BUILDING INHERENT VALUE:

Implementing the Passive House Building Standard

E-ICON ARCHITECTURE

maine passive house MPH

PHIUS 13th Annual North American Passive House Conference

Building Inherent Value:

Implementing the Passive House Building Standard

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Michelle Apigian, AIA, LEED AP, AICP

September 21, 2018

OVERVIEW:

INSULATION
AIR TIGHTNESS
VENTILATION
METRICS
COST

INSULATION

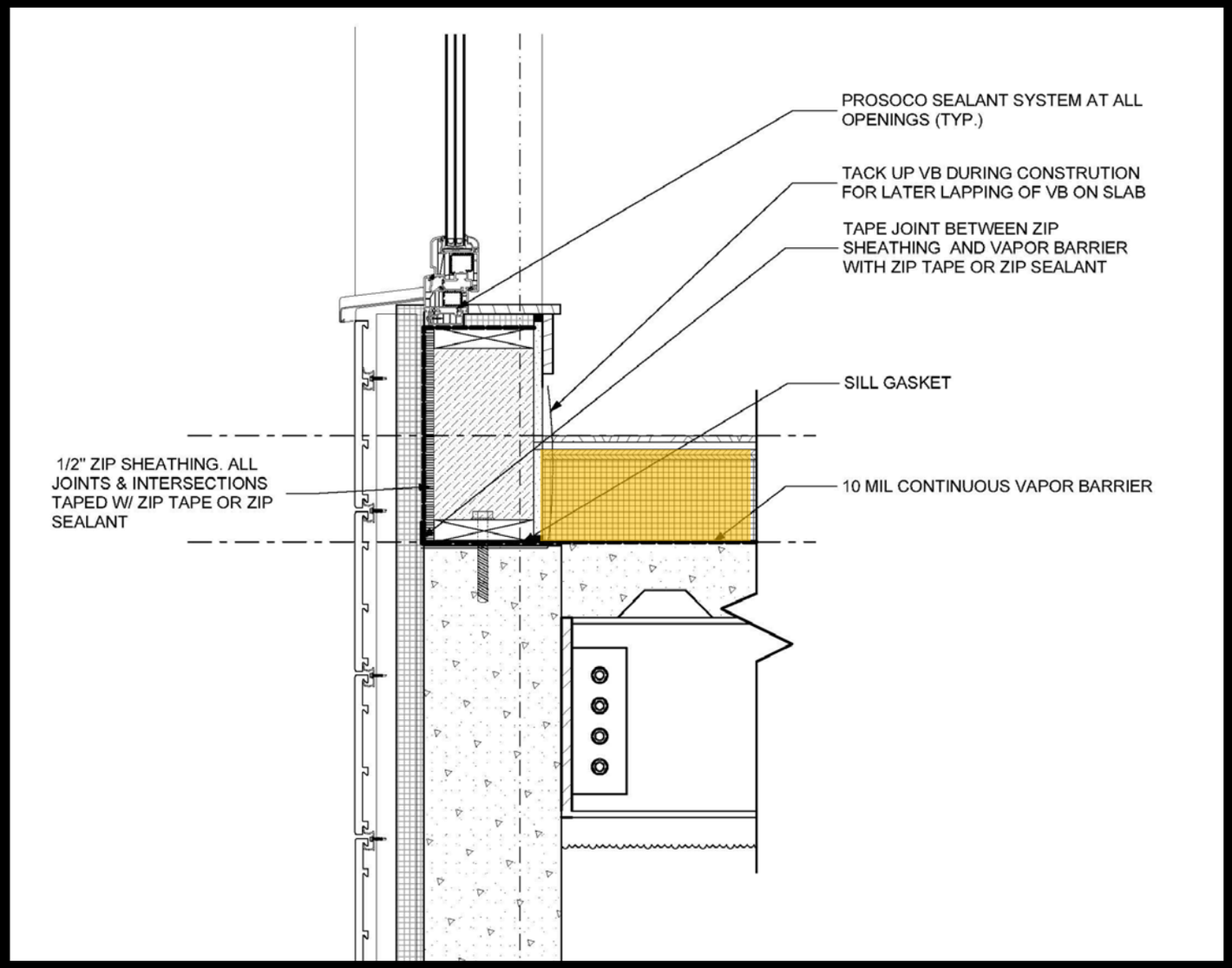
Multifamily

THE DISTILLERY

South Boston, MA

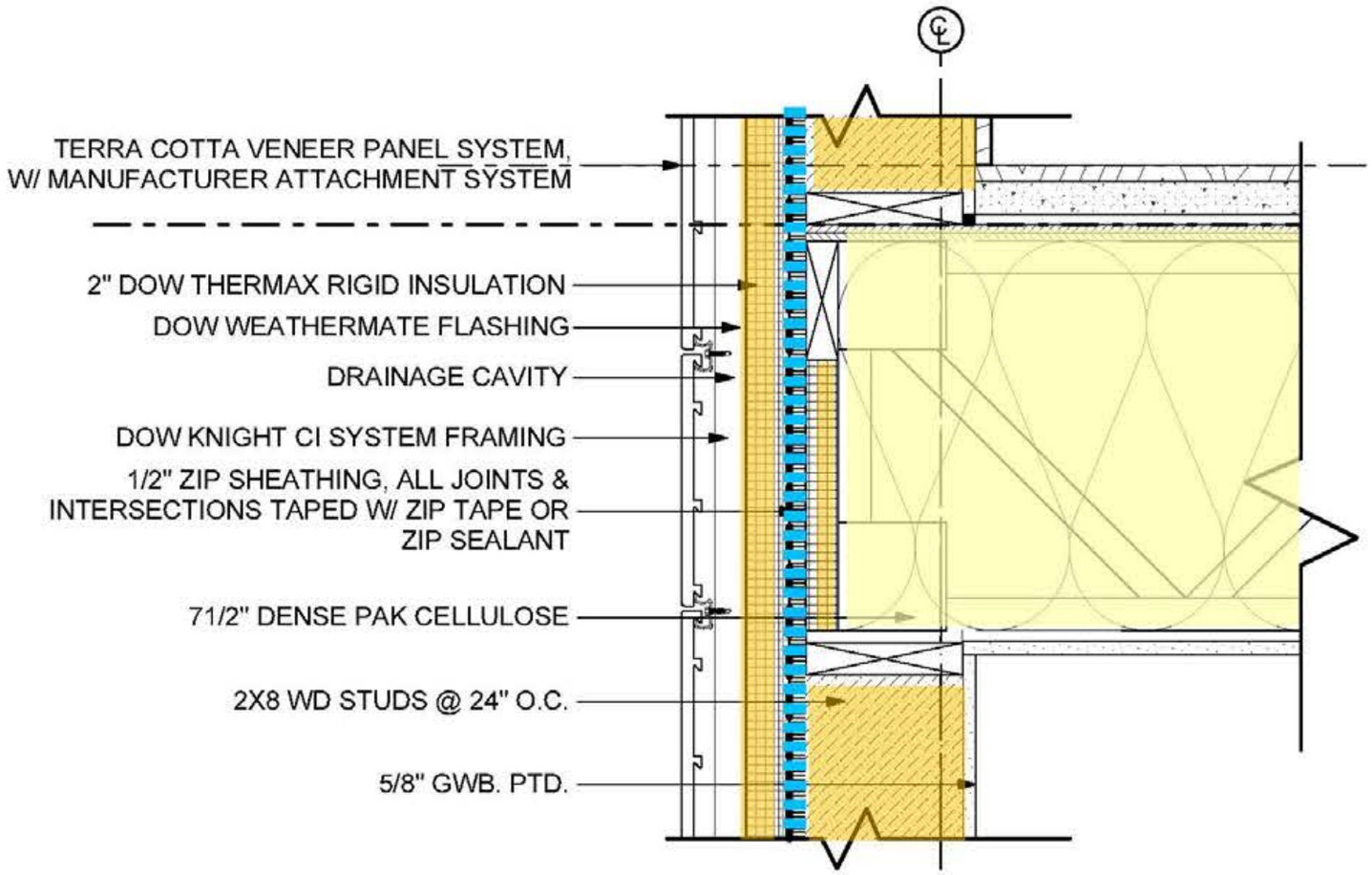
- Mixed Use
- 28 Units

- 6” EPS ABOVE DECK



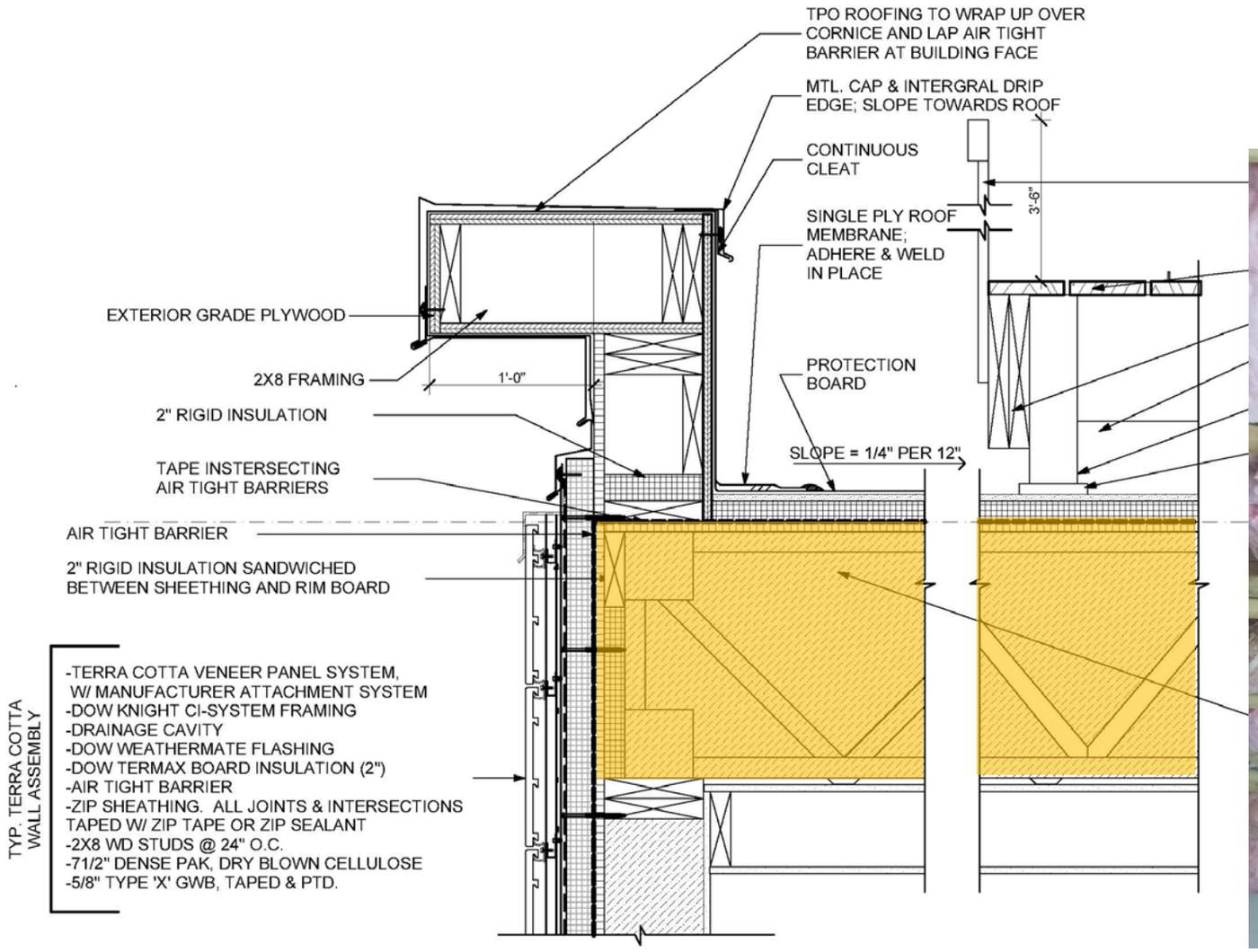
WALLS R:34

- 3” MINERAL WOOL – CONTINUOUS
- 2X8 CAVITY FILLED WITH CELLULO
- CELLULOSE IN FIRST 3’ OF TRUSS



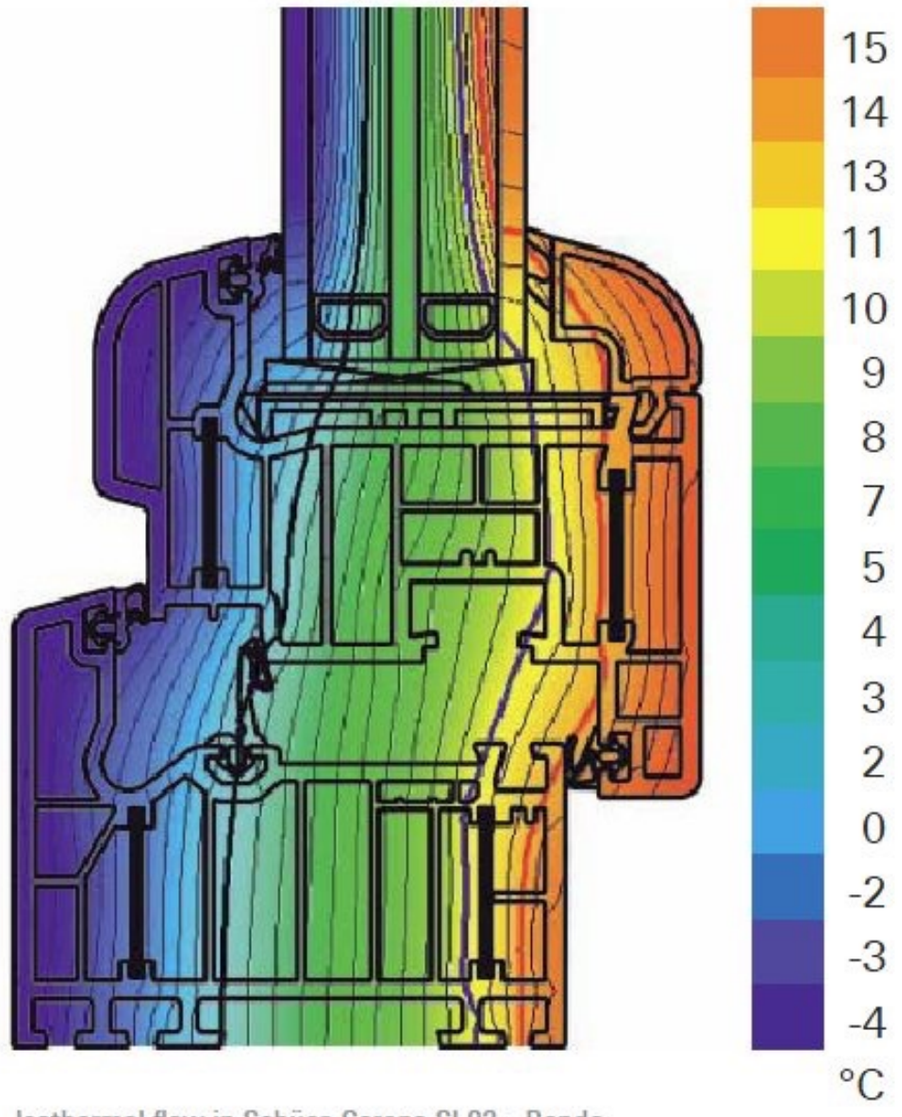
ROOF R:60

- TRUSS CAVITY FILLED WITH CELLULOSE
- 2” MIN CONT INSULATION ABOVE ROOF DECK



WINDOWS U - 0.134

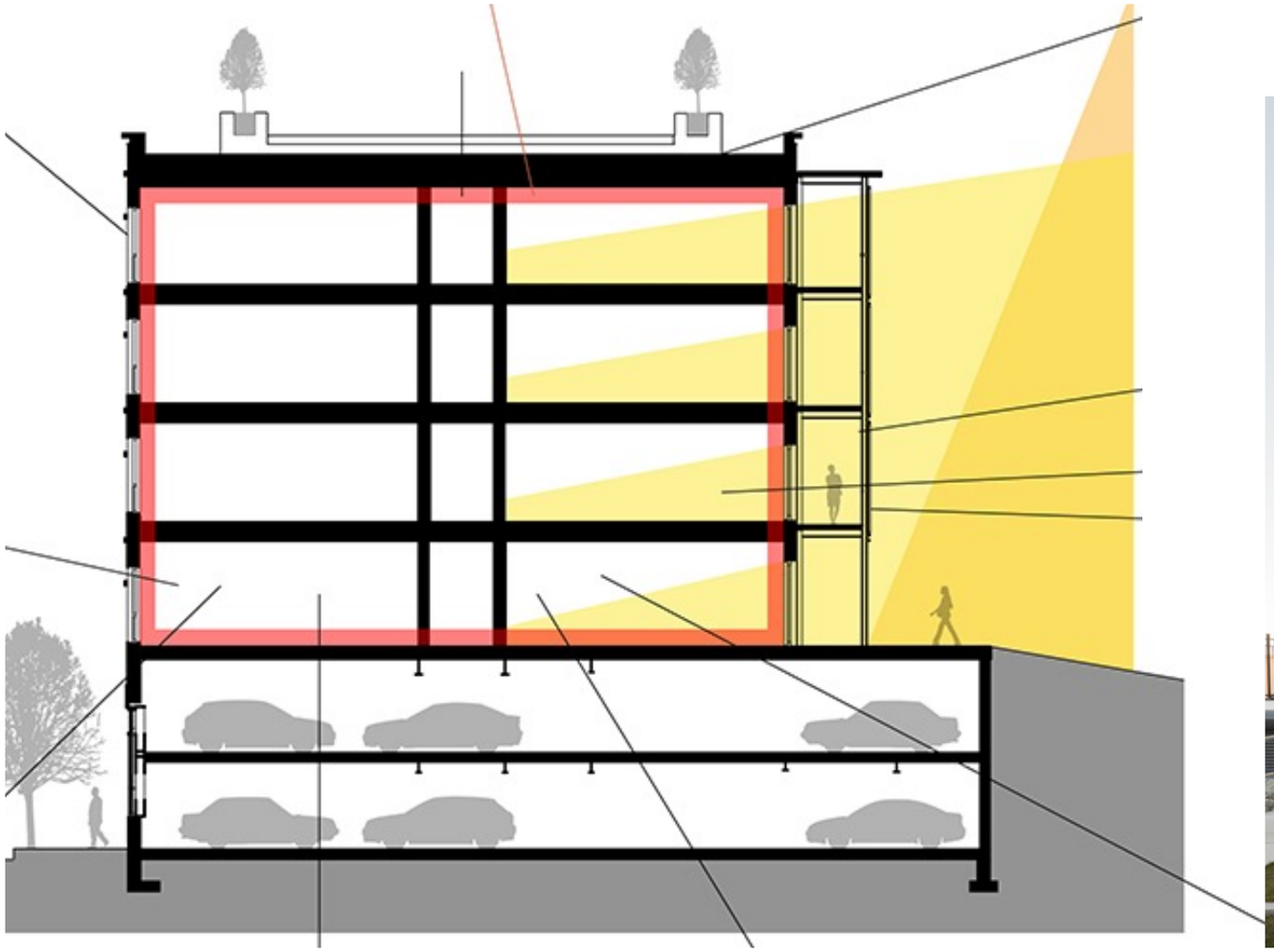
- KLEARWALL uPVC



Isothermal flow in Schüco Corona SI 82+ Rondo

SHADING

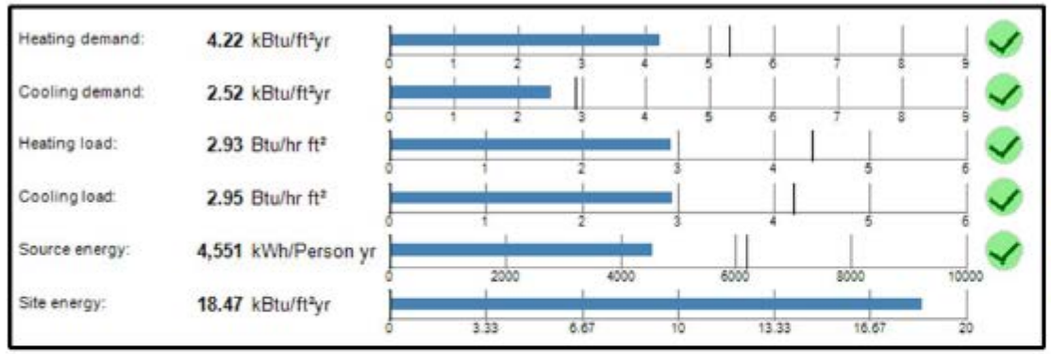
- PERMANENT 5’ DEEP OVERHANG FOR HIGH SUMMER SUN
- MOVEABLE SCREENS ON SOUTH SIDE



ENERGY
COMFORT
DIMINISHING RETURNS

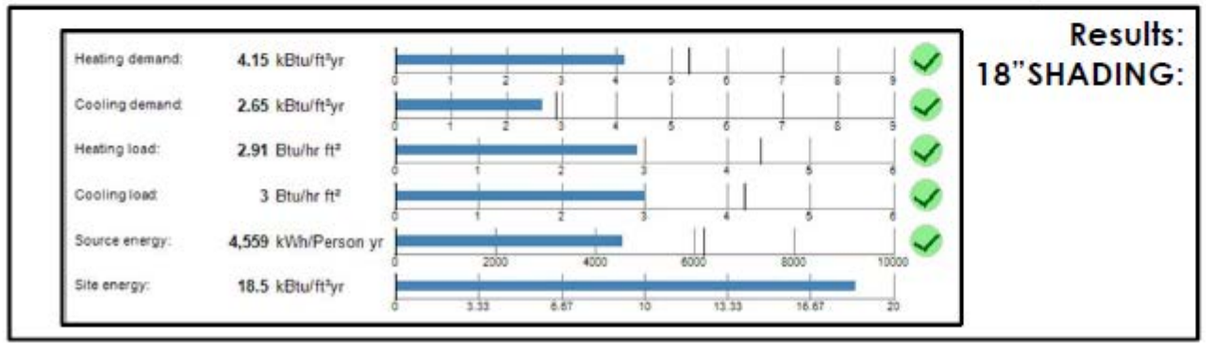
SHADING: SOUTH ONLY (36")

The WUFI results indicated below are based on a design with **36"** shading devices installed on the Southern façade only.



Measured Changes: from 18" Shades

- HD – **Up 0.07 k** kBtu/ft2/yr
- CD – **Down 0.13** kBtu/ft2/yr
- HL – **Up 0.02** Btu/hr/ft2
- CL – **Down 0.05** Btu/hr/ft2
- Source –**Down 8** kwh/p/yr
- Site: **Down 0.03** kBtu/ft2/yr

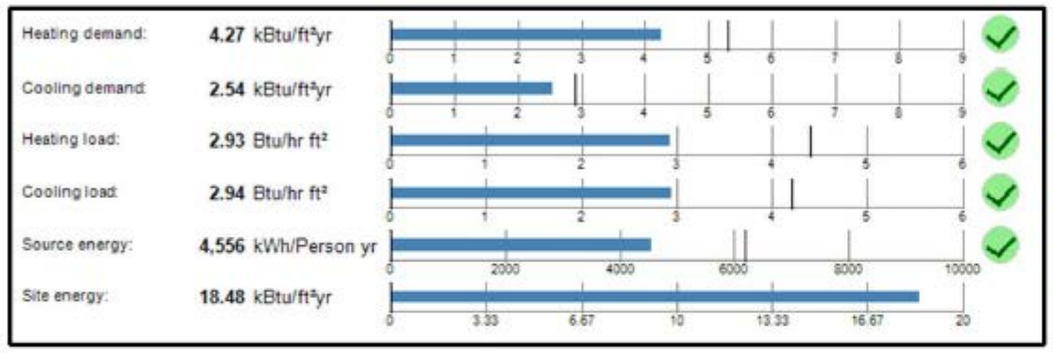


Results: 18"SHADING:

SIGNATURE SUSTAINABILITY

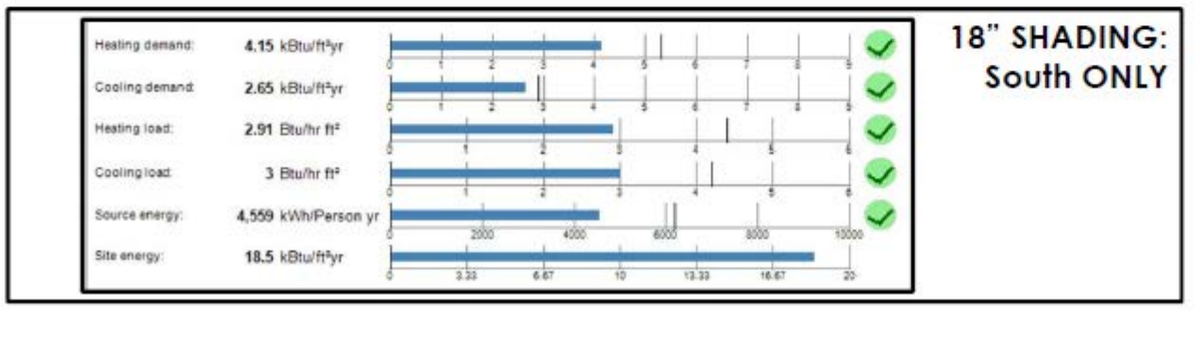
SHADING: SOUTH, EAST & WEST (1'-6")

The WUFI results indicated below are based on a design with **1'- 6"** shading devices installed on the South, East and West façades.



Measured Changes: from 18" South Only

- HD – **Up 0.12 k** kBtu/ft2/yr
- CD – **Down 0.11** kBtu/ft2/yr
- HL – **Up 0.02** Btu/hr/ft2
- CL – **Down 0.06** Btu/hr/ft2
- Source –**Down 3** kwh/p/yr
- Site: **Down 0.02** kBtu/ft2/yr



18" SHADING: South ONLY

SIGNATURE SUSTAINABILITY

Single family

7 PASSIVE HOUSE PROJECTS
3 HIGH PERFORMANCE HOMES

SLAB

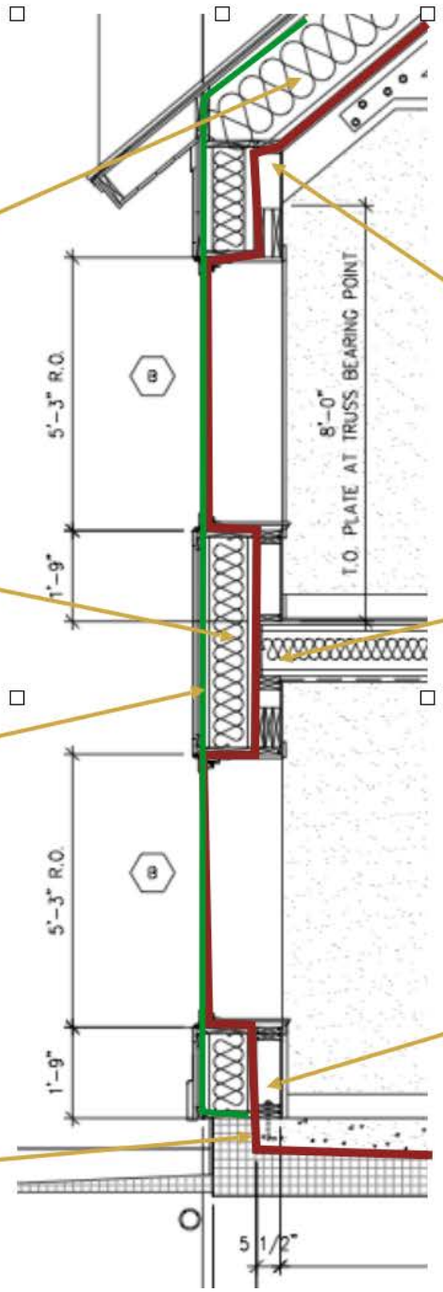
10” EPS foam

15 mill vapor barrier

8” concrete

FOUNDATION

Walls



Dense packed cellulose

Wind and Weather Resistant Barrier with high perm rating

Vapor control layer

Most structural connections inside vapor control layer

Load bearing 2x6 wall sits on concrete


MENTO
PLUS

Roofs

Shading

Calculate shade

Design windows for daylight and views.

September

Exterior shading

Windows

Windows

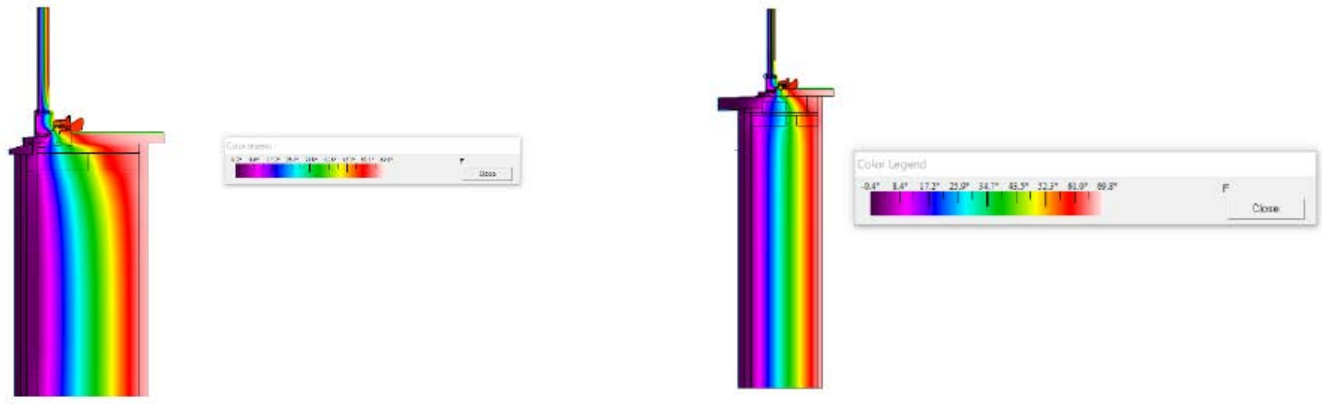


Figure 5: Sill temperature isotherm, (outer on left, centered on right)

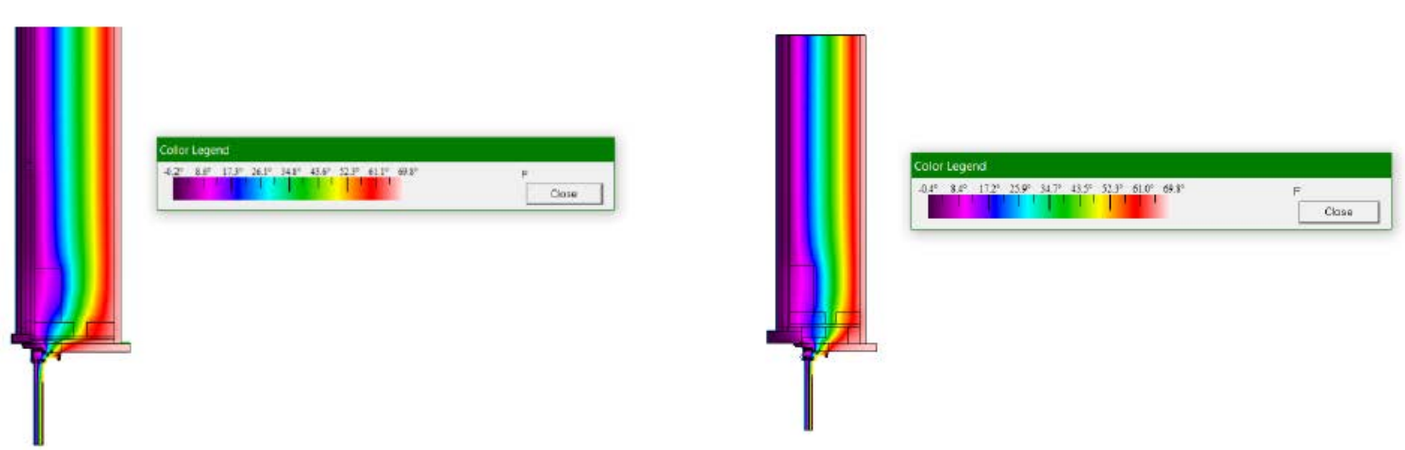


Figure 6: Head temperature isotherms, (outer on left, centered on right)

R-VALUE JUXTAPOSTION

MULTI FAMILY

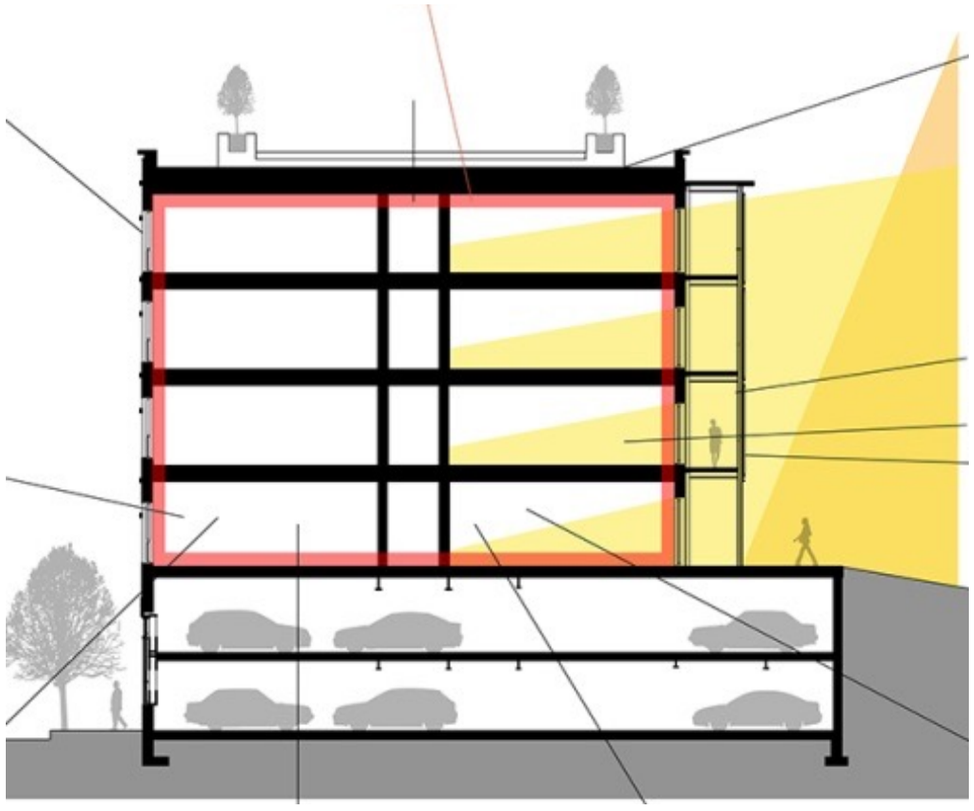
Ground: R 23 (5” EPS foam)
Walls: R 27 (7.5” cellulose)
Roof: R 60 (18-20”)

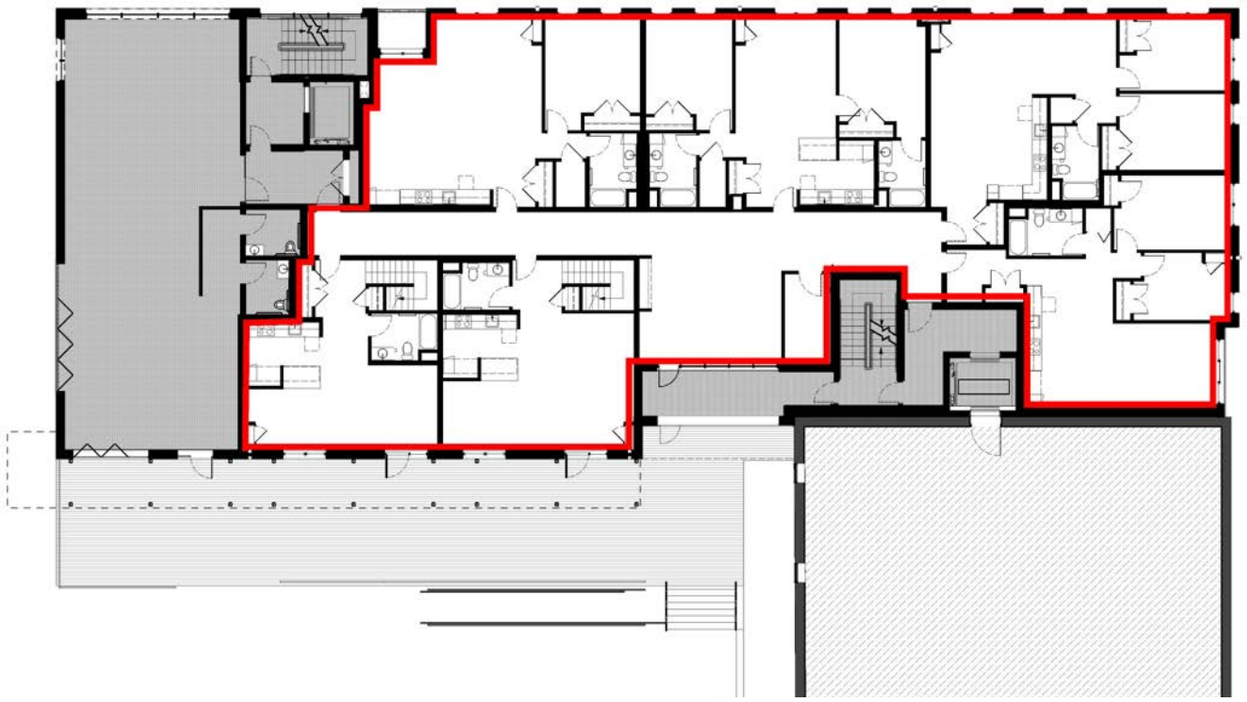
SINGLE FAMILY

Ground: R 45 (10” EPS foam)
Walls: R 57 (15” cellulose)
Roof: R 89-114 (24-36“)

AIR BARRIERS

Multifamily



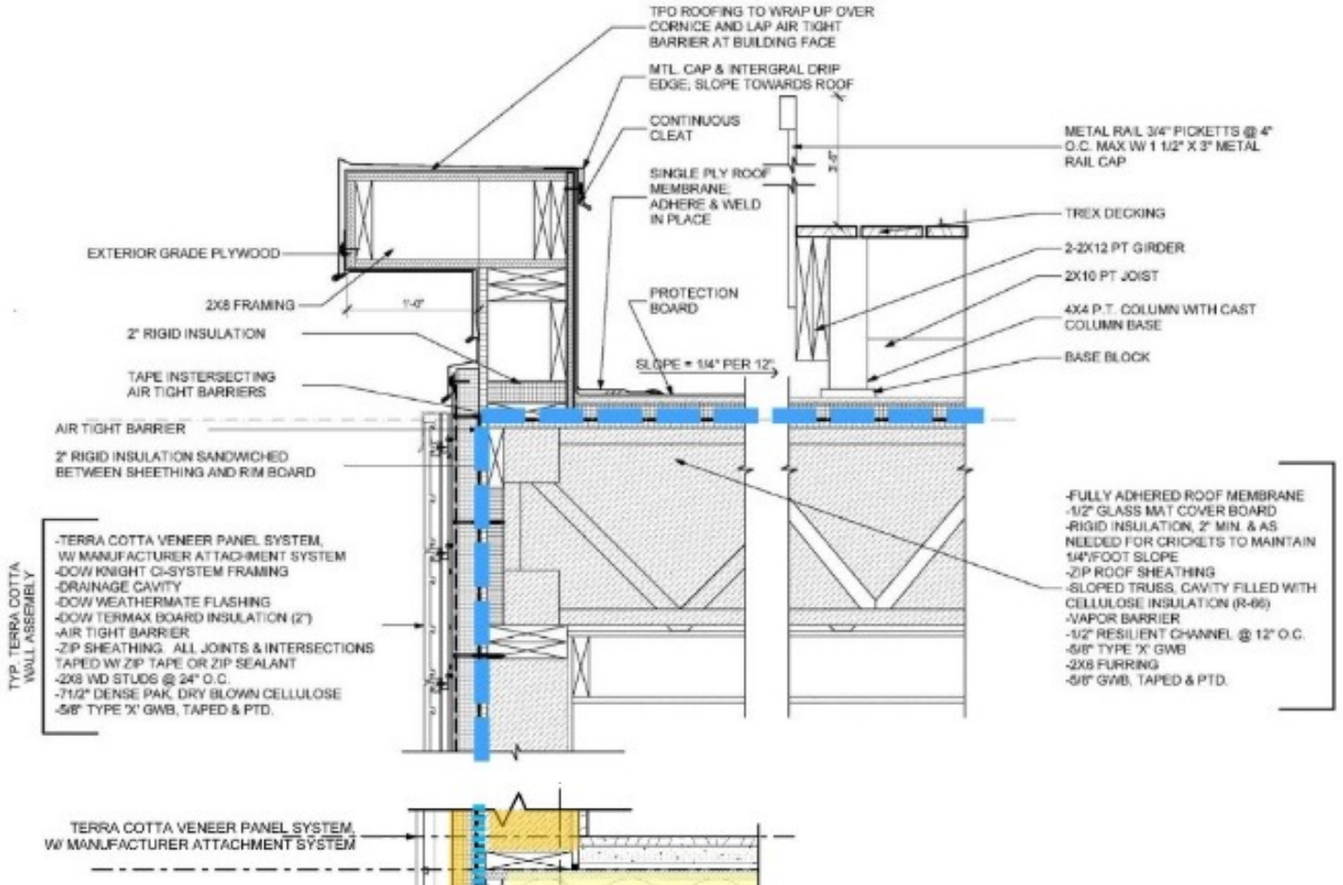


PH ENELOPE

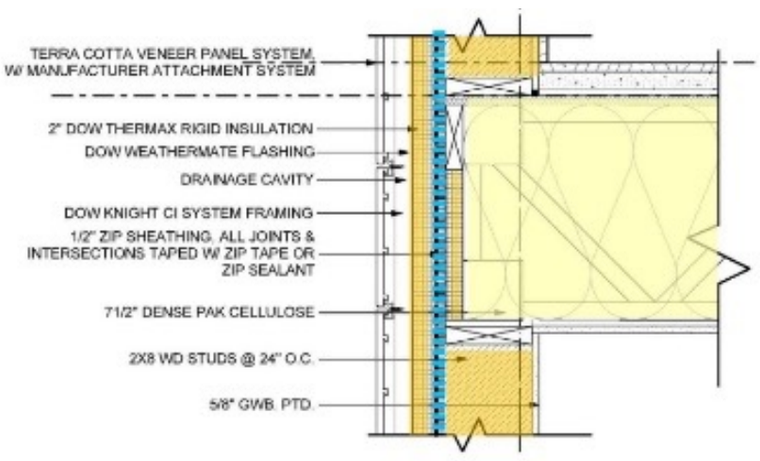
SECTION

PH ENELOPE

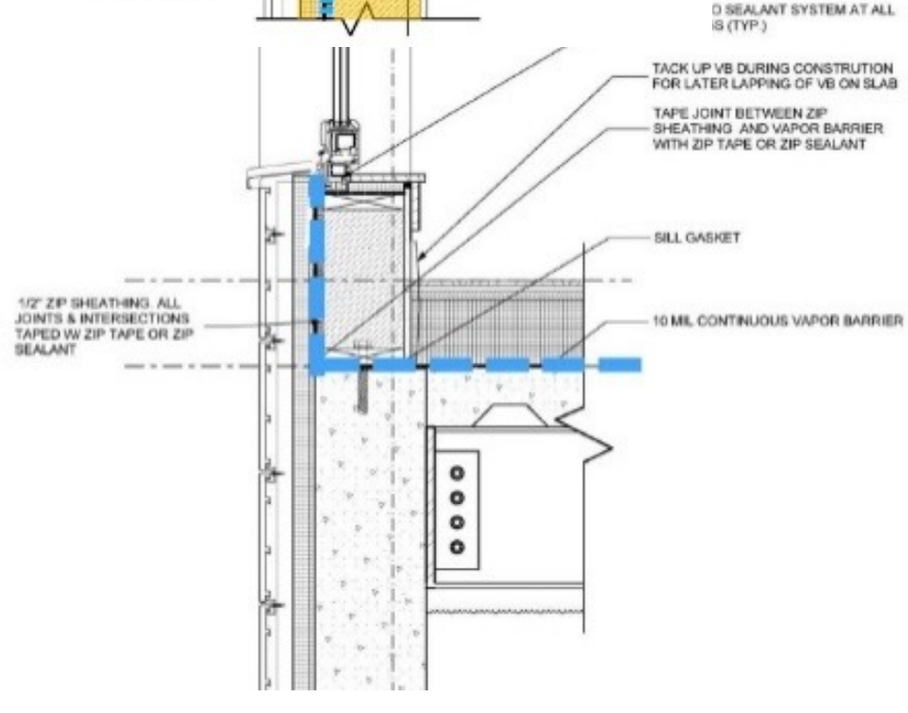
PLAN



ROOF TO WALL

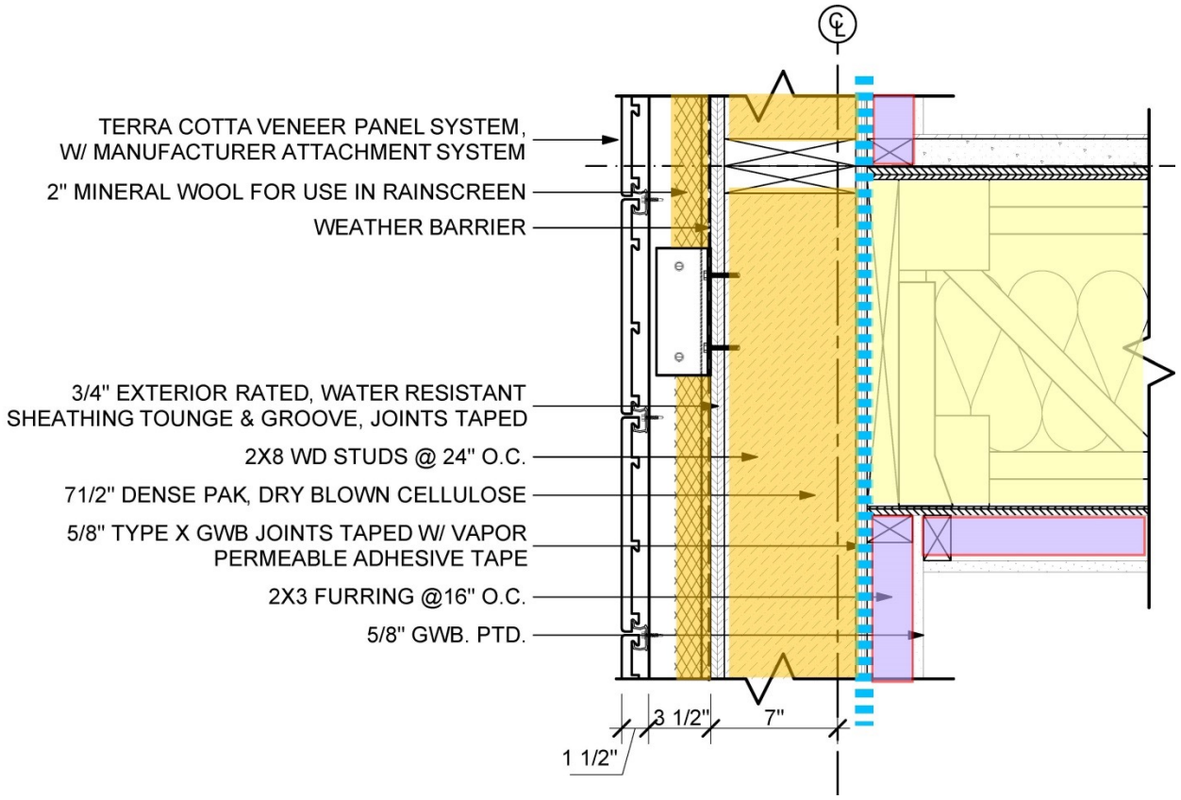


WALL

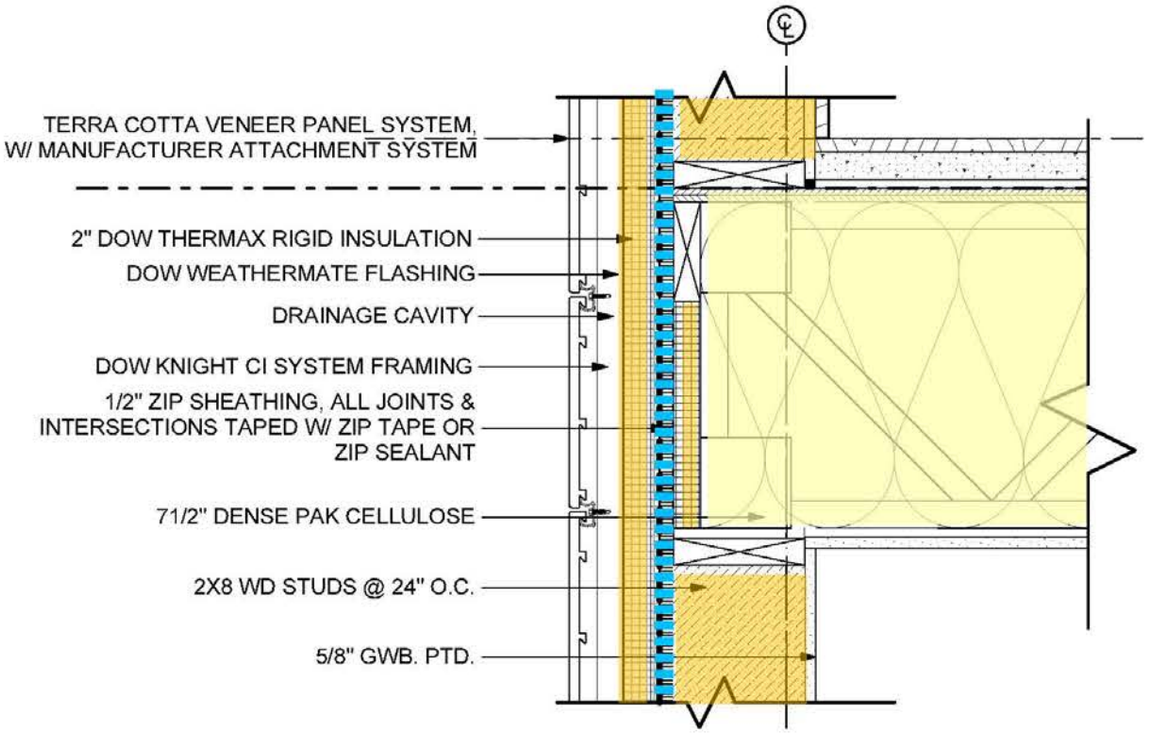


WALL TO SLAB

SECTION EVOLUTION

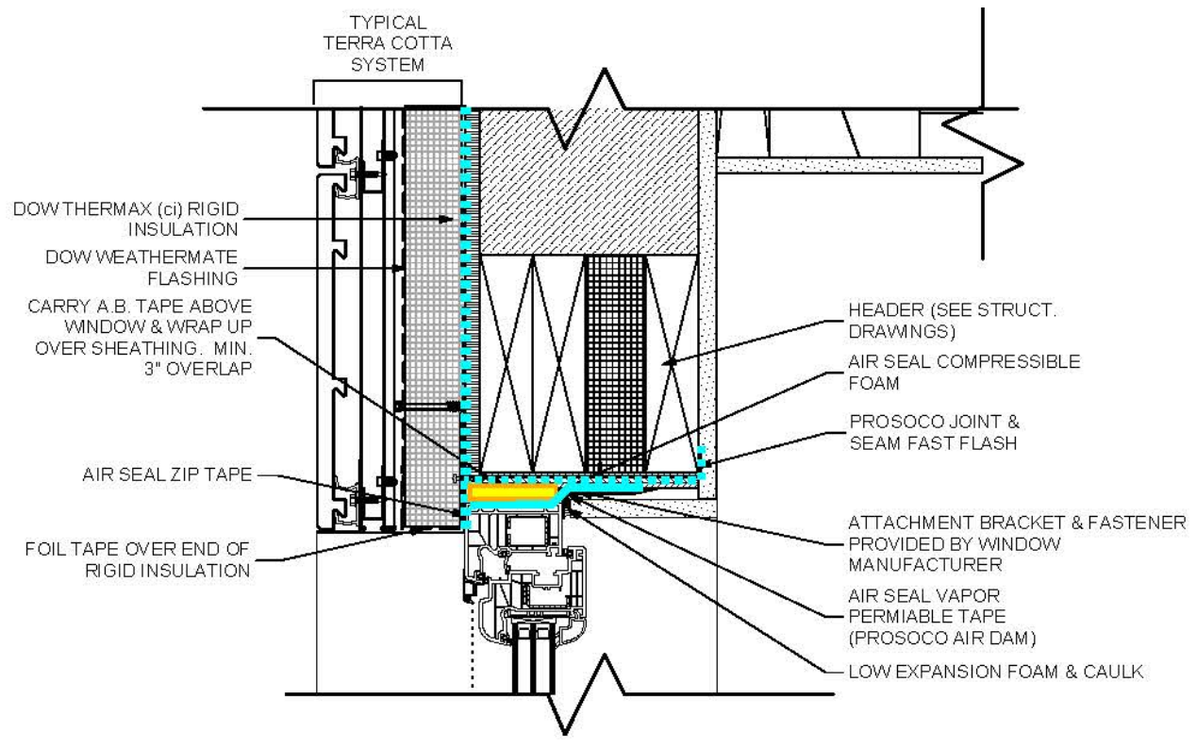


2011



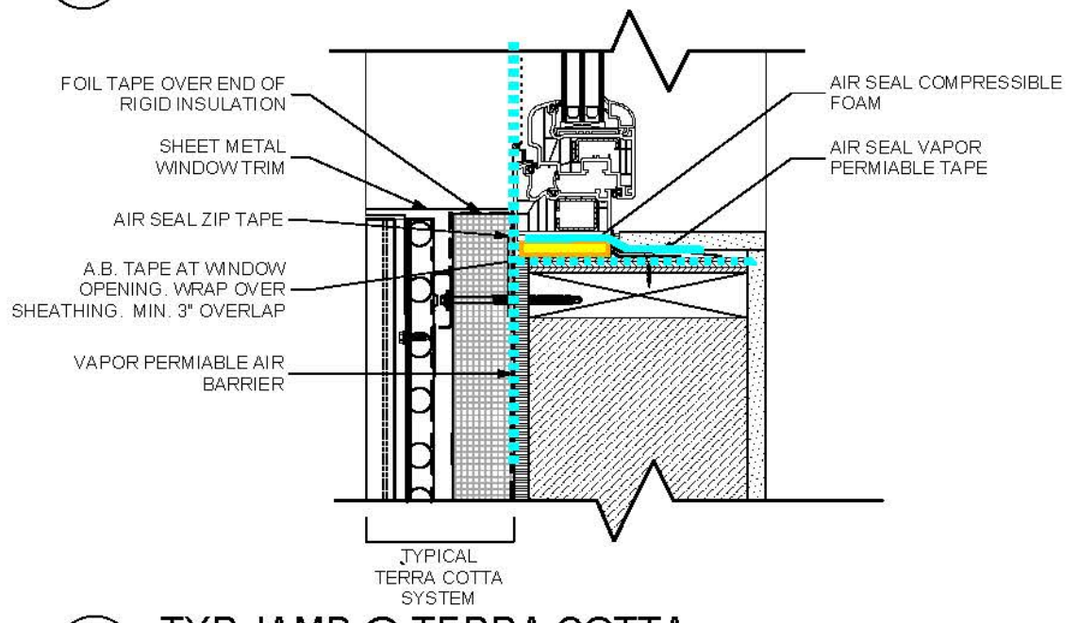
2014

WINDOWS



3 TYP. HEAD @ TERRA COTTA

SCALE: 3" = 1'-0"



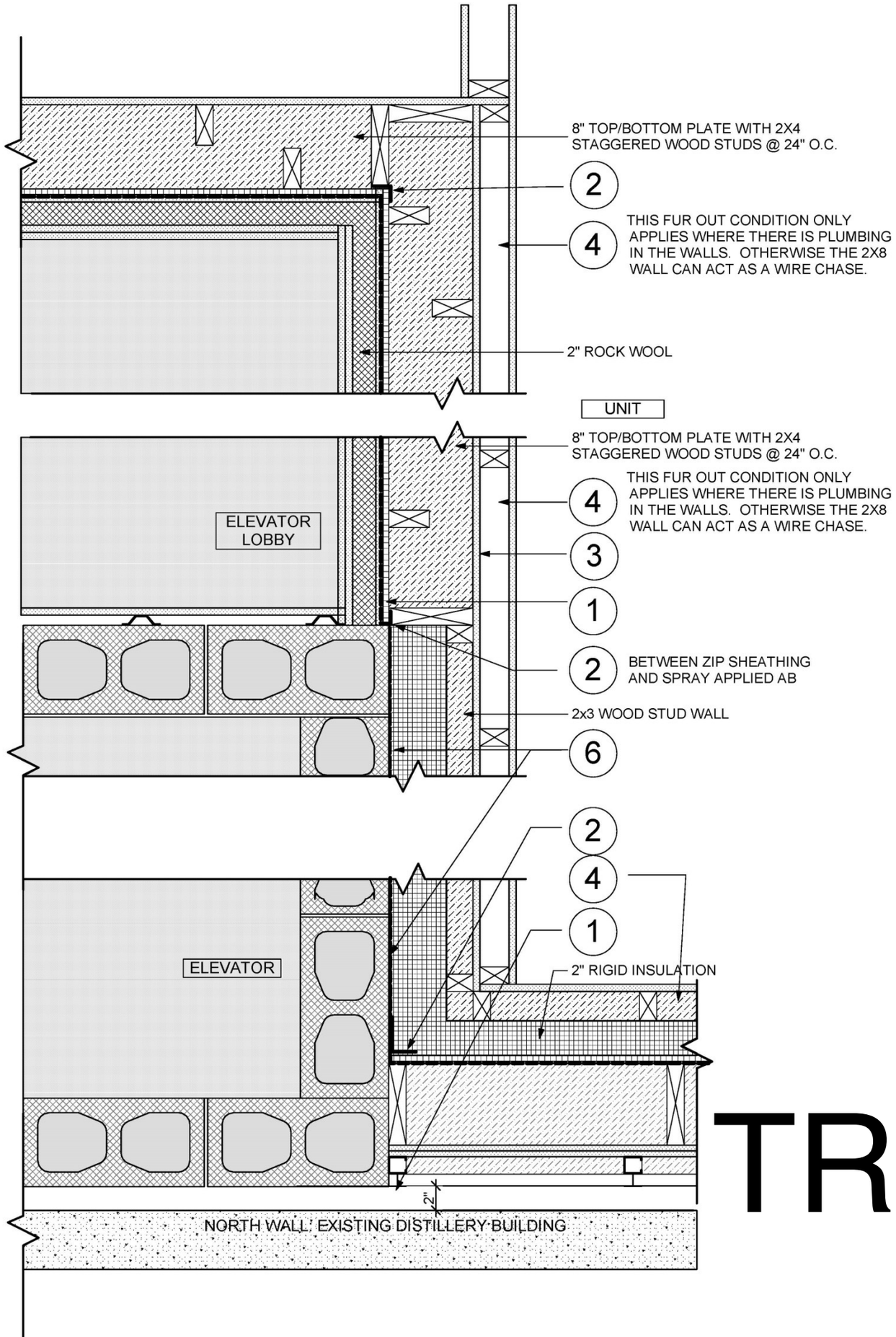
2 TYP JAMB @ TERRA COTTA

SCALE: 3" = 1'-0"

TESTING

.6 ACH_{50}	2611	CFM_{50}
DUCLOS METHOD RECOMENDATIONS		
Stage #1 Test (envelope no windows & Doors)	652.75	CFM_{50}
Stage #2 Test (windows & doors)	1552.75	CFM_{50}
Stage #3 Test (MEP penetrations)	2219.35	CFM_{50}

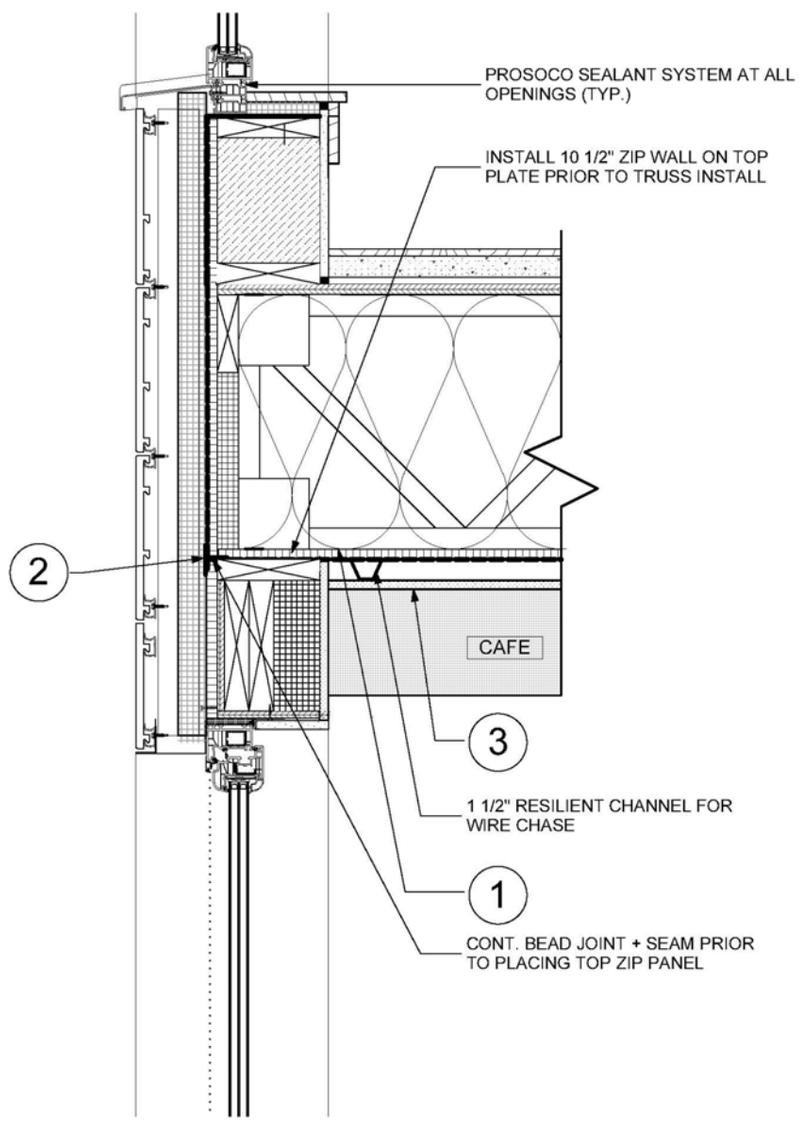
5/16/17: 2563 CFM50 (189.9 in2 leakage area) - .56 ach50

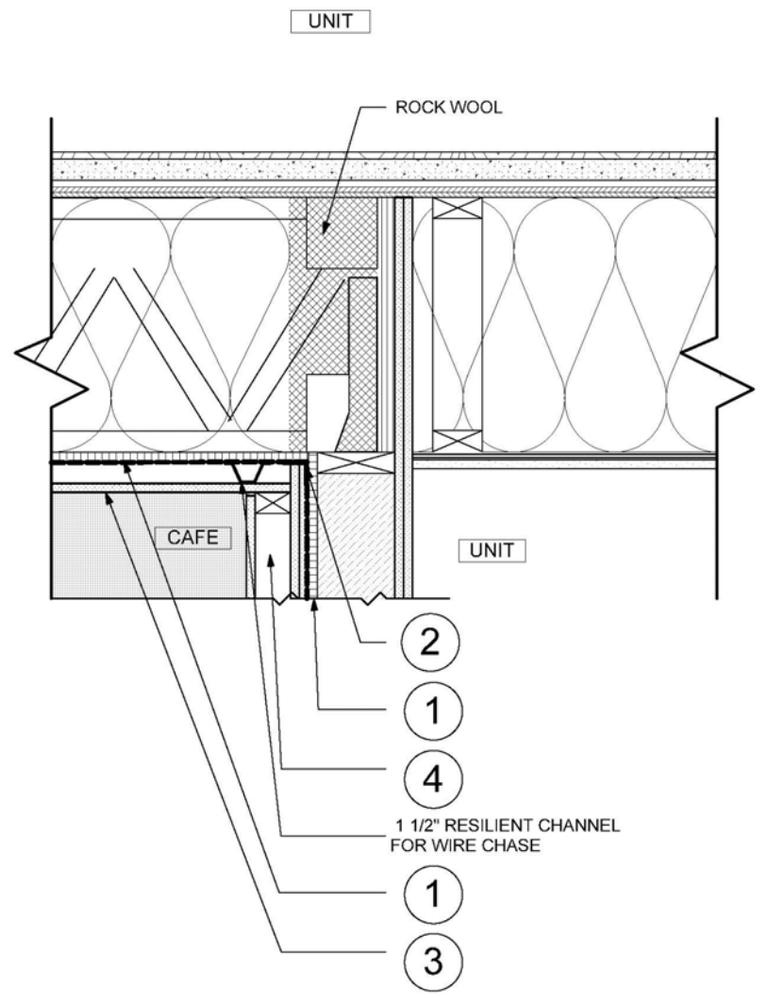


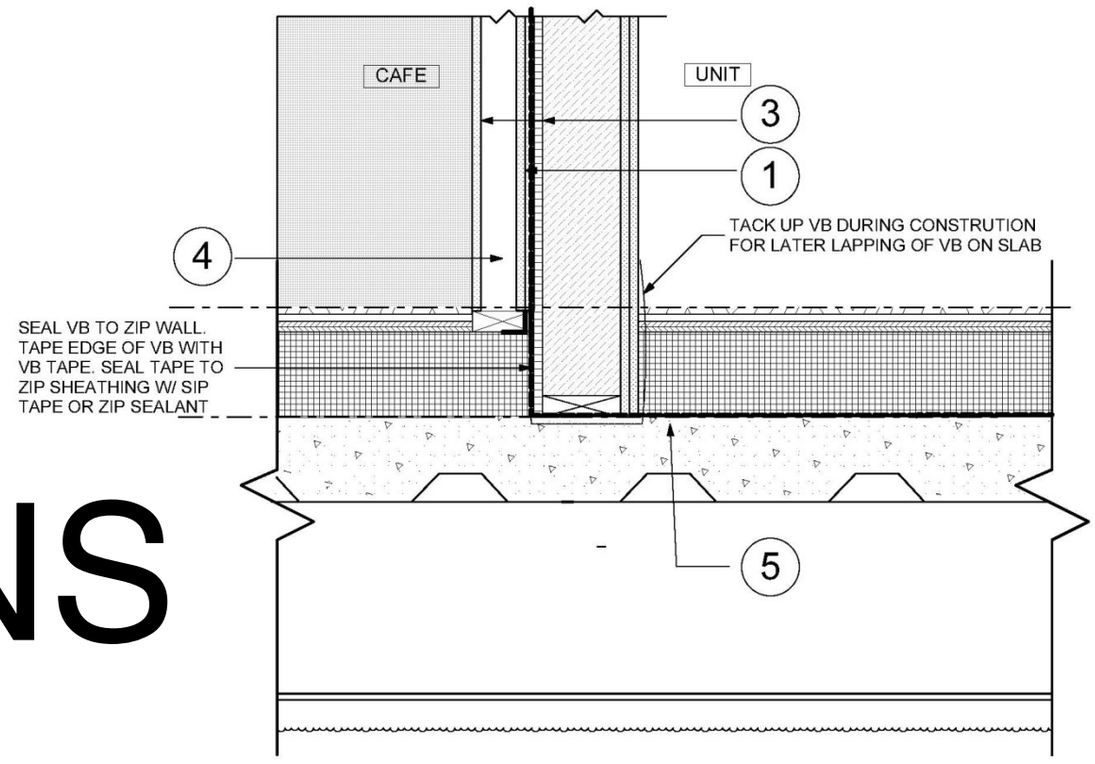
LEGEND

———	DENOTES LOCATION OF CONTINUOUS AIR TIGHT BARRIER
1	1/2" ZIP SHEATHING. ALL JOINTS & INTERSECTIONS TAPED W/ ZIP TAPE OR ZIP SEALANT.
2	TAPE JOINT WITH ZIP TAPE OR ZIP SEALANT
3	5/8" TYPE X GWB., TAPED & PAINTED
4	2X3 FURRING AT 16" O.C.
5	10 MIL CONTINUOUS VAPOR BARRIER
6	LIQUID APPLIED AIR BARRIER

TRANSITIONS







TRANSITIONS


ZIPSystem
FLASHING TAPE
30 YEAR SYSTEM LIMITED WARRANTY
FROM THE CREATORS OF AdvanTech Flooring
KNAACK
EAST COAST
KNAACK

Single family

TJI wall

Double stud wall

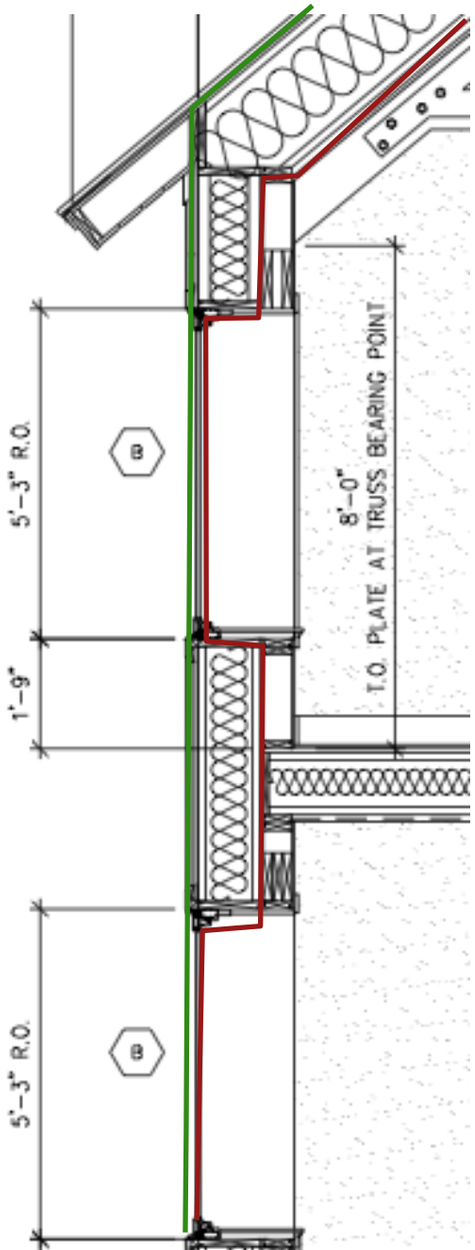
Section (d)evolution

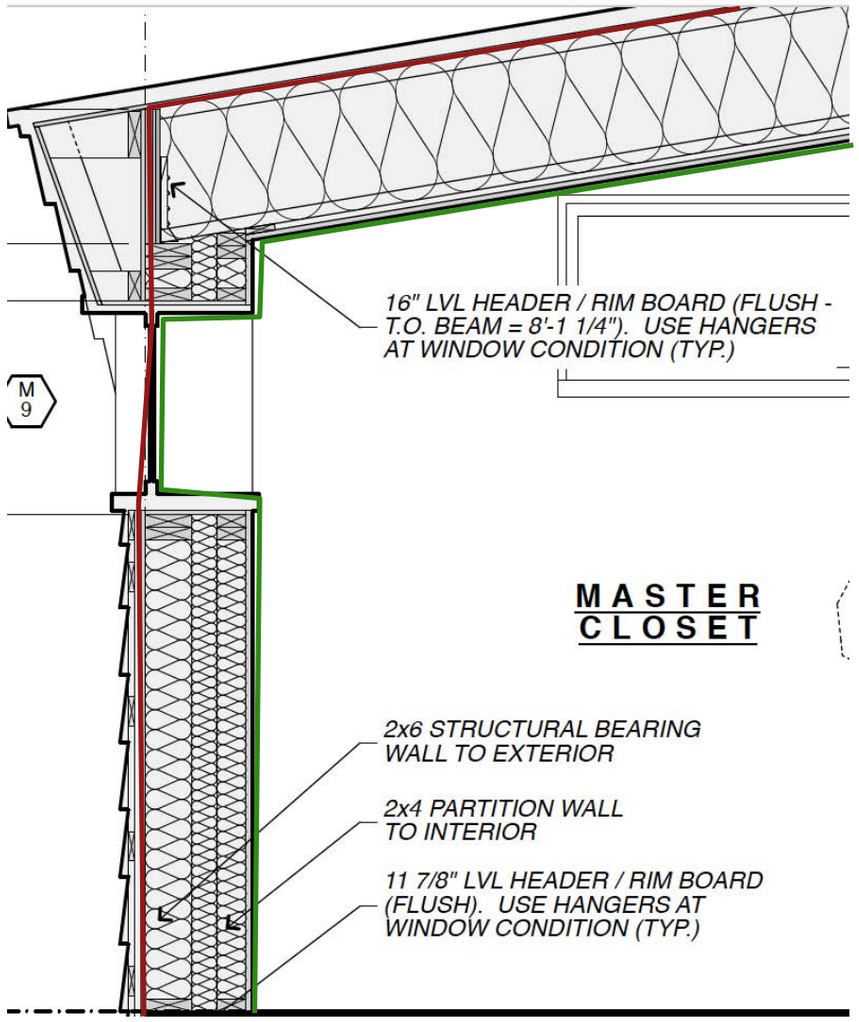
PRIMARY AIR BARRIER 1/2” ZIP

PRIMARY AIR BARRIER 1/2” CDX
WITH VAPOR OPEN WRB

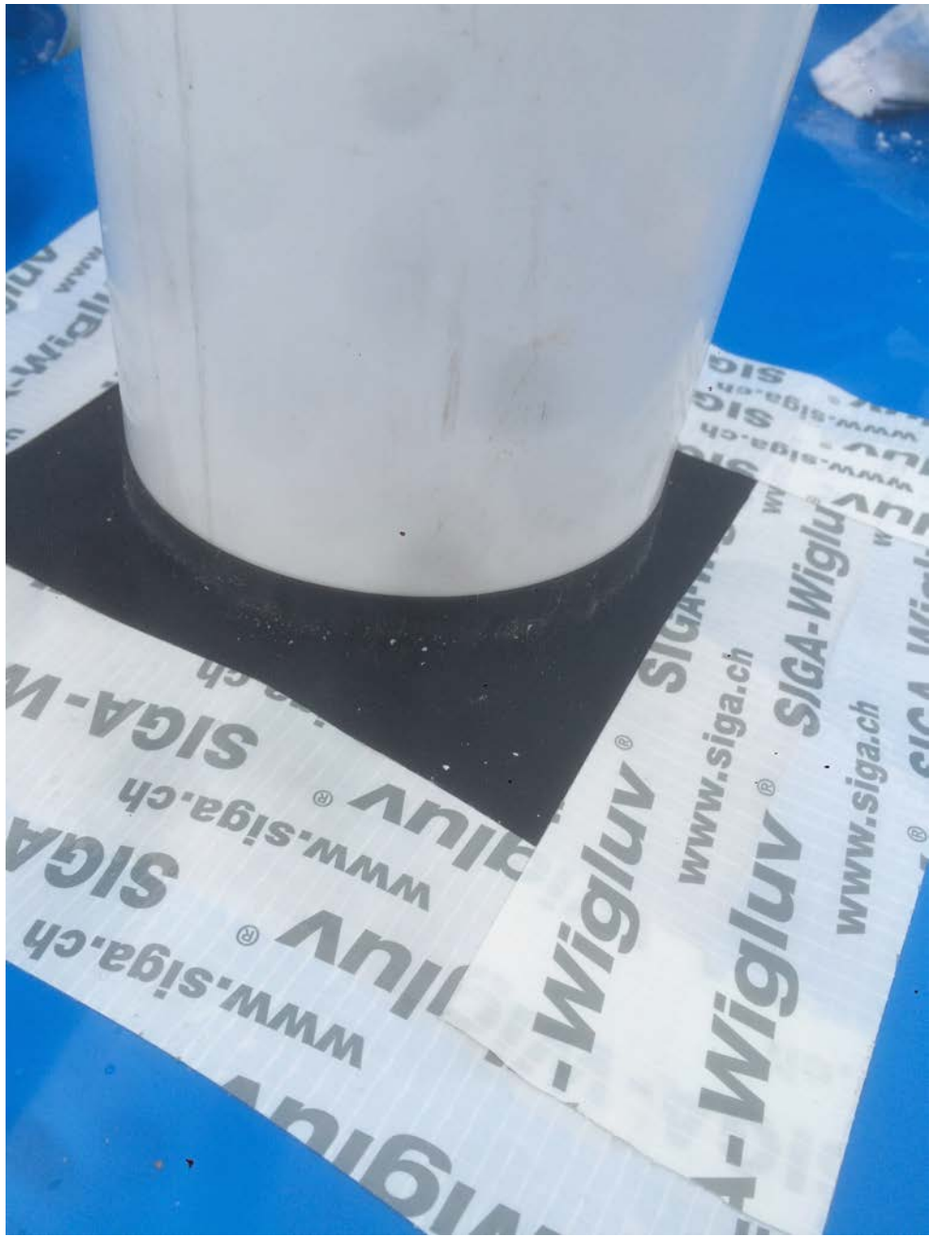
WEATHER AND WIND RESISTANT BARRIER
(CONTINUOUS VAPOR OPEN MEMBRANE)

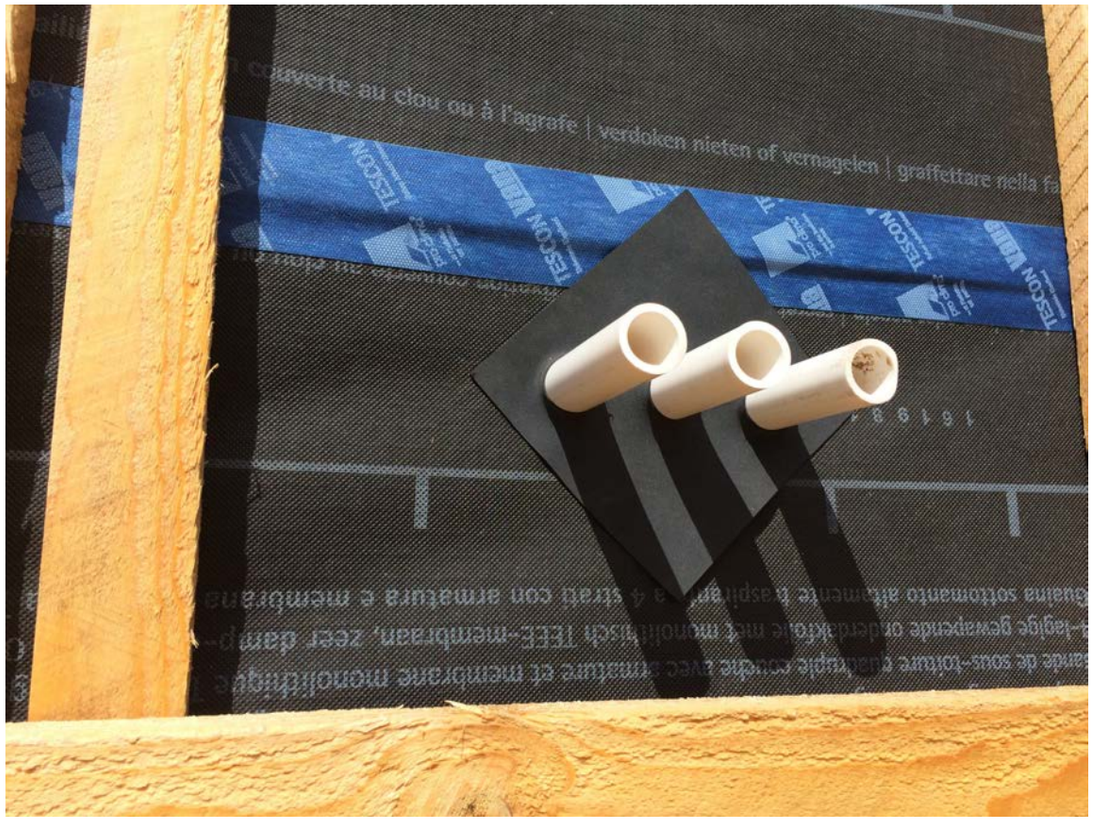
SMART VAPOR RETARDER
MOSTLY CONTINUOUS





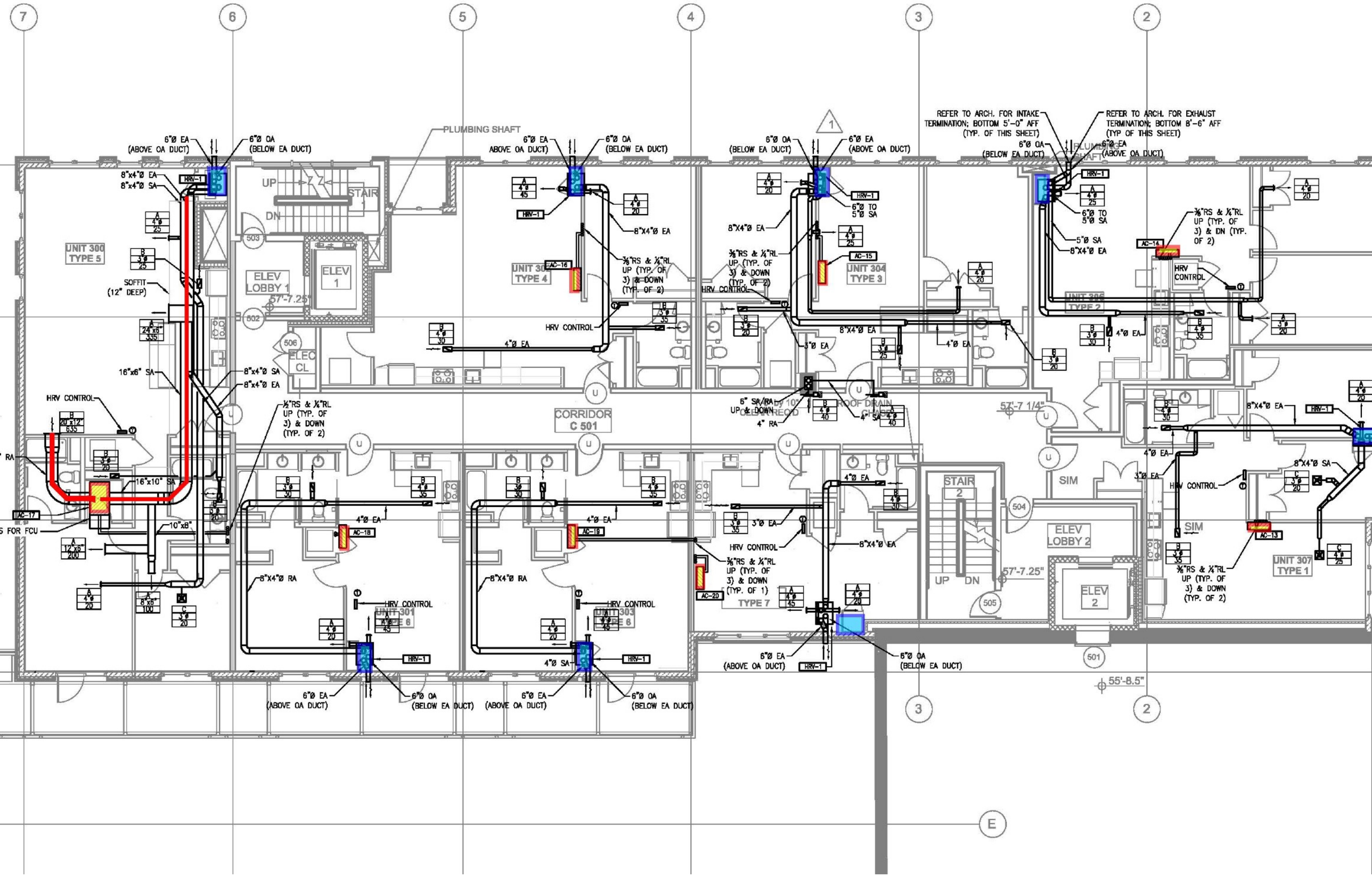
Penetrations





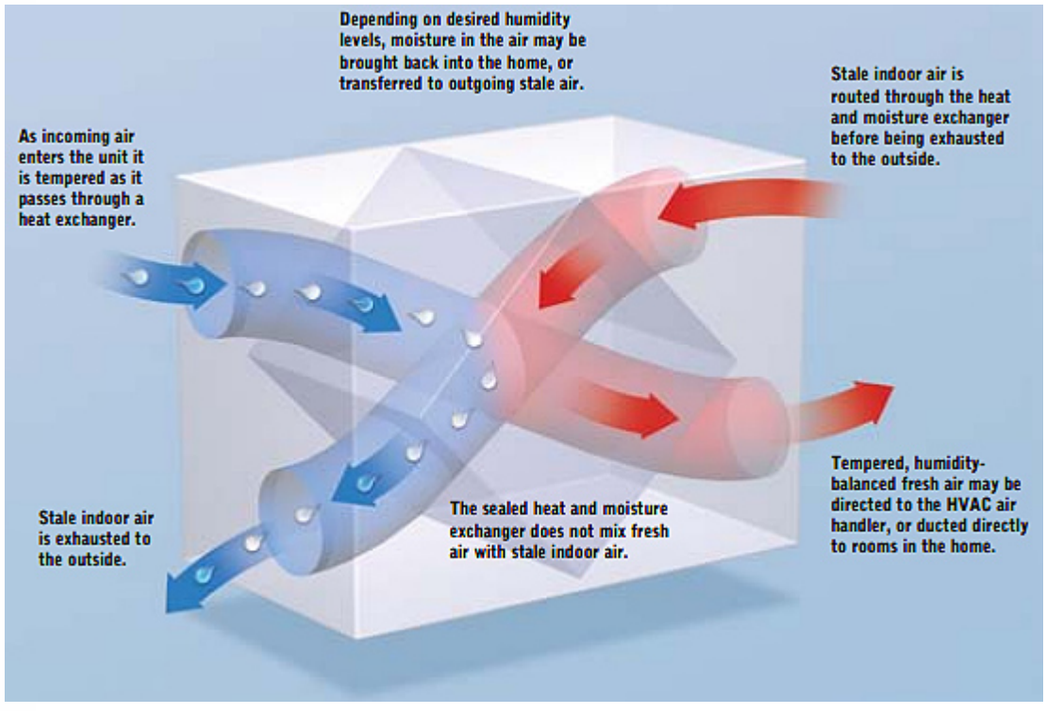
VENTILATION

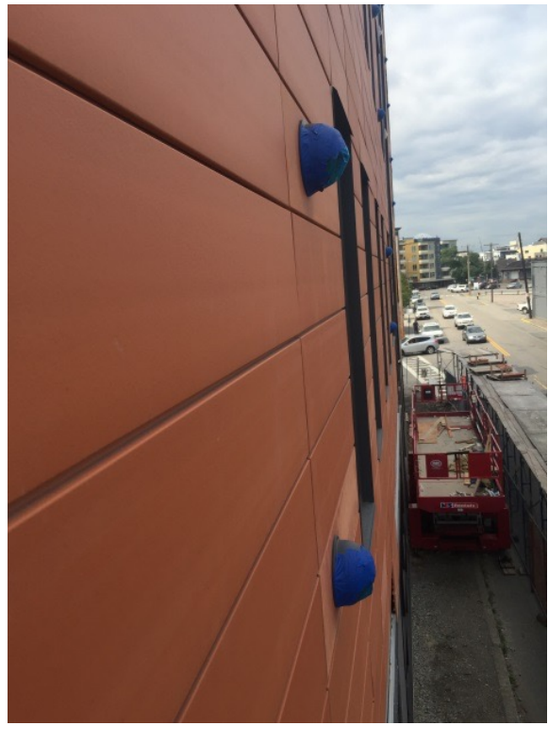
Multifamily


7
6
5
4
3
2
1
E
PLUMBING SHAFT
UNIT 300 TYPE 5
UNIT 302 TYPE 4
UNIT 304 TYPE 3
UNIT 306 TYPE 2
UNIT 307 TYPE 1
UNIT 301 TYPE 6
UNIT 303 TYPE 8
TYPE 7
ELEV LOBBY 1
ELEV 1
ELEV LOBBY 2
ELEV 2
STAIR
STAIR 2
CORRIDOR C 501
ELEC CL
ROOF DRAIN CHASE
SOFFIT (12" DEEP)
HRV-1
HRV CONTROL
SIM
UP
DN
503
502
506
504
505
501
57'-7.25"
57'-7 1/4"
55'-8.5"
6"Ø EA (ABOVE OA DUCT)
6"Ø OA (BELOW EA DUCT)
8"x4"Ø EA
8"x4"Ø SA
8"X4"Ø EA
8"X4"Ø SA
8"X4"Ø RA
6"Ø TO 5"Ø SA
5"Ø SA
8"X4"Ø EA
⅜"RS & ¼"RL UP (TYP. OF 3) & DOWN (TYP. OF 2)
½"RS & ¼"RL UP (TYP. OF 3) & DOWN (TYP. OF 2)
⅜"RS & ¼"RL UP (TYP. OF 3) & DOWN (TYP. OF 1)
⅜"RS & ¼"RL UP (TYP. OF 3) & DN (TYP. OF 2)
4"Ø EA
3"Ø EA
4"Ø SA
4" RA
6" SA/RA By 10" UP & DOWN
16"x6" SA
16"x10" SA
10"x8"
12"x6"
8"x6"
24"x6"
20"x12"
REFER TO ARCH. FOR INTAKE TERMINATION; BOTTOM 5'-0" AFF (TYP. OF THIS SHEET)
REFER TO ARCH. FOR EXHAUST TERMINATION; BOTTOM 8'-6" AFF (TYP OF THIS SHEET)
AC-13
AC-14
AC-15
AC-16
AC-17
AC-18
AC-19
AC-20
S FOR FCU

ENERGY RECOVERY VENTILATOR

- ZEHNDER: COMFOAIR 250





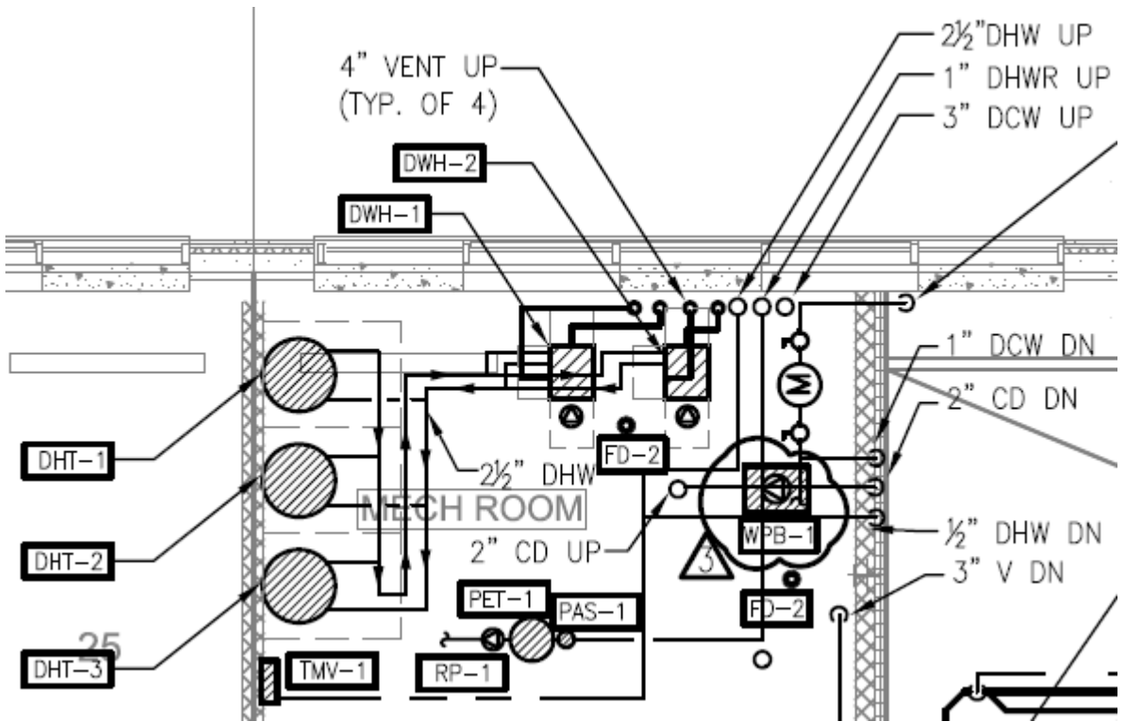
HEATING & COOLING

- INDIVIDUAL MITSUBISHI HEAT PUMPS

HOT WATER

CENTRAL SYSTEM: Lochinvar condensing water heater, gas fired

- Now about 30% of the total energy budget – next Frontier



Single family

-Flexible duct work

-ERV. No drain.

-commission systems

HEAT PUMPS & WOODSTOVES

HOT WATER

Heat Pump Water Heater

Electric water heater
(Vaughn 3”polyurethane foam)

Solar Thermal Systems

METRICS

DISTILLERY

Electric Bills - 455 East First St., Unit 300

	$	Kwh
7/15/2017	$56.07	254
8/16/2017	$90.53	418
9/12/2017	$65.69	298
10/15/2017	$67.68	308
11/14/2017	$56.36	257
12/15/2017	$63.23	297
1/13/2017	$88.87	431
2/16/2018	$195.58	916
3/17/2018	$104.49	437

Annual Electric Bill = Appr. $1050

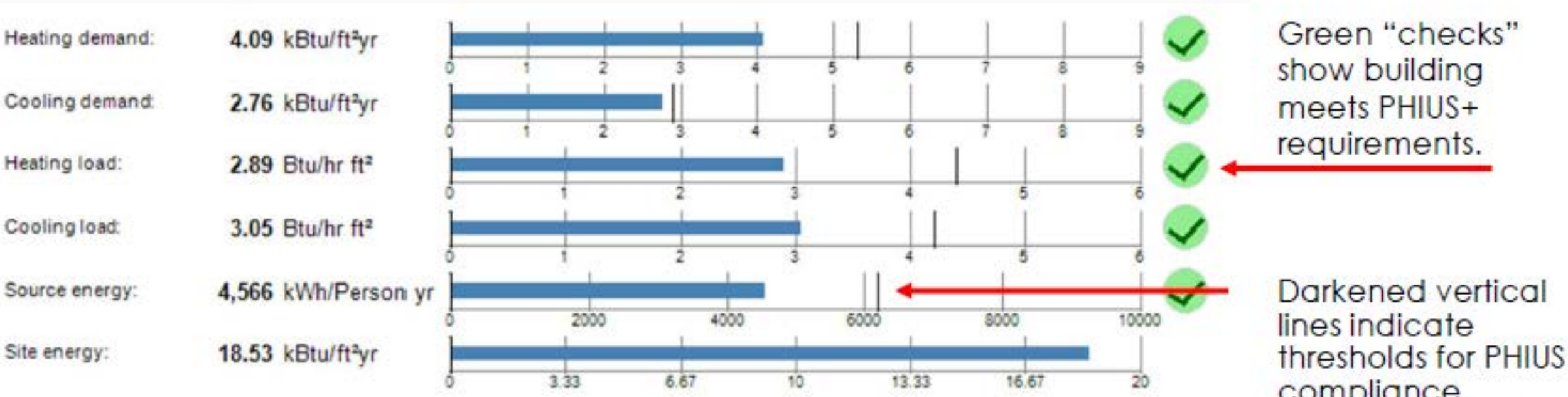
Building Type/Use:	Multi-family	
Treated Floor Area A_{TFA}:	27480	ft²
Space Heat Demand incl. Distribution	2.3	kBTU/(ft2yr)
Useful Cooling Demand:	2.7	kBTU/(ft2yr)

	Final Energy	Primary Energy	Emissions CO_2-Equivalent
CHOOSE UNITS:	kBTU/(ft2yr)	kBTU/(ft2yr)	lb/(ft²yr)

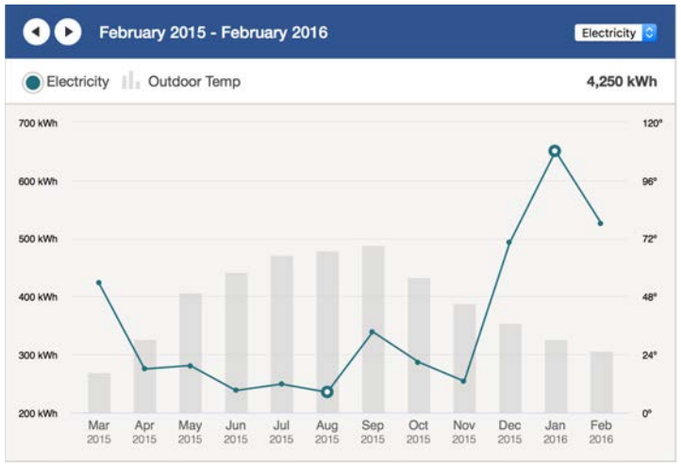
Electricity Demand (without Heat Pump)				PE Value	CO_2-Emissions Factor (CO_2-Equivalent)
Covered Fraction of Space Heat Demand		*(Project)*	0%	kBTU/kBTU	lb/kBTU
Covered Fraction of DHW Demand		*(Project)*	0%	2.7	0.44
Direct Electric Heating	$Q_{H,de}$		0.0	0.0	0.00
DHW Production, Direct Electric (without Wash&Dish)	$Q_{DHW,de}$	*(DHW+Distribution, SolarDHW)*	0.0	0.0	0.00
Electric Postheating DHW Wash&Dish		*(Electricity, SolarDHW)*	0.0	0.0	0.00
Electricity Demand Household Appliances	Q_{EHH}	*(Electricity worksheet)*	3.6	9.6	1.56
Electricity Demand - Auxiliary Electricity			1.2	3.3	0.54
Total Electricity Demand (without Heat Pump)			**4.8**	**12.9**	**2.10**
			kBTU/(ft2yr)	kBTU/(ft2yr)	lb/(ft²yr)

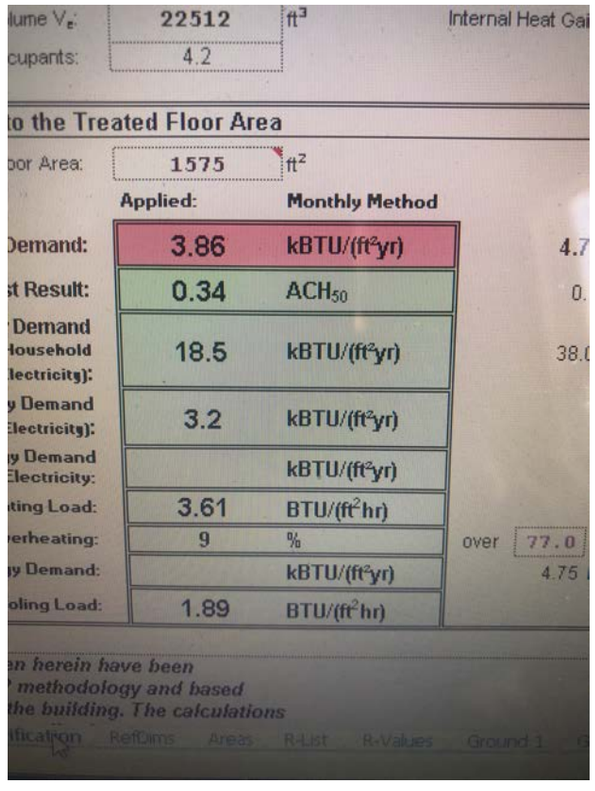
Heat Pump				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered Fraction of Space Heat Demand		*(Project)*	100%	kBTU/kBTU	lb/kBTU
Covered Fraction of DHW Demand		*(Project)*	0%	2.7	0.44
					lb/kBTU
Energy Carrier - Supplementary Heating			Electricity	2.7	
Annual Coefficient of Performance - Heat Pump		*Separate Calculation*	2.17		
Total System Performance Ratio of Heat Generator		*Separate Calculation*	0.46		
Electricity Demand Heat Pump (without DHW Wash&Dish)	Q_{HP}		1.1	2.8	0.46
Non-Electric Demand, DHW Wash&Dish		*(Electricity worksheet)*	0.0	0.0	0.00
Total Electricity Demand Heat Pump			**1.1**	**2.8**	**0.46**
			kBTU/(ft2yr)	kBTU/(ft2yr)	lb/(ft²yr)

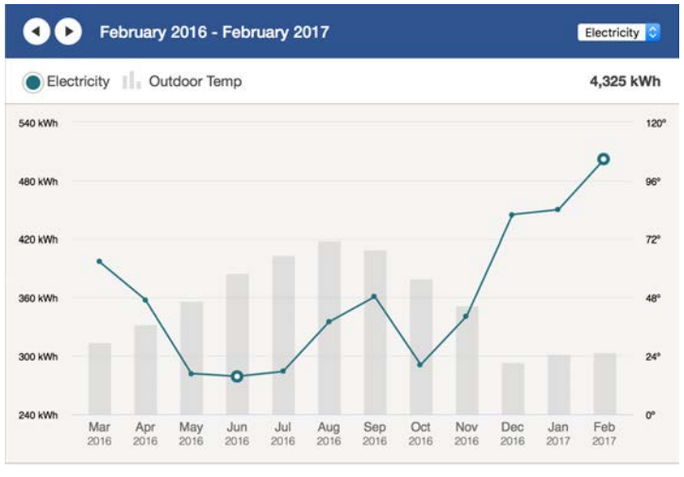
CONCORD HIGHLANDS



Hidden Lake passive house



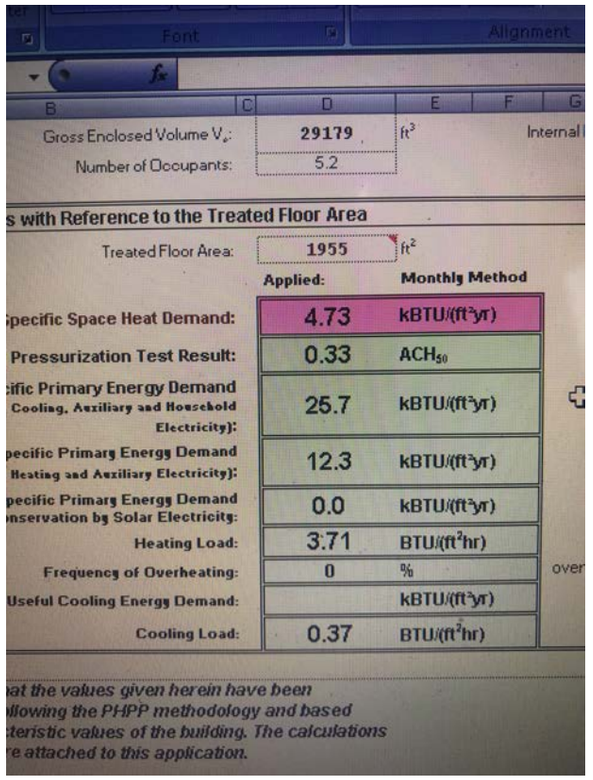




Calculated energy usage:
3,822 kWh/yr
(12% off PHPP)

Newry passive house

Energy Usage 2017:
6658kWh
1/8 cord hardwood (880kWh)
Total 7538 kWh (16% off PHPP)



More $ - Envelope
Less $ - Mechanical Systems/ductwork
Always Saving- Low Operational Costs for life

cost

SheepskinBog Addition

Original proposal:
2x6 wall w/ 2x2 (7” wall)
Andersen 400 windows
No heat
$108,000 - $193/SF (INCL SITEWORK)

Updated proposal:
12” double stud wall
Triple pane windows
electric heaters
Airtight details
$115,000 ($206 SF)
(6.5% increase)