible Recovery Efficiency %	Net Moisture Transfer %
C°	F°	L/s	CFM				
Heating							
0°	32°	28	59	21	88	90	77
0°	32°	57	121	37	81	83	69
0°	32°	95	201	114	74	77	60
0°	32°	107	227	171	71	76	56
Cooling					Total Recovery Efficiency %	Adjusted Total Recovery Efficiency %	
35°	95°	29	61	20	76	77	

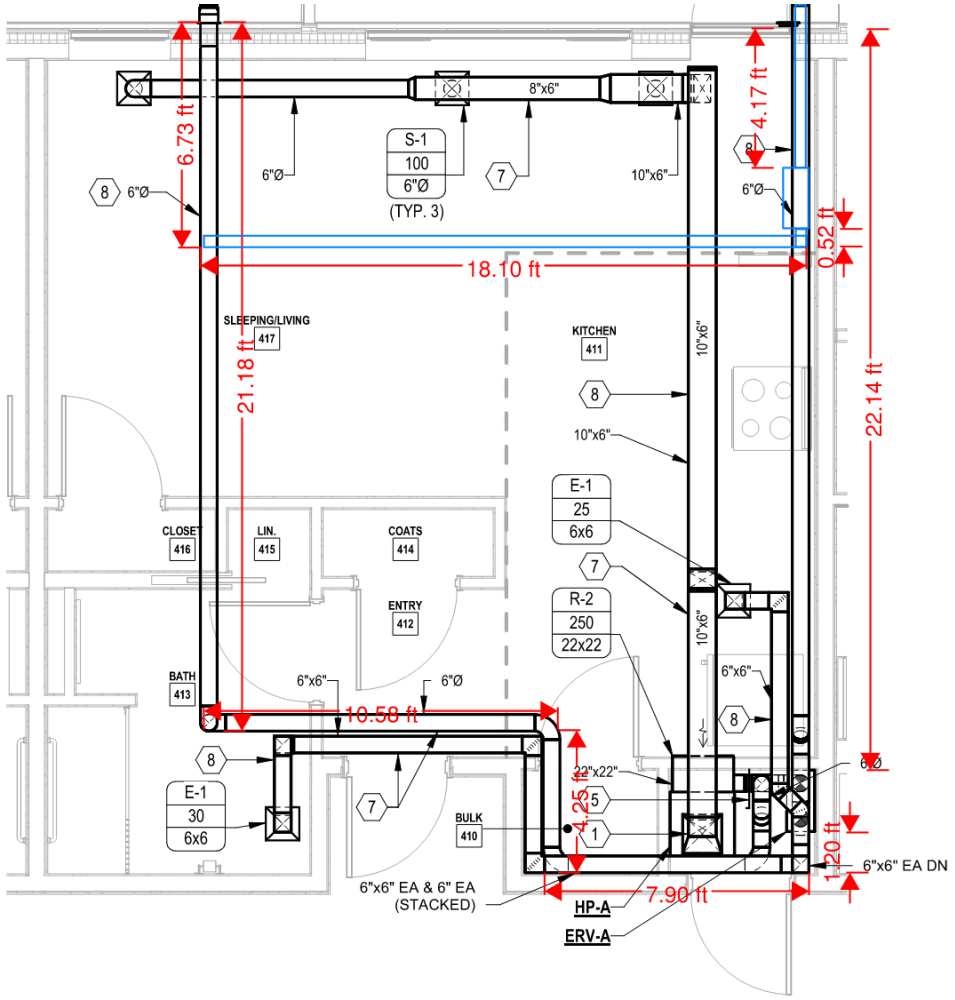
ERVs – Equipment Efficiency – Common Areas

SL75H/SL75 – Energy Performance							
Supply Temperature		Net Airflow		Average Power Watts	Sensible Recovery Efficiency %	Adjusted Sensible Recovery Efficiency %	Net Moisture Transfer %
C°	F°	L/s	CFM				
Heating							
0°	32°	24	51	30	78	82	64
0°	32°	36	76	50	74	79	56
0°	32°	47	100	79	70	75	50
Cooling					Total Recovery Efficiency %	Adjusted Total Recovery Efficiency %	
35°	95°	25	53	32	57	59	

EV200 – Energy Performance							
Supply Temperature		Net Airflow		Average Power Watts	Sensible Recovery Efficiency %	Adjusted Sensible Recovery Efficiency %	Net Moisture Transfer %
C°	F°	L/s	CFM				
Heating							
0°	32°	85	180	146	74	79	57
Cooling					Total Recovery Efficiency %	Adjusted Total Recovery Efficiency %	
35°	95°	79	167	137	57	60	

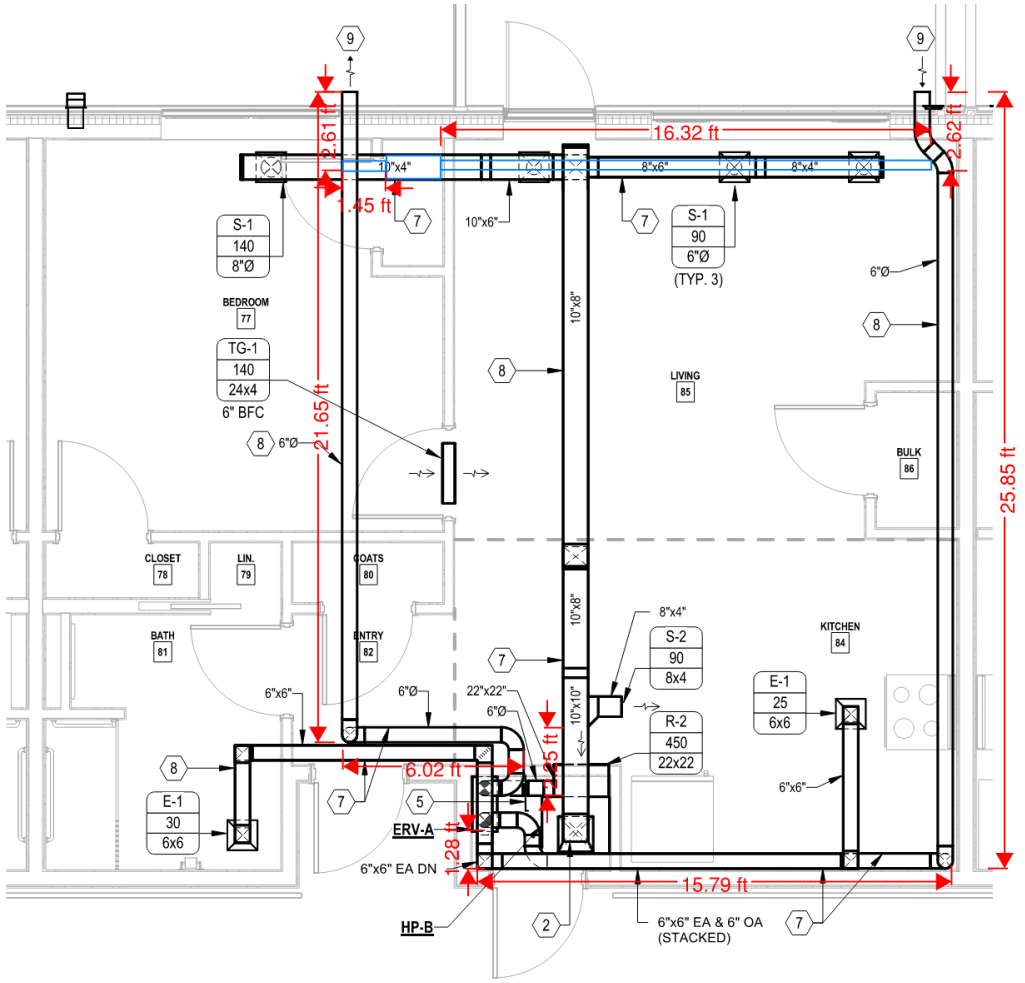
ERVs – Duct Runs

Studio (Bldg A: x0, Bldg B: x10)



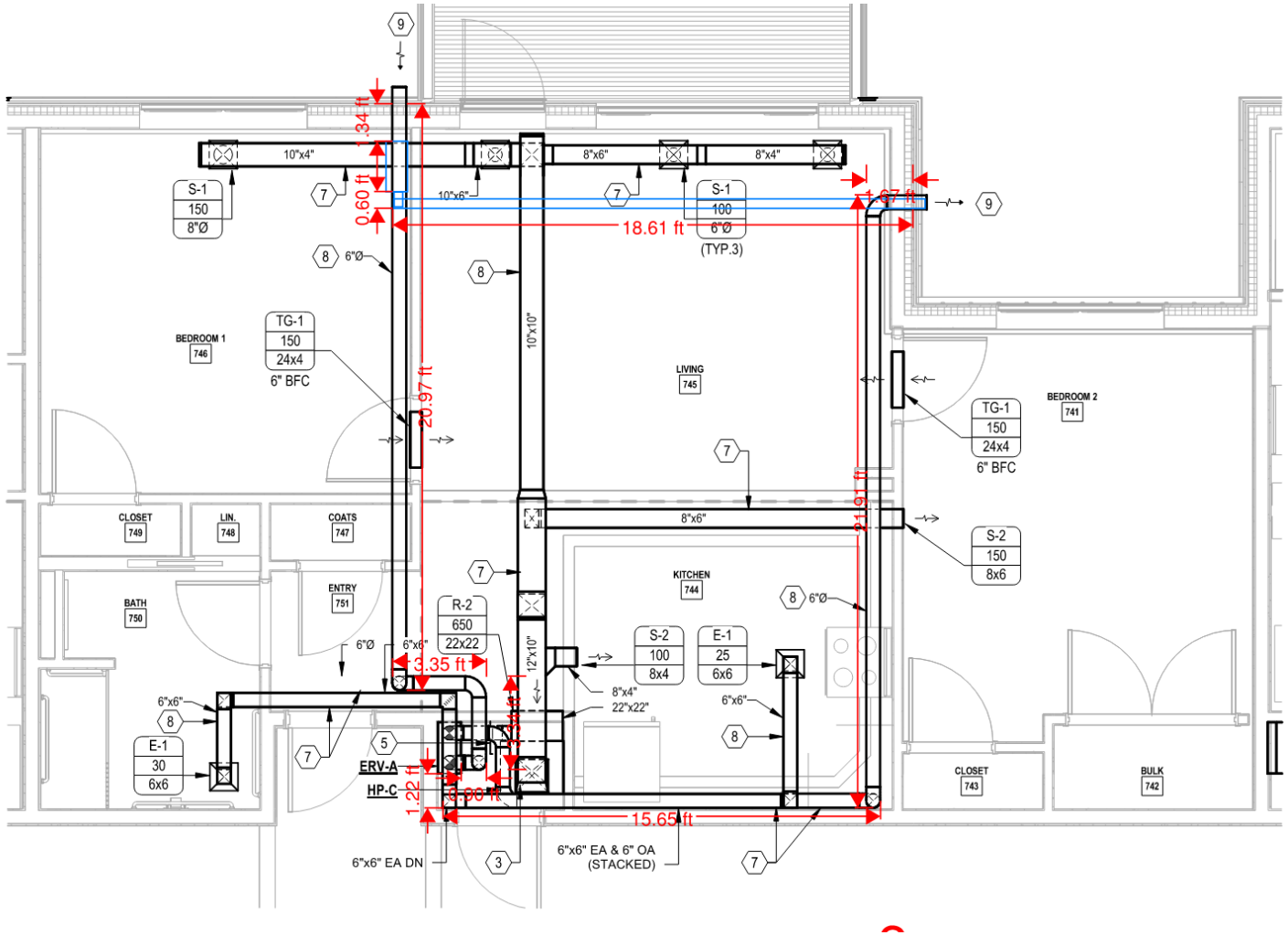
ERVs – Duct Runs

1 Bedroom (Bldg A: x15, Bldg B: x16)



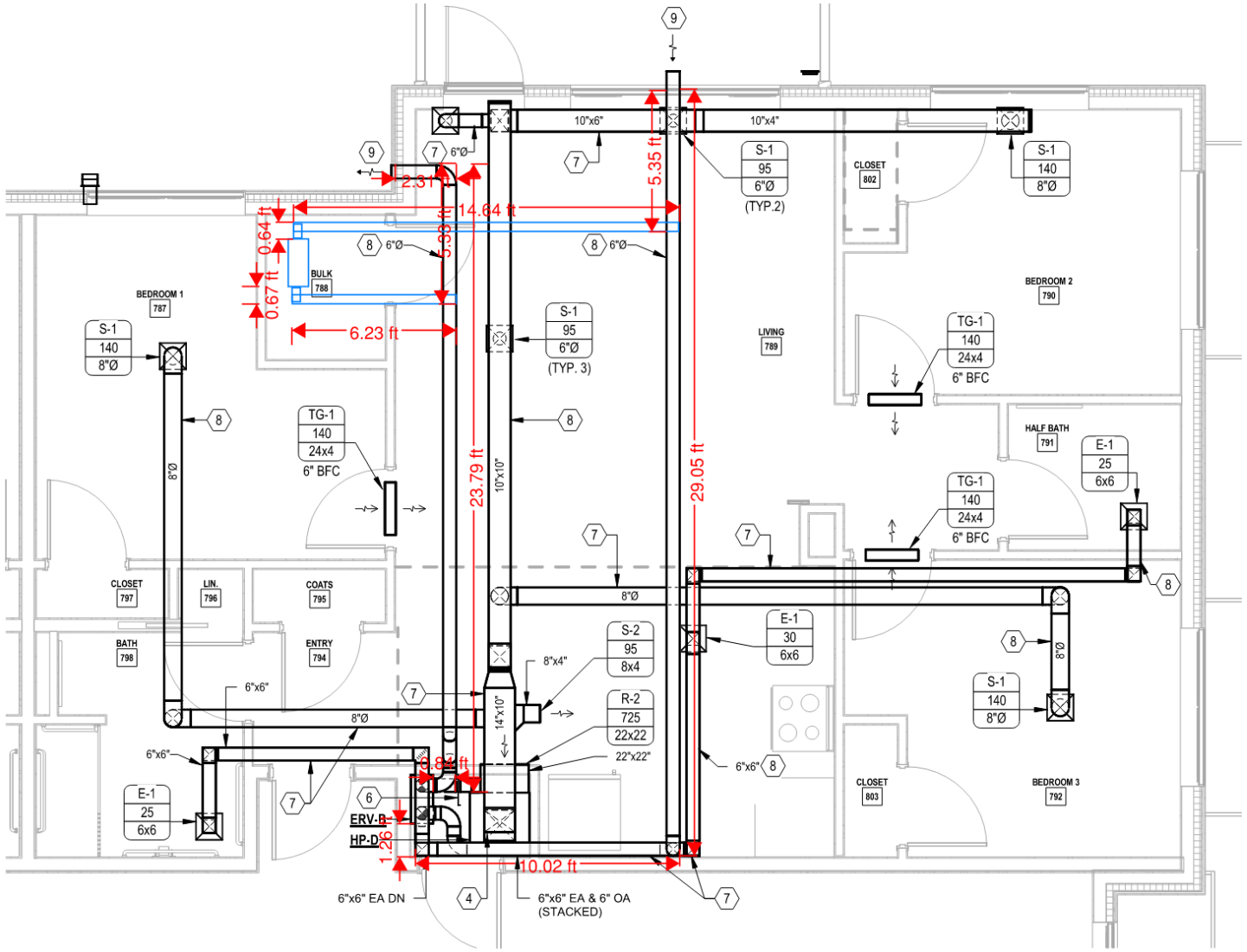
ERVs – Duct Runs

2 Bedrooms (Bldg A: x0, Bldg B: x8)



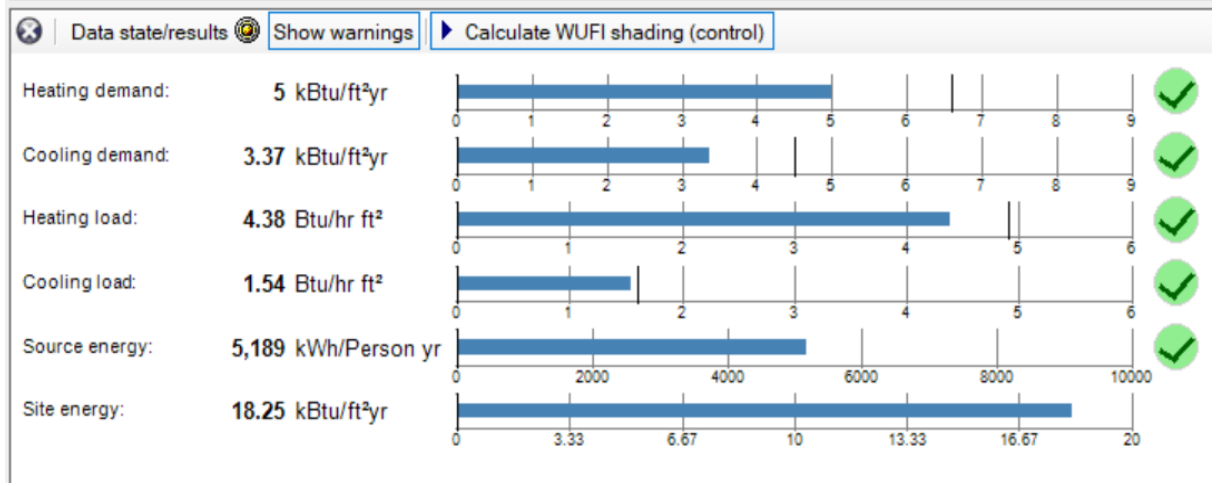
ERVs – Duct Runs

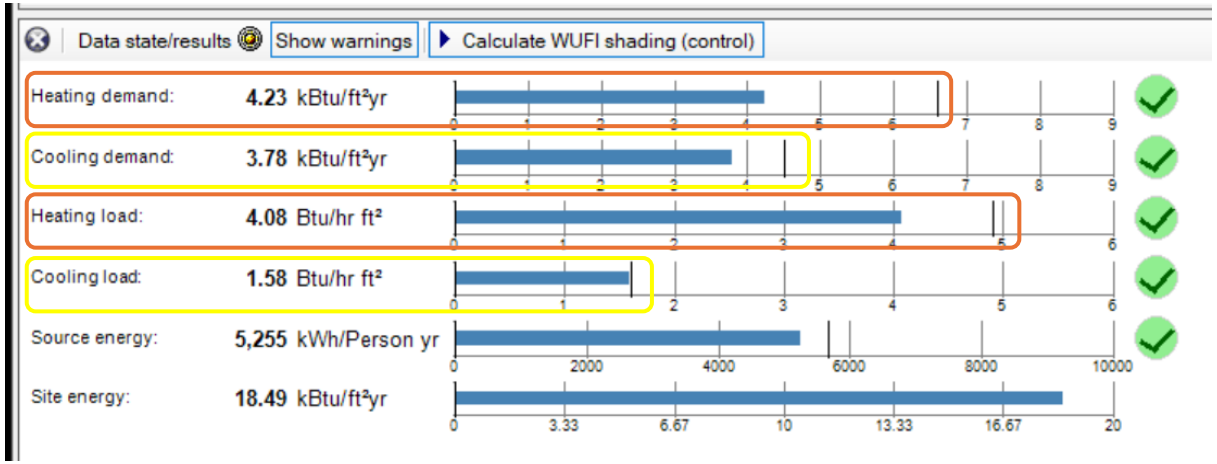
3 Bedrooms (Bldg A: x0, Bldg B: x6)

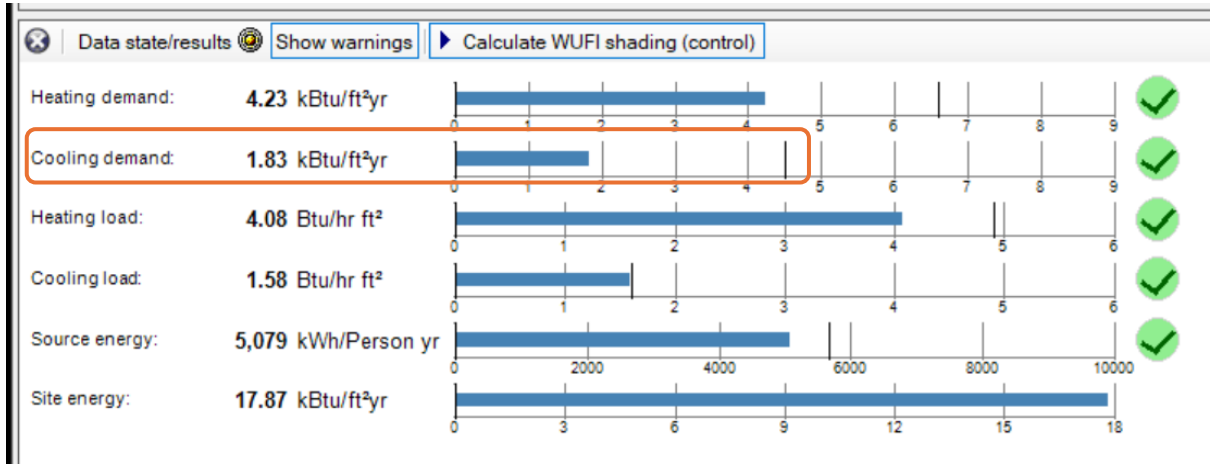


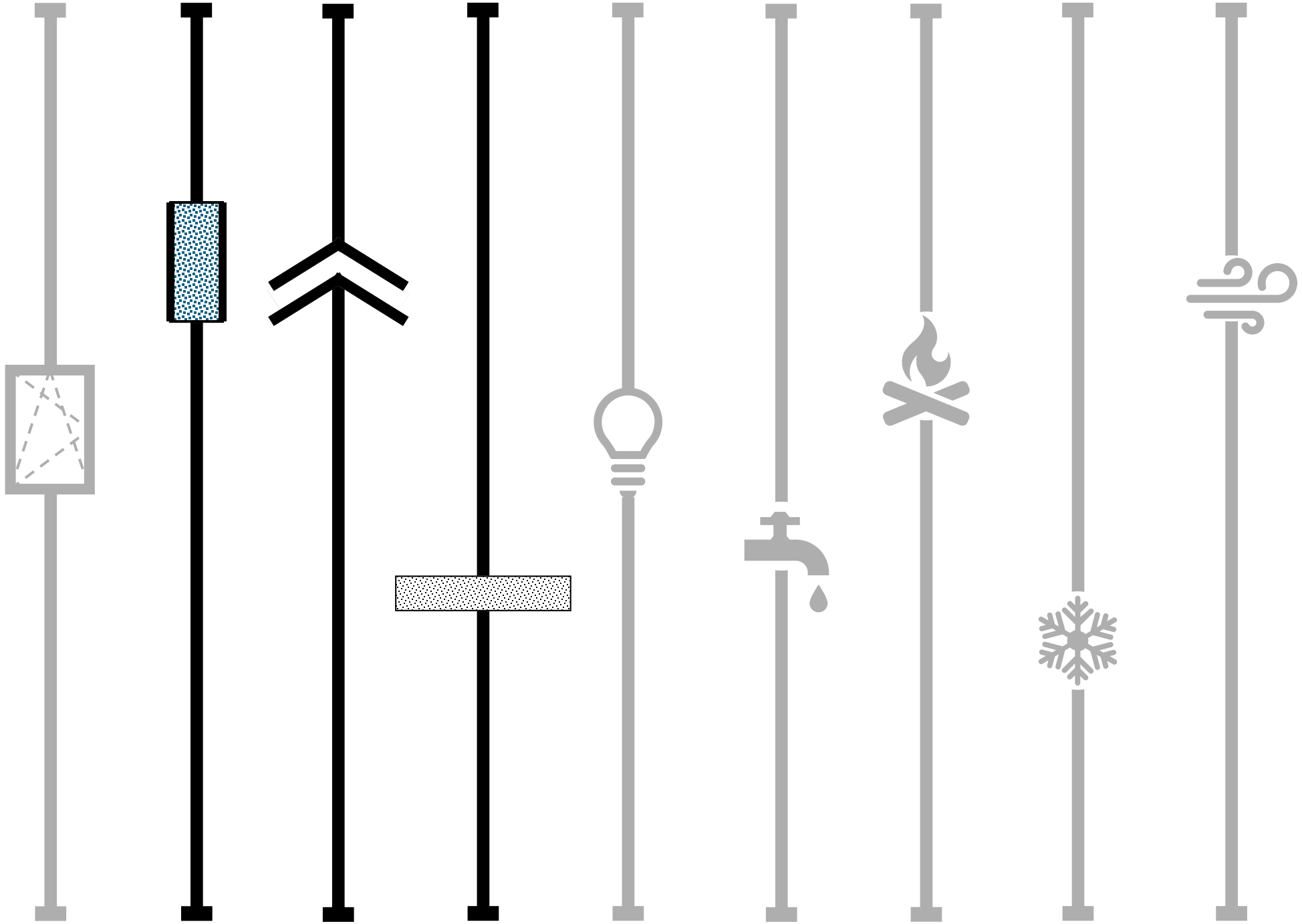
Hindsight Options

- Individual ERVs
- Centralized ERVs
- Centralized with Enthalpy Controlled Bypass



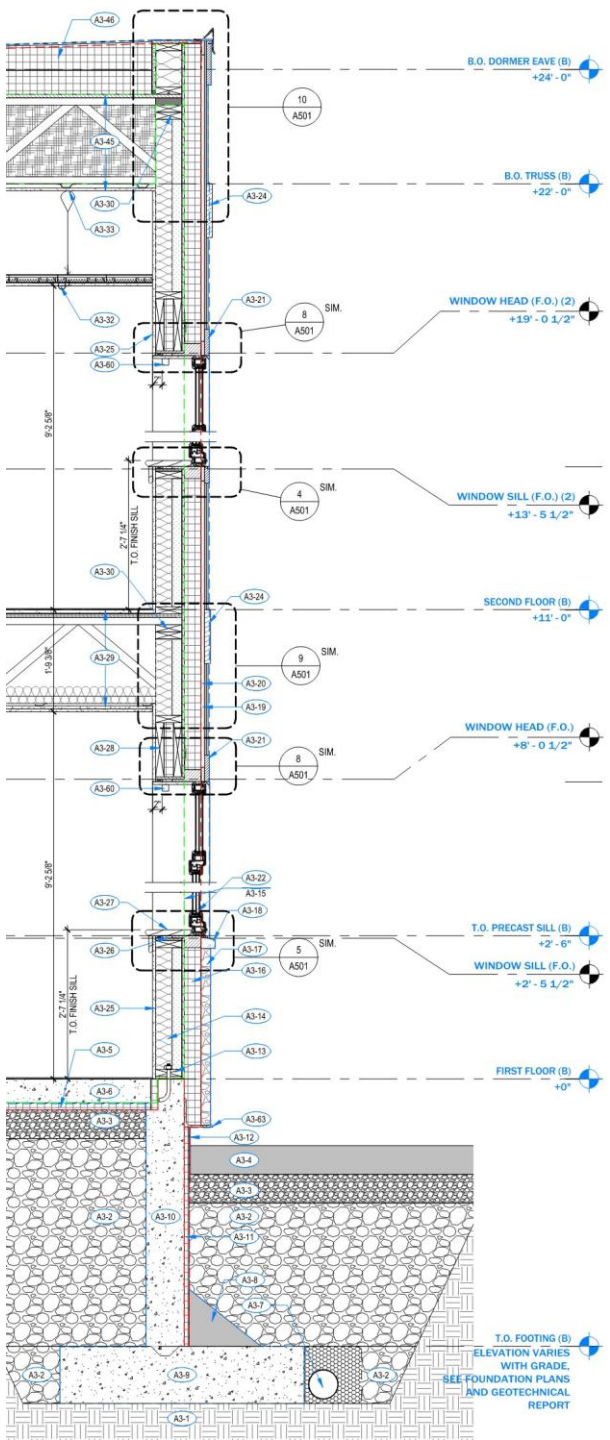


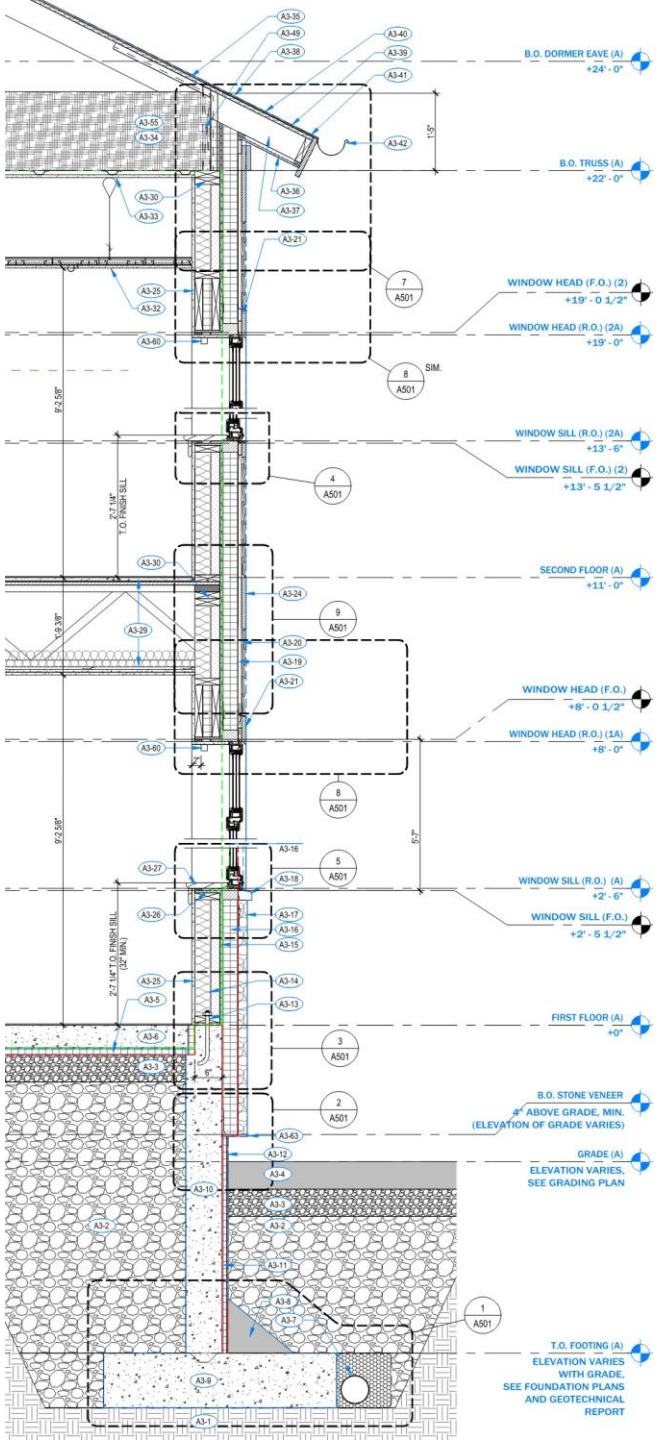




Composition

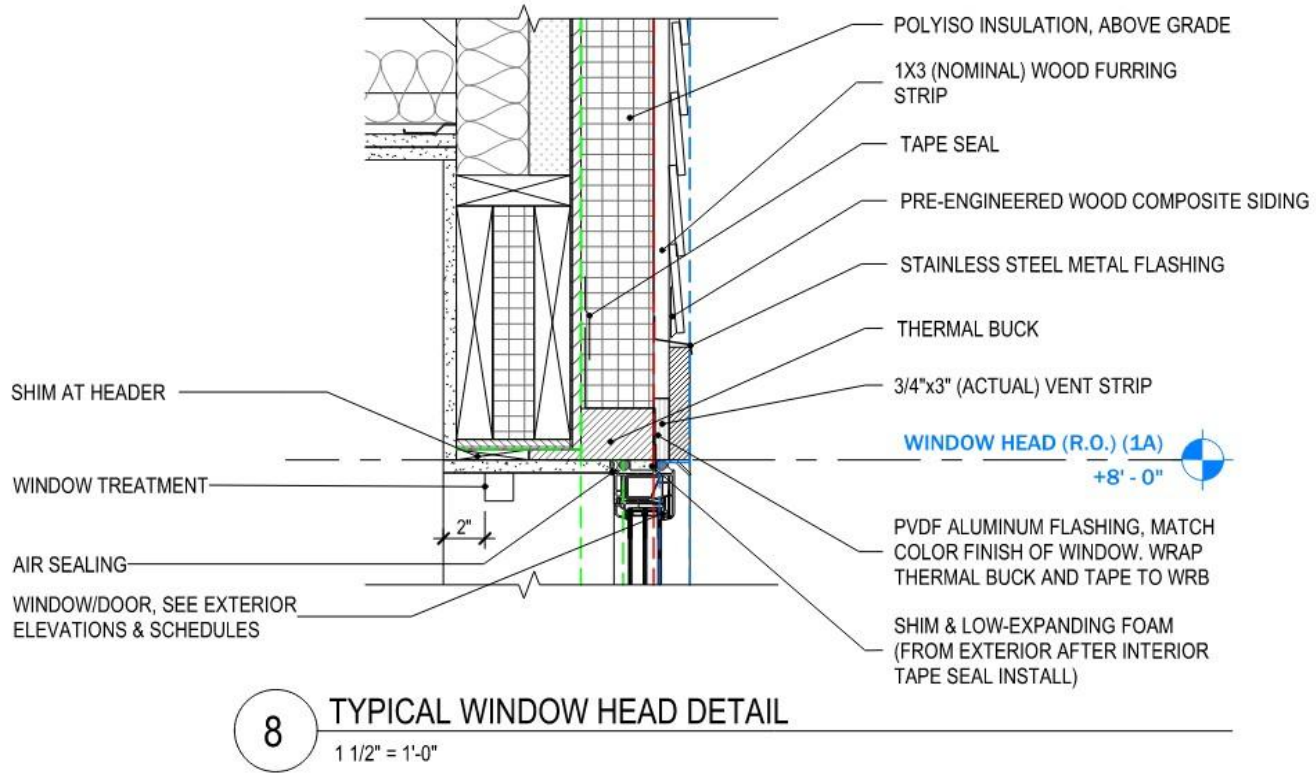
- High Performance Envelope
- Slab-on-Grade R-6.7
  - Polyiso Insulation
- Conventional Wood Framing R-47
  - Flash & Batt with Continuous
- Roof/Ceiling (Pitched & Flat) R-86/55
  - Blown-in Cellulose
  - Polyiso (Flat Roofs)

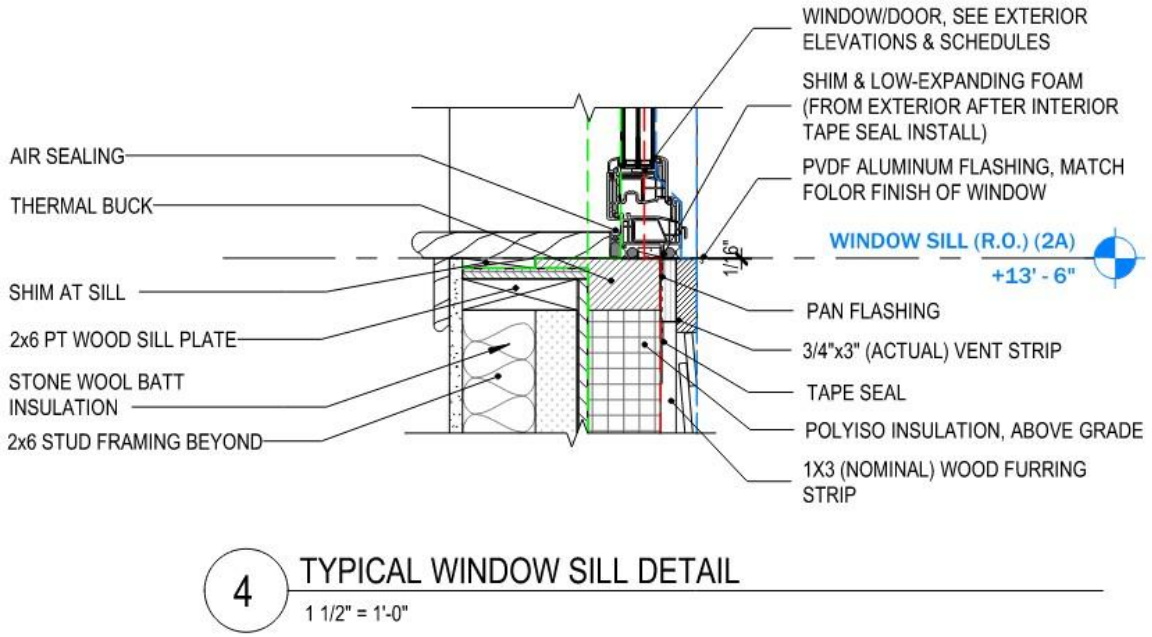




The Notes

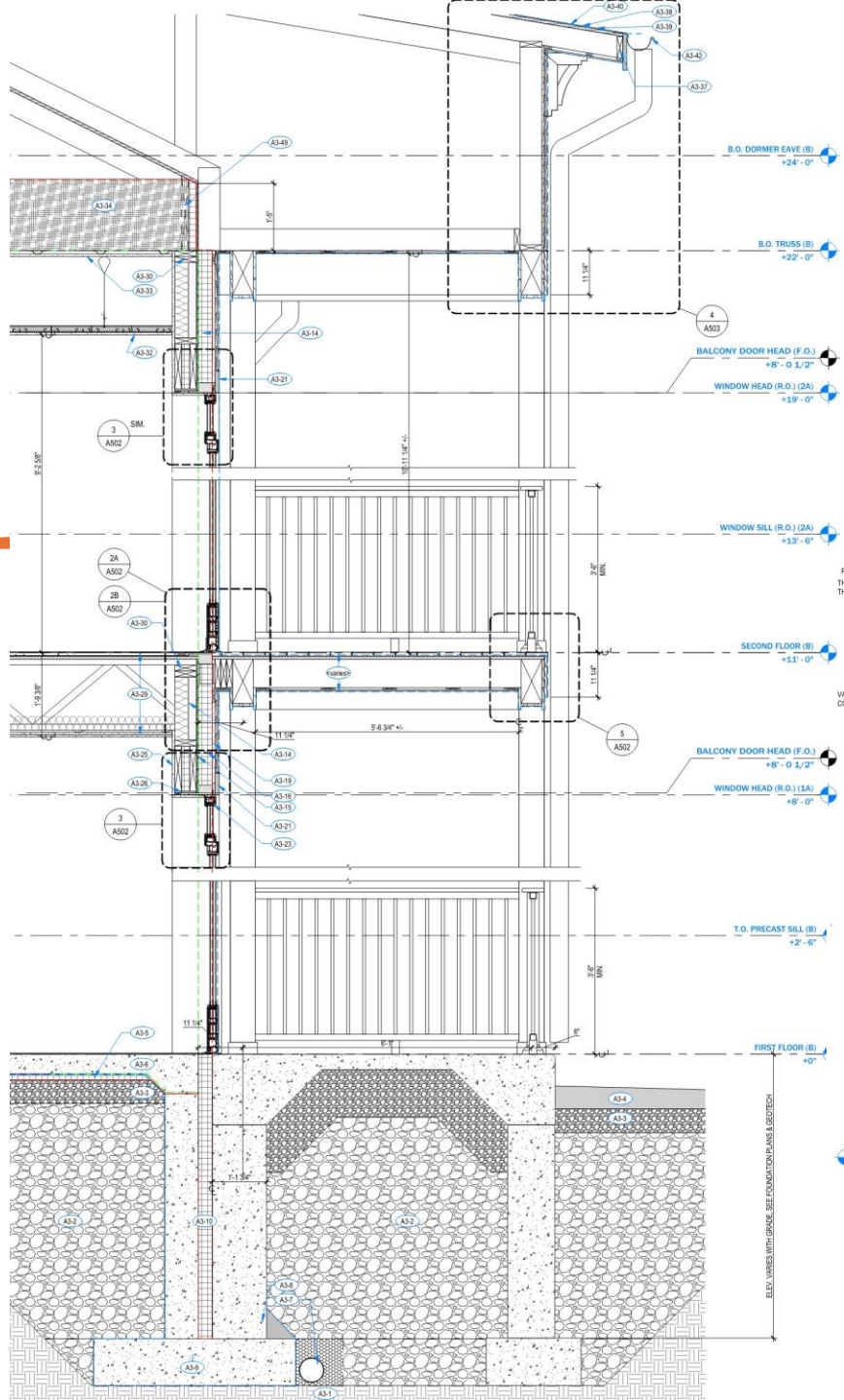
- Pencil Test
  - Air/Vapor Control
  - Water Control
  - Thermal Control
- Devil in the Details
  - Slab Edge
  - Sills, Heads, Jambs
  - Floor/Ceiling to Wall
  - Eaves & Soffits

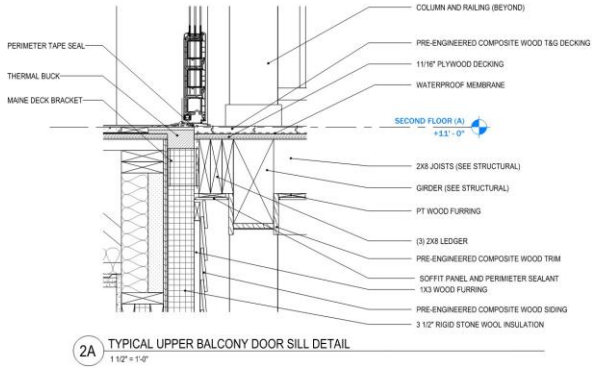




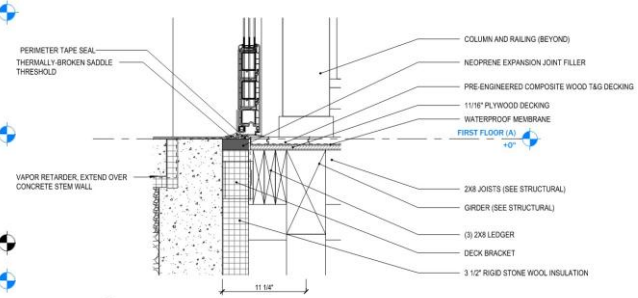
Challenges

- Structural Design
- Thermal Bridges
- Awnings & Canopies
- Patios & Balconies

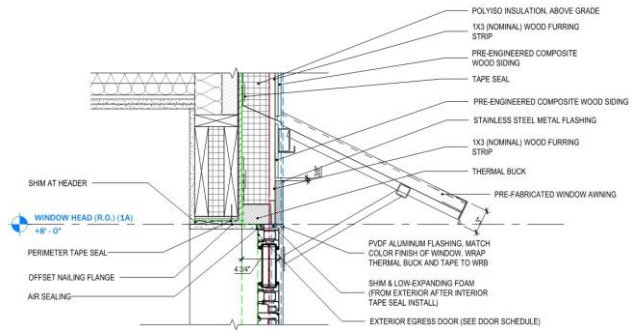




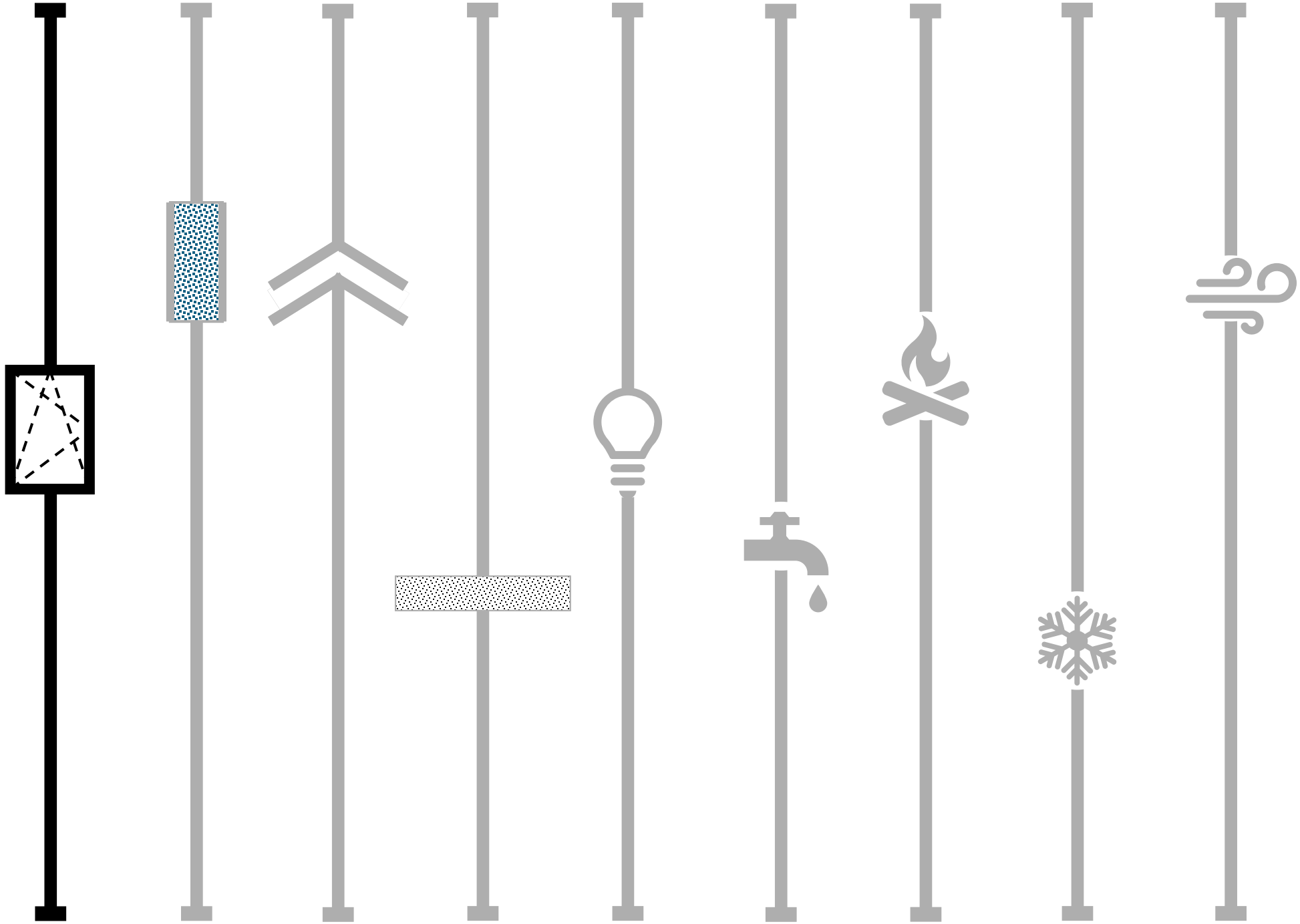
2A TYPICAL UPPER BALCONY DOOR SILL DETAIL
1 1/2" = 1'-0"

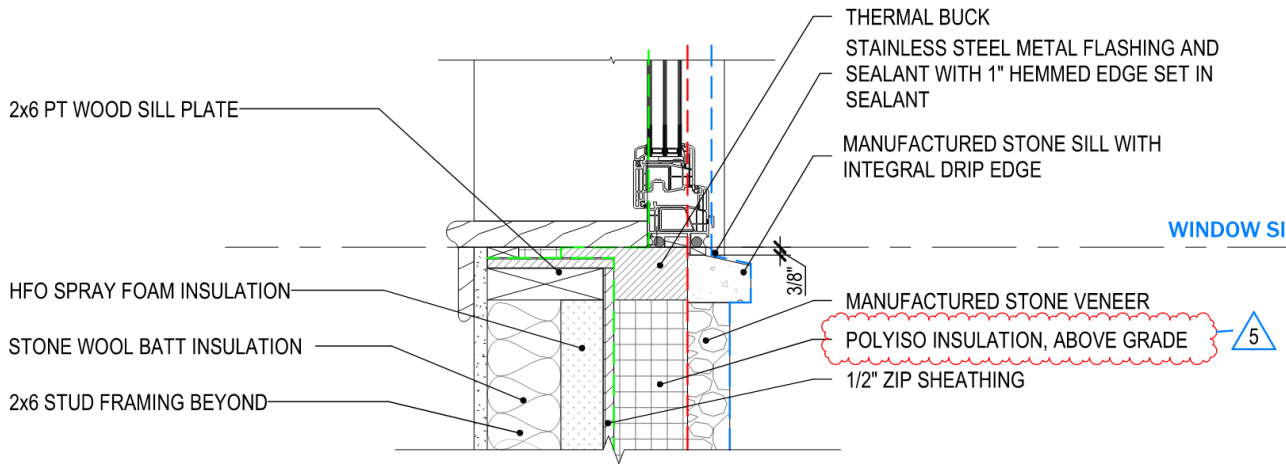


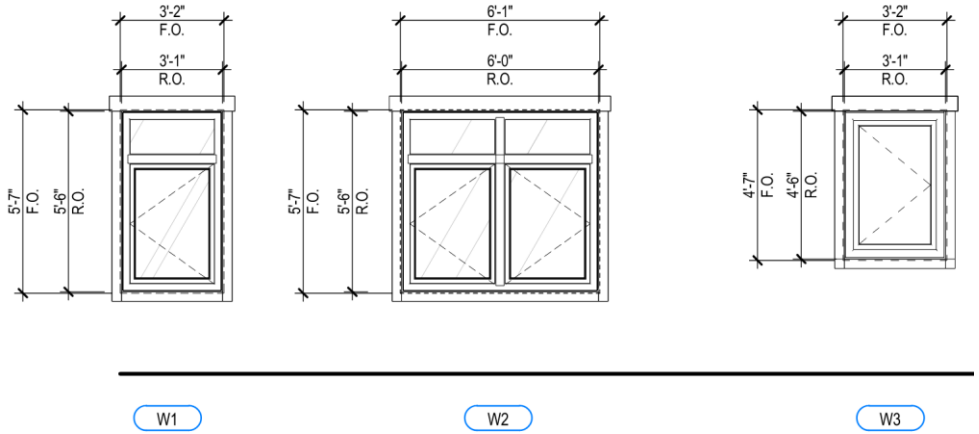
1 TYPICAL FIRST FLOOR BALCONY DOOR SILL DETAIL
1 1/2" = 1'-0"



2 TYPICAL EGRESS DOOR HEAD DETAIL
1 1/2" = 1'-0"

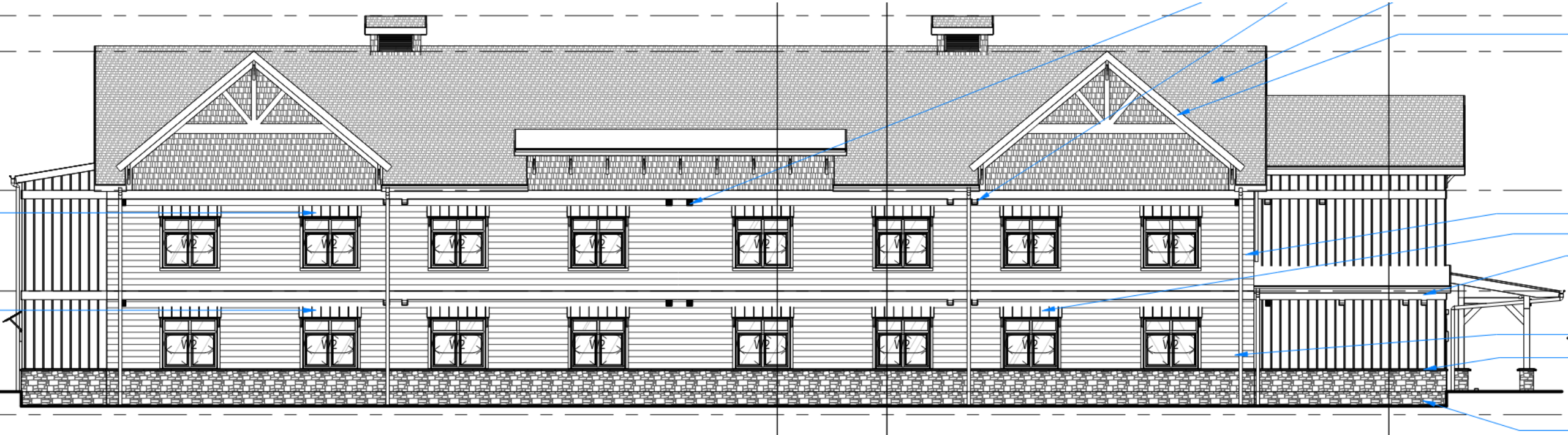






5 TYPICAL WINDOW SILL DETAIL AT MASONRY STRING COURSE

1 1/2" = 1'-0"



Phius Product Number: W-101226
Date Last Certified: 08/15/2023
THERM Files Available: Yes

Phius Certification Path: Orange Path
Valid Through: 08/15/2025
Air Leakage Test Data Available: No

PRODUCT INFORMATION		
Product Name: Intus Supera CW Fixed		
Manufacturer: Intus Windows		**Primary Frame Material:** Vinyl
Series: Supera		**Fixed or Operable:** Fixed
Model: Supera CW Fixed		**Operation Type:** Fixed
IGU DETAILS		
Glazing Name: SN51_28_4x18Arx4x18ArxCG4		
Glass Layers: Triple	**Gas Fill:** Argon	**Spacer:** SWISSPACER ULTIMATE

RECOMMENDED CLIMATE ZONES *(NOTE: This information is not for use in building energy models. See next section.)*

Recommended Climate Zones and Whole-Window U-values by Zone, at Standard Model Size [Btu/hr•ft²•°F]

Climate Zone	0, 1, 2	3A	3B	3C	4A, 4B	4C, 5C	5A, 5B	6	7	8
Recommended Zones	✔	✔	✔	✔	✔	✔	✔	✔		
U-Whole-Window	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.13	0.14	0.14

Modeled Size [W×H] 47.24" × 59.06" **SHGC, Whole Window:** 0.19 **Condensation Resistance:**

COMPONENT-LEVEL PERFORMANCE DATA [IP Units] | *Compatible with building energy modeling tools*

U-COG | Center of Glass U-Values, by Climate Zone [Btu/hr•ft²•°F]

Climate Zone	0, 1, 2	3A	3B	3C	4A, 4B	4C, 5C	5A, 5B	6	7	8
U-COG Value	0.09	0.09	0.09	0.09	0.09	0.09	0.10	0.10	0.11	0.11

SHGC-COG | Center of Glass Solar Heat Gain Coefficient, All Climate Zones 0.23

Frame Parameters	*Left Jamb*	*Right Jamb*	*Head*	*Sill*
Frame Section	**Left**	**Right**	**Top**	**Bottom**
Frame Width	2.60"	2.60"	2.60"	2.60"
Frame U-Value [Btu/hr•ft²•°F]	0.20	0.20	0.21	0.21
Glazing-to-Frame Psi Value [Btu/hr•ft•°F]	0.0108	0.0108	0.0105	0.0105

Frame-to-Wall Psi Value is dependent on the on-site installation condition. *(See Phius Guidebook for more details.)*

Phius Product Number: W-101221
Date Last Certified: 08/15/2023
THERM Files Available: Yes

Phius Certification Path: Orange Path
Valid Through: 08/15/2025
Air Leakage Test Data Available: No

PRODUCT INFORMATION		
Product Name: Intus Supera CW Casement		
Manufacturer: Intus Windows		**Primary Frame Material:** Vinyl
Series: Supera CW		**Fixed or Operable:** Operable
Model: Supera CW Casement		**Operation Type:** Casement
IGU DETAILS		
Glazing Name: SN51_28_4x18Arx4x18ArxCG4		
Glass Layers: Triple	**Gas Fill:** Argon	**Spacer:** SWISSPACER ULTIMATE

RECOMMENDED CLIMATE ZONES *(NOTE: This information is not for use in building energy models. See next section.)*

Recommended Climate Zones and Whole-Window U-values by Zone, at Standard Model Size [Btu/hr•ft²•°F]

Climate Zone	0, 1, 2	3A	3B	3C	4A, 4B	4C, 5C	5A, 5B	6	7	8
Recommended Zones	✔	✔	✔	✔	✔	✔				
U-Whole-Window	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.18	0.18

Modeled Size [W×H] 23.62" × 59.06" **SHGC, Whole Window:** 0.12 **Condensation Resistance:**

COMPONENT-LEVEL PERFORMANCE DATA [IP Units] | *Compatible with building energy modeling tools*

U-COG | Center of Glass U-Values, by Climate Zone [Btu/hr•ft²•°F]

Climate Zone	0, 1, 2	3A	3B	3C	4A, 4B	4C, 5C	5A, 5B	6	7	8
U-COG Value	0.09	0.09	0.09	0.09	0.09	0.09	0.10	0.10	0.11	0.11

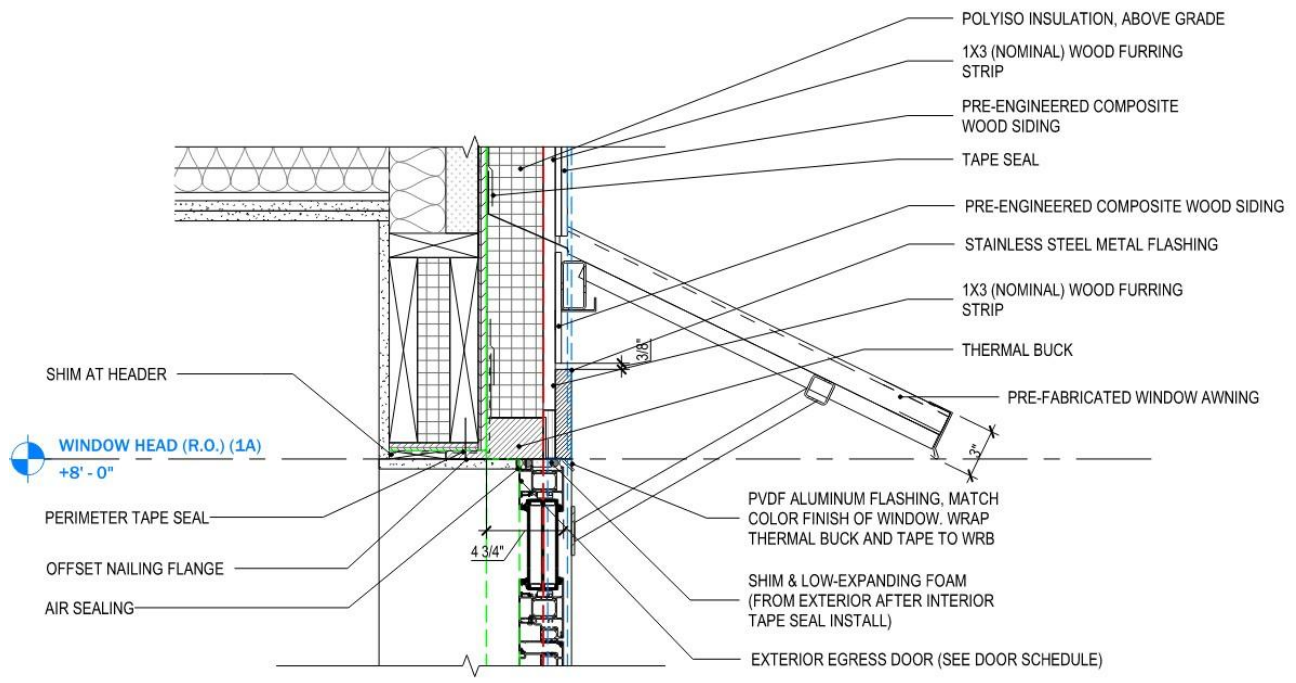
SHGC-COG | Center of Glass Solar Heat Gain Coefficient, All Climate Zones 0.23

Frame Parameters	*Left Jamb*	*Right Jamb*	*Head*	*Sill*
Frame Section	**Left**	**Right**	**Top**	**Bottom**
Frame Width	4.57"	4.57"	4.57"	4.57"
Frame U-Value [Btu/hr•ft²•°F]	0.23	0.23	0.23	0.23
Glazing-to-Frame Psi Value [Btu/hr•ft•°F]	0.0101	0.0101	0.0098	0.0098

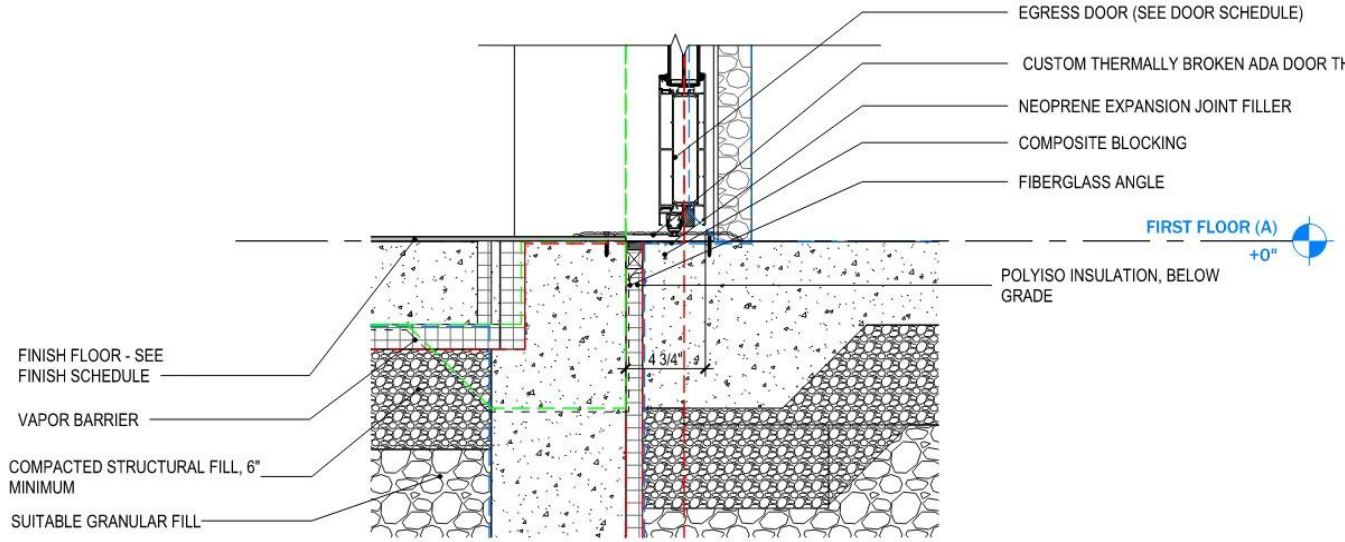
Frame-to-Wall Psi Value is dependent on the on-site installation condition. *(See Phius Guidebook for more details.)*

Entry/Exit Doors

- Passive House Certified
- ADA-Compliant Thresholds
- Commercial Rated for High Traffic



2 TYPICAL EGRESS DOOR HEAD DETAIL
1 1/2" = 1'-0"



1 TYPICAL EGRESS DOOR SILL
1 1/2" = 1'-0"

Climate

phius 2021 Custom Performance Criteria Calculator v3.3		
BUILDING FUNCTION	RESIDENTIAL	
Climate Location	TANNERSVILLE, NY | 5A	
Envelope Area (sf)	27,858	
iCFA (sf)	16,167	
Dwelling Units (Count)	15	
Total Bedrooms (Count)	15	
Space Conditioning Criteria		
Annual Heating Demand	6.6	kBTU/sf.yr
Annual Cooling Demand	4.5	kBTU/sf.yr
Peak Heating Load	4.9	BTU/sf.hr
Peak Cooling Load	1.6	BTU/sf.hr
Source Energy Criteria		
phius CORE	5,675.0	kWh/person.yr

Phius 2021 Performance Criteria Calculator v3.3	
UNITS:	IMPERIAL (IP)
BUILDING FUNCTION:	RESIDENTIAL
PROJECT TYPE:	NEW CONSTRUCTION
STATE/ PROVINCE	MASSACHUSETTS
CITY	BOSTON LOGAN INT ARF
Envelope Area (ft²)	27,858.0
iCFA (ft²)	16,167.0
Dwelling Units (Count)	15
Total Bedrooms (Count)	15

Space Conditioning Criteria		
Annual Heating Demand	5.5	kBtu/ft²yr
Annual Cooling Demand	5.5	kBtu/ft²yr
Peak Heating Load	4.0	Btu/ft²hr
Peak Cooling Load	2.7	Btu/ft²hr

Source Energy Criteria		
Phius CORE	5675	kWh/person.yr
Phius ZERO	0	kWh/person.yr

Localization | Climate | Source energy/CO2-Factor

Data: TANNERSVILLE, NY

Setting	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Heating W. 1	Heating W. 2	Cooling W. 1	Cooling W. 2
Temperature [°F]																
Ambient	23	25.34	33.44	45.68	56.66	64.22	69.08	67.46	60.8	49.46	38.48	28.58	7.34	18.14	74.48	
Dew point	14.54	15.44	21.2	31.1	44.24	54.32	58.64	58.1	52.16	40.46	29.12	21.02				
Sky*	-6.88	-5.98	3.02	16.52	31.82	42.8	48.2	47.12	39.38	26.42	13.28	2.48				
Ground*																
Solar radiation [kBtu/ft²Month]													Solar radiation [Btu/hr ft²]			
North	3.8	5.39	8.24	10.78	14.9	16.48	15.85	12.36	9.19	6.97	4.75	3.8	5.07	3.8	20.6	
East	11.09	15.53	21.87	25.68	32.65	32.65	33.92	30.11	25.68	16.8	10.46	8.88	11.41	5.71	44.06	
South	28.85	32.97	34.24	28.21	27.26	25.04	26.31	30.43	33.92	32.33	25.04	25.04	30.43	11.09	33.28	
West	11.09	16.17	22.19	24.41	31.38	30.75	31.38	29.48	24.73	19.34	11.73	10.14	12.05	6.02	41.21	
Global	15.85	23.14	35.19	41.84	53.89	55.16	55.79	50.72	40.26	27.26	16.48	13.63	18.39	10.14	72.28	

* Optional input, Sky/Ground: if not defined, temperatures will be estimated)

Localization | Climate | Source energy/CO2-Factor

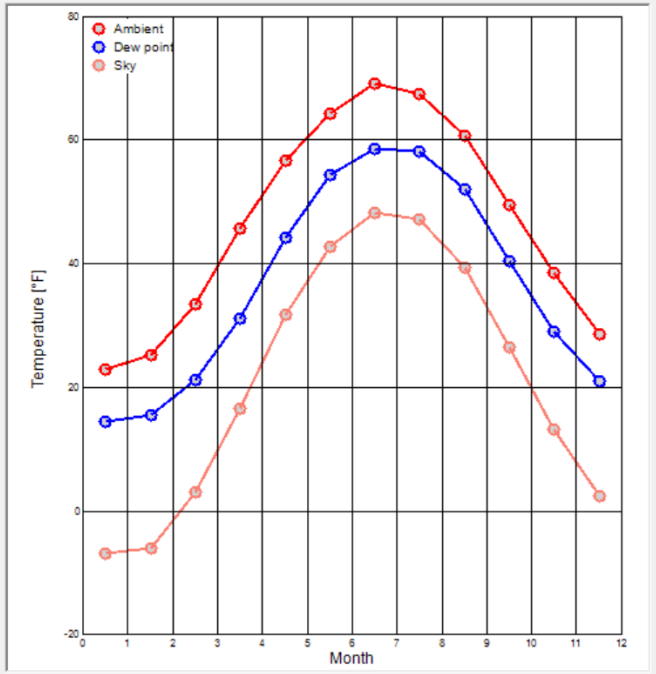
Data: BOSTON LOGAN INT ARPT MA

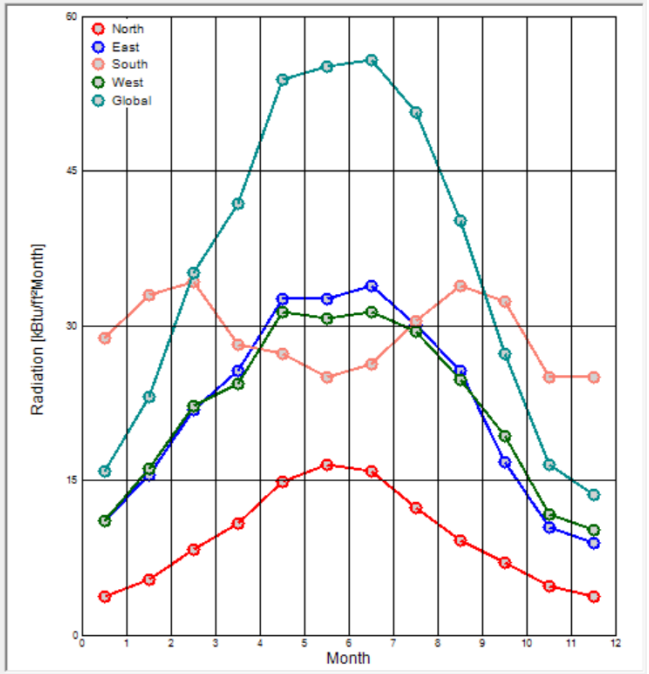
Setting	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Heating W. 1	Heating W. 2	Cooling W. 1	Cooling W. 2
Temperature [°F]																
Ambient	26.6	31.1	38.84	47.48	58.82	66.02	74.12	71.06	64.58	53.96	43.34	35.96	16.88	31.64	83.48	
Dew point	13.82	17.42	24.62	35.06	47.12	54.14	60.62	60.98	53.24	41.72	33.44	23				
Sky*	-6.52	-1.66	8.6	21.38	35.78	45.86	51.98	51.26	42.44	29.3	18.32	8.96				
Ground*																
Solar radiation [kBtu/ft²Month]													Solar radiation [Btu/hr ft²]			
North	7.61	10.78	12.36	12.68	16.17	16.8	18.07	14.9	11.09	8.56	6.02	6.02	12.05	7.92	27.58	
East	14.9	19.34	25.36	25.99	30.43	28.21	32.33	29.16	25.68	19.34	12.36	11.73	22.82	13.31	61.5	
South	32.97	36.14	34.87	27.58	27.26	23.77	27.58	31.38	33.92	35.19	29.8	30.75	49.45	27.26	41.84	
West	13.95	19.65	22.82	25.04	29.8	31.07	32.65	29.16	24.09	18.7	13.63	13	22.19	11.41	53.26	
Global	17.75	24.73	35.5	42.79	54.84	54.84	59.6	52.62	40.58	29.16	19.02	14.9	26.94	16.48	101.44	

* Optional input, Sky/Ground: if not defined, temperatures will be estimated)

Data state/results | Show warnings | Calculate WUFI shading (control)

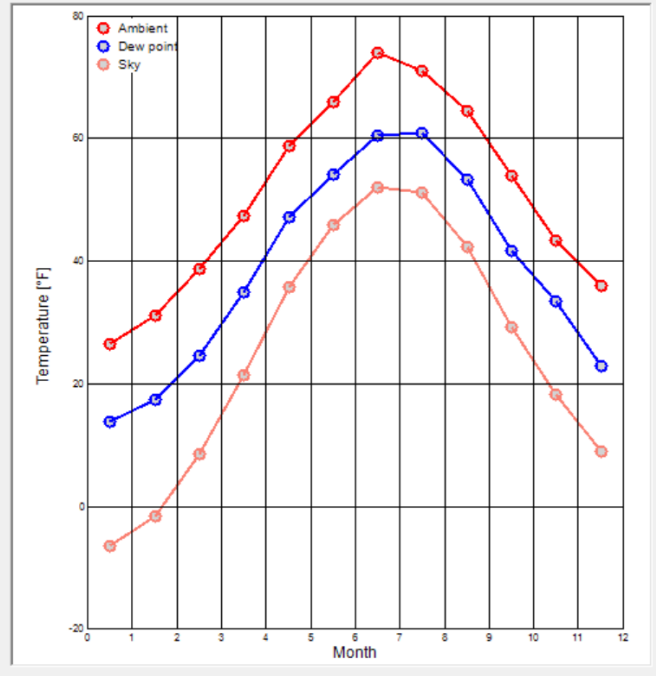
Heating demand:	5	kBtu/ft²yr
Cooling demand:	3.37	kBtu/ft²yr
Heating load:	4.38	Btu/hr ft²
Cooling load:	1.54	Btu/hr ft²
Source energy:	5,189	kWh/Person yr
Site energy:	18.25	kBtu/ft²yr

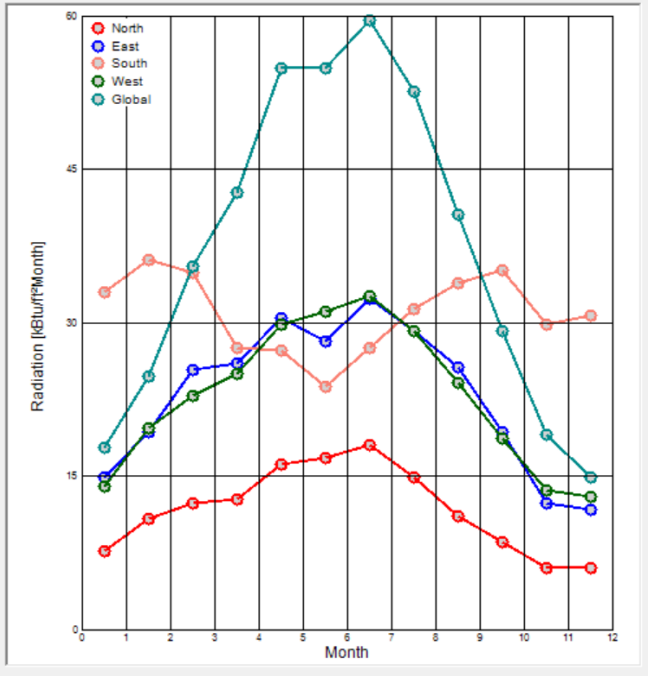




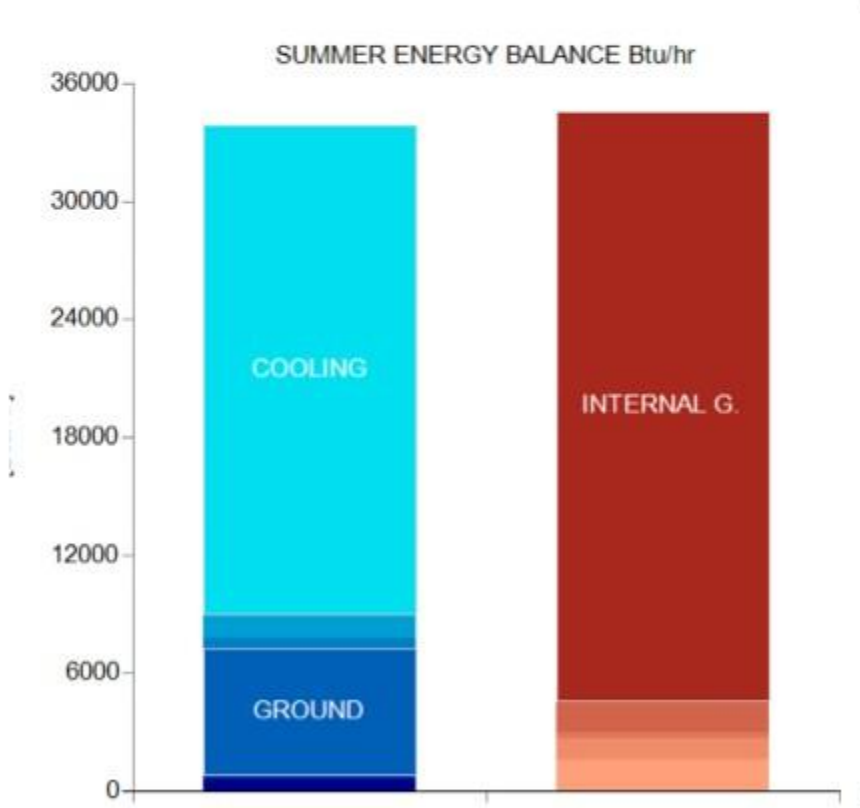
Data state/results | Show warnings | Calculate WUFI shading (control)

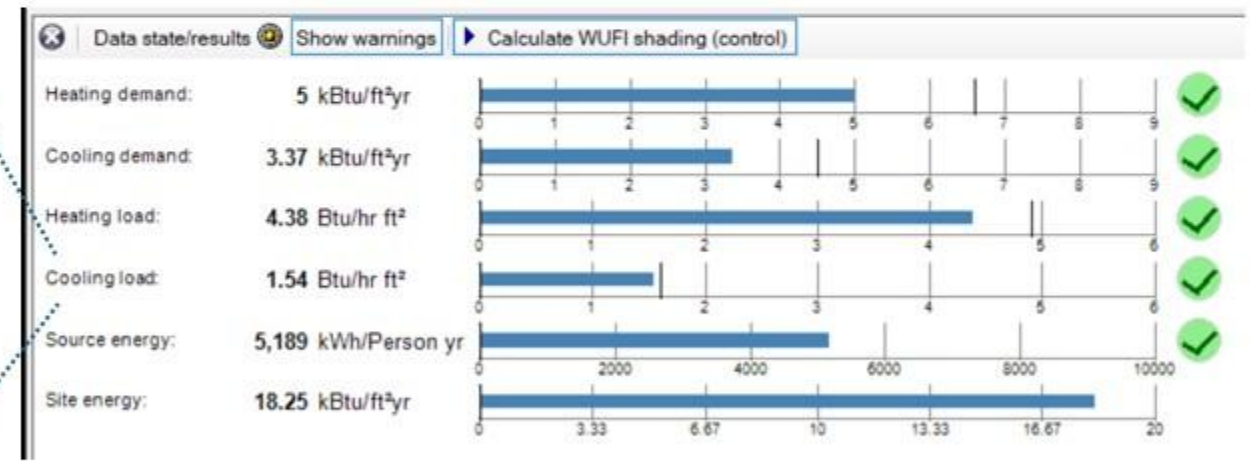
Heating demand:	5.4	kBtu/ft²yr
Cooling demand:	2.7	kBtu/ft²yr
Heating load:	4.12	Btu/hr ft²
Cooling load:	1.76	Btu/hr ft²
Source energy:	5,257	kWh/Person yr
Site energy:	18.49	kBtu/ft²yr

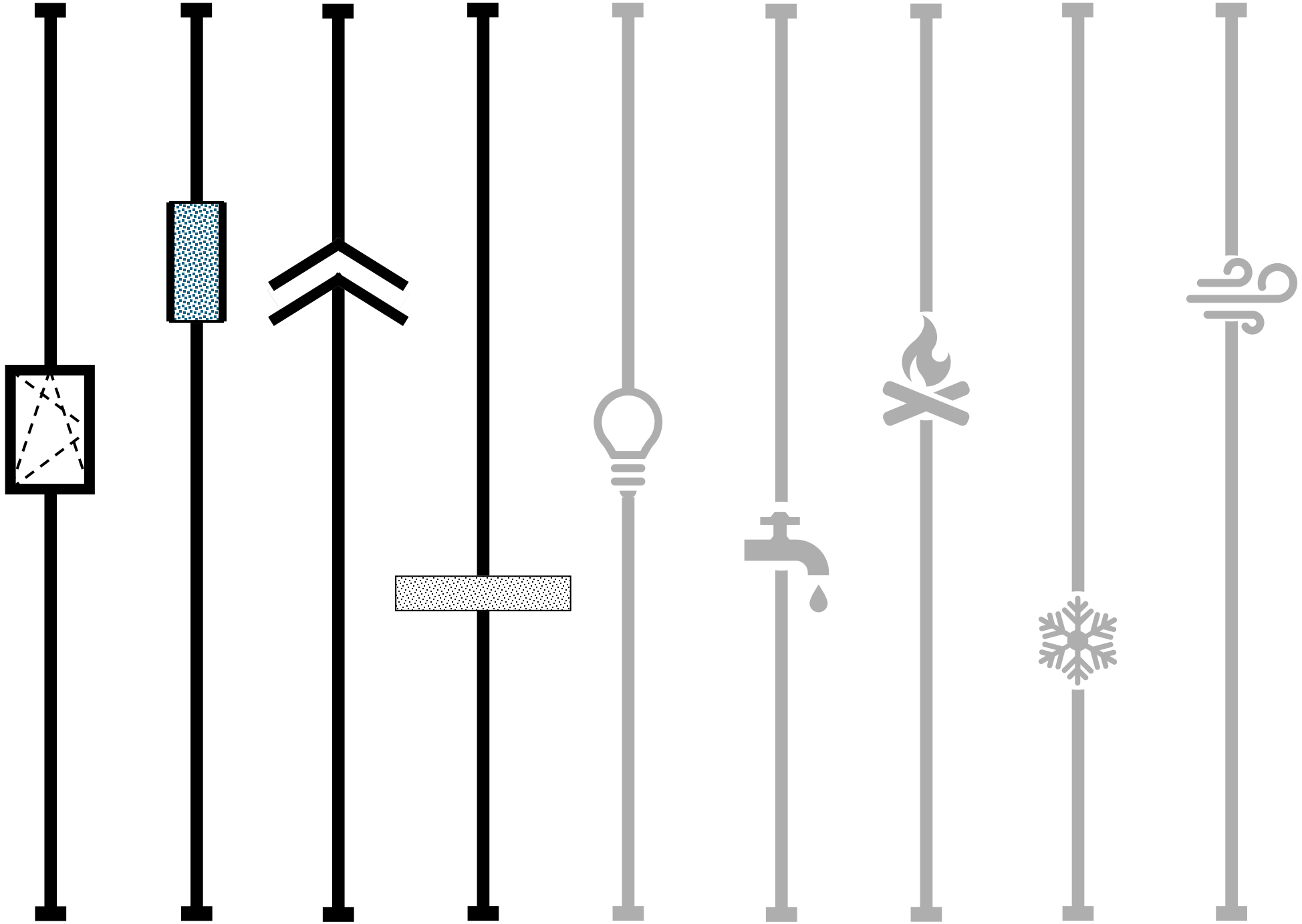


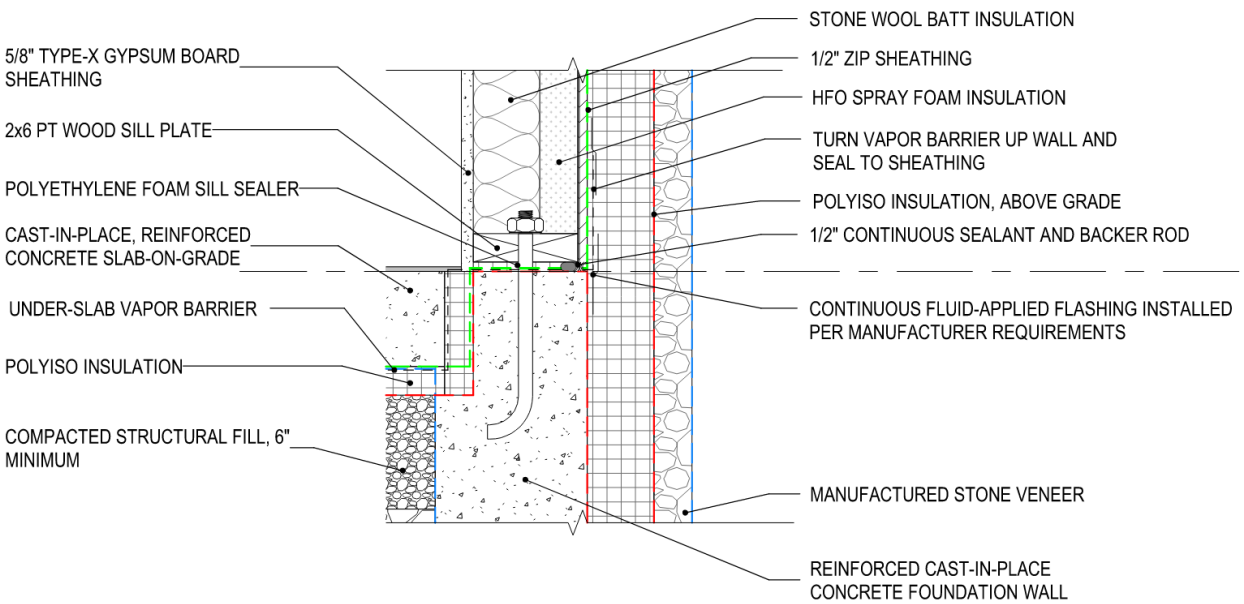


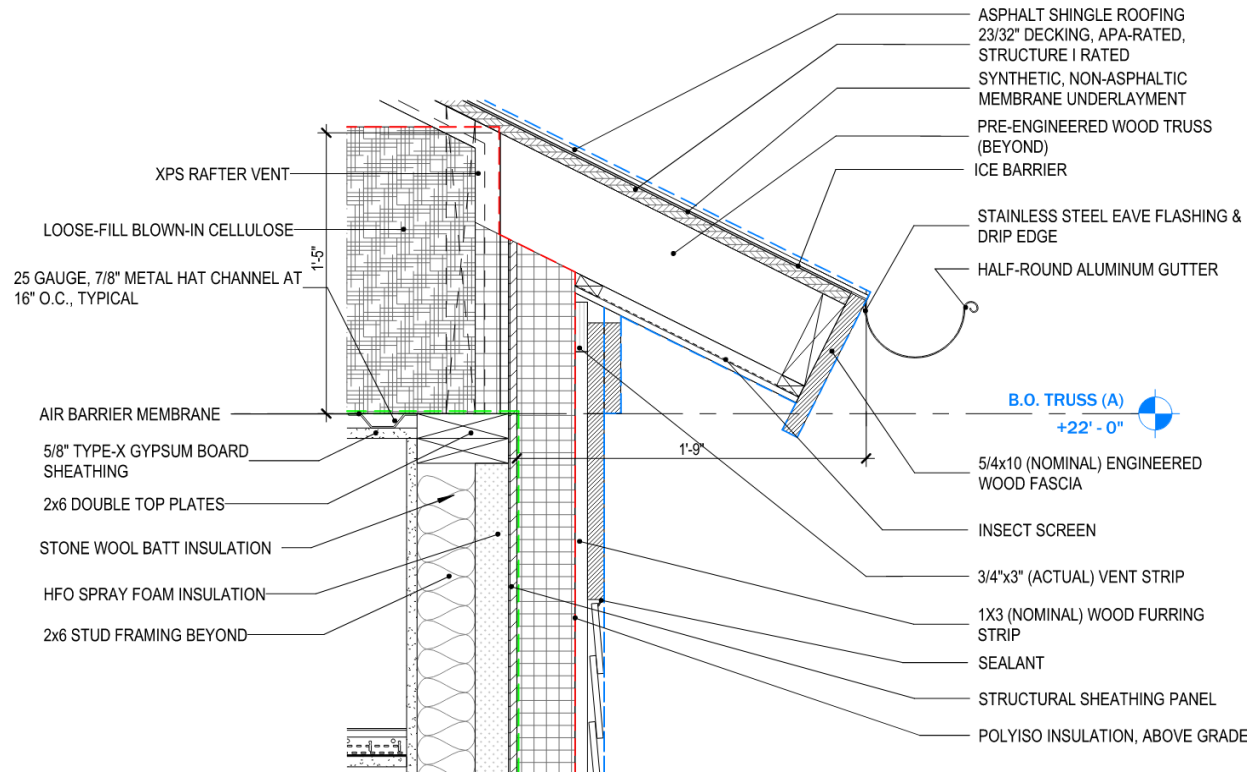
Internal Gains V. Climate








5/8" TYPE-X GYPSUM BOARD SHEATHING
2x6 PT WOOD SILL PLATE
POLYETHYLENE FOAM SILL SEALER
CAST-IN-PLACE, REINFORCED CONCRETE SLAB-ON-GRADE
UNDER-SLAB VAPOR BARRIER
POLYISO INSULATION
COMPACTED STRUCTURAL FILL, 6" MINIMUM
STONE WOOL BATT INSULATION
1/2" ZIP SHEATHING
HFO SPRAY FOAM INSULATION
TURN VAPOR BARRIER UP WALL AND SEAL TO SHEATHING
POLYISO INSULATION, ABOVE GRADE
1/2" CONTINUOUS SEALANT AND BACKER ROD
CONTINUOUS FLUID-APPLIED FLASHING INSTALLED PER MANUFACTURER REQUIREMENTS
MANUFACTURED STONE VENEER
REINFORCED CAST-IN-PLACE CONCRETE FOUNDATION WALL


ASPHALT SHINGLE ROOFING
23/32" DECKING, APA-RATED, STRUCTURE I RATED
SYNTHETIC, NON-ASPHALTIC MEMBRANE UNDERLAYMENT
PRE-ENGINEERED WOOD TRUSS (BEYOND)
ICE BARRIER
STAINLESS STEEL EAVE FLASHING & DRIP EDGE
HALF-ROUND ALUMINUM GUTTER
XPS RAFTER VENT
LOOSE-FILL BLOWN-IN CELLULOSE
25 GAUGE, 7/8" METAL HAT CHANNEL AT 16" O.C., TYPICAL
1'-5"
B.O. TRUSS (A)
+22' - 0"
AIR BARRIER MEMBRANE
1'-9"
5/8" TYPE-X GYPSUM BOARD SHEATHING
2x6 DOUBLE TOP PLATES
STONE WOOL BATT INSULATION
HFO SPRAY FOAM INSULATION
2x6 STUD FRAMING BEYOND
5/4x10 (NOMINAL) ENGINEERED WOOD FASCIA
INSECT SCREEN
3/4"x3" (ACTUAL) VENT STRIP
1X3 (NOMINAL) WOOD FURRING STRIP
SEALANT
STRUCTURAL SHEATHING PANEL
POLYISO INSULATION, ABOVE GRADE

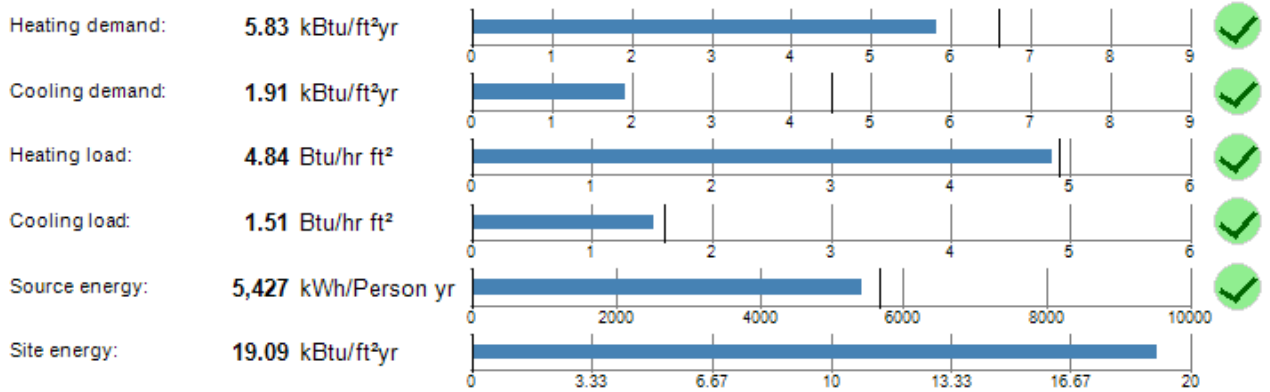
Window Properties

Basic data

Uw -mounted	[Btu/hr ft² °F]	0.1755
Frame factor		0.6815
Glass U-value	[Btu/hr ft² °F]	0.1
SHGC/Solar energy transmittance (perpendicular)		0.392

Frame data

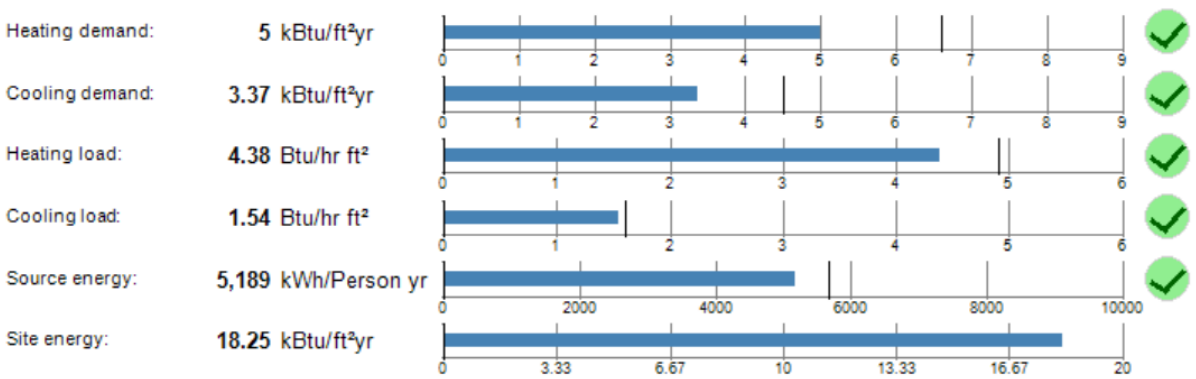
Data state/results | Show warnings | Calculate WUFI shading (control)

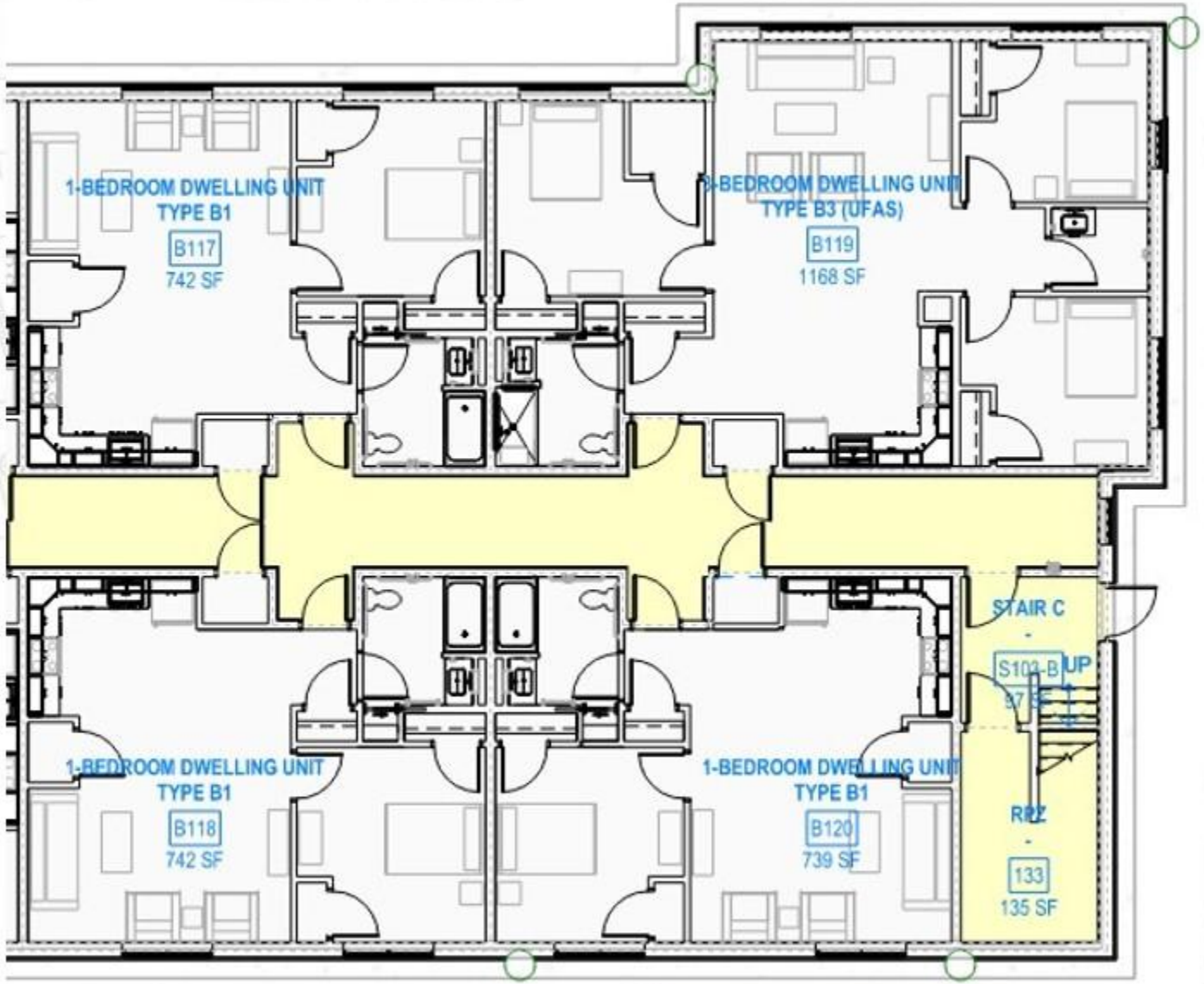


Basic data

Uw -mounted	[Btu/hr ft² °F]	0.1667
Frame factor		0.684
Glass U-value	[Btu/hr ft² °F]	0.1
SHGC/Solar energy transmittance (perpendicular)		0.23

Data state/results | Show warnings | Calculate WUFI shading (control)





Constructability

- Programming:
  - Floor Plans
  - Dwelling Unit Types
  - Plumbing Stacks
- Simple Forms
  - Exterior Diaphragm
  - Demising Walls
  - Minimize Shear
- Conventional Design

- Nicole Schuster, AIA, CPHC, LEED AP, Nicole@positive-trace.com
- Andrew Van Roo, vanroo@ashleymcgraw.com

KEYNOTES

FOR REFERENCE

KEYNOTES - WALL SECTIONS

NOTE: NOT ALL KEYNOTES MAY BE REFERENCED.

NO.	DESCRIPTION
A3-1	SUITABLE UNDISTURBED NATIVE SOIL -OR- SUITABLE GRANULAR FILL, REFER TO STRUCTURAL AND GEOTECHNICAL REPORT.
A3-2	SUITABLE GRANULAR FILL, REFER TO STRUCTURAL AND GEOTECHNICAL REPORT.
A3-3	MINIMUM 6" COMPACTED STRUCTURAL FILL, REFER TO STRUCTURAL.
A3-4	GRADE (TOPSOIL/SEED), REFER TO CIVIL.
A3-5	R-10 (1.5") POLYISO INSULATION AT UNDERSIDE OF SLAB IN IT'S ENTIRETY, U.N.O.. R-10 (1-1/2") POLYISO INSULATION AT SLAB EDGE, ENTIRE PERIMETER OF SLAB.
A3-6	REINFORCED CONCRETE SLAB-ON-GRADE, REFER TO STRUCTURAL. INSTALL 15-MIL POLYOLEFIN VAPOR RETARDER WITH JOINTS LAPPED NOT LESS THAN 6" AT UNDERSIDE OF ENTIRE SLAB.
A3-7	RIGID PERFORATED DRAIN PIPE AT ENTIRE PERIMETER OF BUILDING, REFER TO CIVIL. INSTALL 6" MIN., OF STONE DRAINAGE BED AROUND PIPE AND WRAP WITH GEOTEXTILE FILTER FABRIC. TIE-IN ROOF DRAINS, REFER TO PLUMBING.
A3-8	FIBERGLASS CANT.
A3-9	REINFORCED CAST-IN-PLACE CONCRETE FOOTING, REFER TO STRUCTURAL.
A3-10	REINFORCED CAST-IN-PLACE FOUNDATION WALL, REFER TO STRUCTURAL.
A3-11	BUILDING A & B: R-6 (1") POLYISO INSULATION. BUILDING C: R-15.3 (2.3") POLYISO INSULATION. SUITABLE FOR BELOW GRADE APPLICATION, EXTEND FROM FOOTING UP TIGHT TO UNDERSIDE FRP ANGLE.
A3-12	1/4" XPS PROTECTION BOARD. TROWEL ON PROTECTIVE,
A3-13	2X P.T. WOOD SILL PLATE OVER POLYETHYLENE FOAM SILL SEALER. FASTEN SILL PLATE TO FOUNDATION WALL WITH GALVANIZED ANCHOR BOLTS, REFER TO STRUCTURAL.
A3-14	2X6 WOOD FRAMING (BEYOND), REFER TO STRUCTURAL. FILL THE ENTIRE STUD CAVITY WITH R-14.4 (2") HFO SPRAY FOAM INSULATION & R-15 (3-1/2") STONE WOOL BATT INSULATION.
A3-15	1/2" ENGINEERED STRUCTURAL SHEATHING PANEL WITH INTEGRAL WEATHER-RESISTANT BARRIER, TAPE ALL SEAMS.
A3-16	R-21.7 (3-1/2") POLYISO INSULATION, ABOVE GRADE.
A3-17	MANUFACTURED STONE VENEER.
A3-18	PRE-FORMED MANUFACTURED STONE SILL.
A3-19	1X3 P.T. SOLID WOOD FURRING STRIPS AT 16" O.C. VERTICALLY (BEYOND).
A3-20	0.315" THICK, ENGINEERED WOOD COMPOSITE SIDING, FACTORY PRIMED AND PREFINISHED CEDAR TEXTURE, INSTALL PER MANUFACTURER'S REQUIREMENTS. SEE EXTERIOR ELEVATIONS FOR ADDITIONAL INFORMATION
A3-21	5/4 (NOMINAL), ENGINEERED WOOD TRIM, FACTORY PRIMED AND PREFINISHED CEDAR TEXTURE, INSTALL PER MANUFACTURER'S REQUIREMENTS. SEE EXTERIOR ELEVATIONS FOR ADDITIONAL INFORMATION.
A3-22	POLYMER STEEL REINFORCED WINDOW ASSEMBLY WITH FULLY SIMULATED DIVIDED LITES, SEE EXTERIOR ELEVATIONS & WINDOW SCHEDULE.
A3-24	5/4X12 (NOMINAL), ENGINEERED WOOD BAND TRIM, FACTORY PRIMED AND PREFINISHED CEDAR TEXTURE, INSTALL PER MANUFACTURER'S REQUIREMENTS. SEE EXTERIOR ELEVATIONS FOR ADDITIONAL INFORMATION
A3-25	5/8" TYPE-X GYPSUM BOARD SHEATHING, PREP, PRIME, AND PAINT, REFER TO FINISH SCHEDULE.
A3-26	1/2" PLYWOOD BLOCKING OVER 2X SOLID WOOD SILL PLATE AND 2X SOLID WOOD JAMB/HEAD BLOCKING, ENTIRE PERIMETER OF OPENING.
A3-27	5/4X8 (NOMINAL) SOLID POPLAR SILL AND 1X4 (NOMINAL SOLID POPLAR APRON, PREP, PRIME, AND PAINT. ALL OUTSIDE CORNERS SHOULD BE EASED 1/8" RADIUS.
A3-28	HEADER WITH INSULATION, SEE STRUCTURAL.
A3-29	FLOOR/CEILING ASSEMBLY TYPE F1, SEE FLOOR/CEILING TYPE SCHEDULE.
A3-30	DOUBLE 2X WOOD TOP PLATES
A3-31	ROOF ASSEMBLY TYPE R2, SEE ROOF/CEILING TYPE SCHEDULE.
A3-32	5/8" TYPE-X GYPSUM BOARD, SUSPENDED CEILING SYSTEM, PREP, PRIME, & PAINT.
A3-33	5/8" TYPE-X GYPSUM BOARD SHEATHING ON 7/8" METAL HAT CHANNELS AT 16" O.C.
A3-34	R-88 (24") LOOSE-FILL, BLOWN-IN INSULATION. AT UNDERSIDE OF ROOF TRUSS: INSTALL POLYETHYLENE AIR BARRIER WITH INTEGRAL MESH REINFORCEMENT TO ACCOMMODATE BLOWN-IN INSULATION. WRAP WOOD TOP PLATES AND OVERLAP WEATHER-RESISTANT BARRIER AT EXTERIOR WALL.
A3-35	ATTIC VENTS (BAFFLES) BETWEEN EACH ROOF TRUSS.
A3-36	0.354" THICK, ENGINEERED WOOD COMPOSITE VENTED SOFFIT PANEL.
A3-37	PRE-ENGINEERED ROOF TRUSSES AT 16" O.C., TO BE DESIGNED BY TRUSS MANUFACTURER.
A3-38	11/16" ROOF DECKING WITH INTEGRAL WEATHER-RESISTANT BARRIER, APA-RATED, EXPOSURE I, WITH CLIPS. TAPE ALL SEAMS.
A3-39	SELF-ADHERING POLYMER MODIFIED BITUMEN SHEETING TO COMPLY WITH ASTM D1970. AT ALL EAVES: INSTALL ICE BARRIER EQUAL TO (2) LAYERS OF 36" WIDE SELF-ADHERING POLYMER MODIFIED BITUMEN SHEETING.
A3-40	ASPHALT SHINGLE ROOFING. AT GABLE ROOF RIDGE: INSTALL RIDGE CAP SHINGLES OVER RIDGE VENT.
A3-41	0.032" THICK ALUMINUM EAVE FLASHING/DRIP.
A3-42	0.032" THICK ALUMINUM, HALF-ROUND GUTTER & ASSOCIATED MOUNTING SUPPORTS. ALL MINIMUM DOWNSPOUTS SHALL TIE-INTO FOUNDATION DRAINS.
A3-43	5/4X10 (NOMINAL), ENGINEERED WOOD FASCIA, FACTORY PRIMED AND PREFINISHED CEDAR TEXTURE, INSTALL PER MANUFACTURER'S REQUIREMENTS.
A3-45	ROOF/CEILING ASSEMBLY TYPE R3, SEE ROOF/CEILING TYPE SCHEDULE. FILL ENTIRE CAVITY WITH LOOSE FILL BLOWN-IN CELLULOSE INSULATION R-60, MIN.
A3-46	R-53.6 (9") POLYISO ROOF INSULATION WITH TAPERED COVER BOARD, SLOPE 1/4" PER FOOT TOWARDS ROOF DRAINS.
A3-47	FULLY ADHERED, 60 MIL MEMBRANE ROOFING, WRAP OVER TOP OF ROOF EDGE FRAMING.
A3-49	1-3/4"X20" MICROLAM LVL BETWEEN EVERY OTHER TRUSS, REFER TO STRUCTURAL.
A3-50	MANUFACTURED STONE VENEER AND PRE-CAST STONE CAP APPLIED TO CONCRETE PIER PER MANUFACTURER REQUIREMENTS, REFER TO STRUCTURAL
A3-51	8X8 (NOMINAL) PSL WOOD COLUMN, STAIN, REFER TO STRUCTURAL
A3-52	6X8 (NOMINAL) WOOD KICKER, STAIN, REFER TO STRUCTURAL
A3-53	8X18 (NOMINAL) GIRDER, STAIN, REFER TO STRUCTURAL
A3-54	4X12 (NOMINAL) WOOD RAFTERS, STAIN, REFER TO STRUCTURAL
A3-55	ROOF ASSEMBLY TYPE R1, SEE ROOF/CEILING TYPE SCHEDULE.
A3-57	EXTERIOR SLAB ON GRADE, REFER TO CIVIL
A3-58	2X WOOD FRAMING AT 16" O.C.
A3-59	1/2" RESILIENT CHANNEL
A3-60	PROVIDE & INSTALL WINDOW TREATMENT AND ASSOCIATED SOLID THROUGH-WALL BLOCKING, AS REQUIRED, SEE FINISHES.
A3-63	FIBERGLASS SHELF ANGLE, SEE STRUCTURAL