WAYNFLETE LOWER SCHOOL

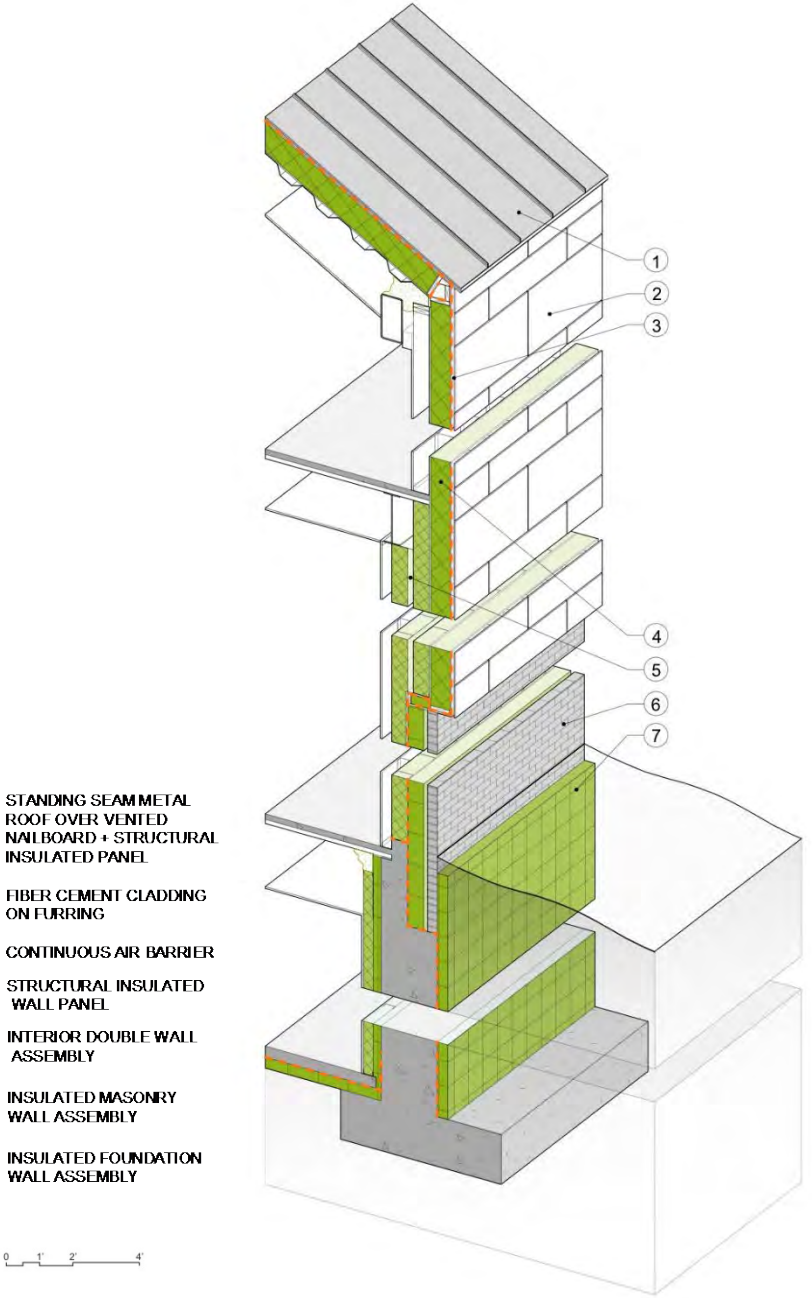
BUILDING ENVELOPE

ASSEMBLIES

ROOF / WALL / SLAB


more like
disassemblies. . .

1. STANDING SEAM METAL ROOF OVER VENTED NAILBOARD + STRUCTURAL INSULATED PANEL
2. FIBER CEMENT CLADDING ON FURRING
3. CONTINUOUS AIR BARRIER
4. STRUCTURAL INSULATED WALL PANEL
5. INTERIOR DOUBLE WALL ASSEMBLY
6. INSULATED MASONRY WALL ASSEMBLY
7. INSULATED FOUNDATION WALL ASSEMBLY



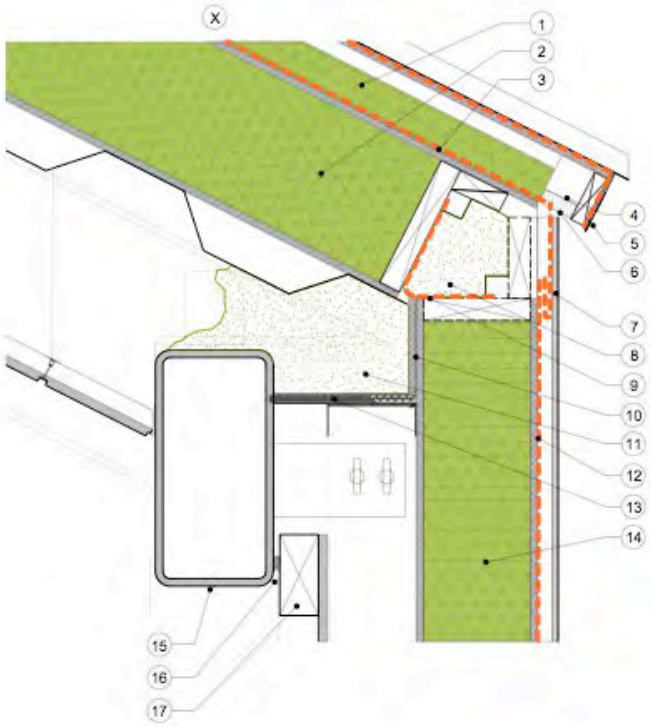
1. STANDING SEAM METAL ROOF OVER HIGH TEMPERATURE UNDERLAYMENT AND VENTILATED INSULATED NAILBASE ASSEMBLY
2. 10 1/4" SIP WITH GRAPHITE POLYSTYRENE RIGID FOAM CORE OVER METAL DECK
3. VAPOR PERMEABLE, SELF-ADHERED WATER RESISTIVE AIR BARRIER
4. 1" CLEAR CONTINUOUS VENTILATION
5. METAL ROOF EDGE
6. INSECT SCREEN
7. MEMBRANE FLASHING CONTINUOUS TO ROOF, LOOP AND LAP TO PROVIDE 1" MIN. OF MOVEMENT AT TRANSITION TO SIP
8. COMPRESSIBLE INSULATION
9. FLEXIBLE MEMBRANE, SEALED TO ROOF AND WALL PANEL
10. PLYWOOD SHEATHING AND BLOCKING SECURED TO ROOF STRUCTURE
11. SPRAY FOAM INSULATION
12. MECHANICALLY FASTENED VAPOR PERMEABLE AIR BARRIER
13. PLYWOOD CLOSURE PLATE
14. 8 1/4" SIP WITH GRAPHITE POLYSTYRENE RIGID FOAM CORE
15. STRUCTURE
16. SEALANT AND BACKER ROD
17. PAINTED WD TRIM
18. 5 1/2" OPEN CELL SPRAY FOAM INSULARION, MIN. (R-20)
19. 5/8" EXT GYPSUM SHEATHING
20. FLEXIBLE MEMBRANE FLASHING
21. POLYISO RIGID INSULATION TO FILL VOID
22. REVEAL VENT SCREEN
23. REVEAL DRIP SILL
24. FIBER CEMENT SOFFIT PANEL
25. COMPRESSIBLE VENT
26. VENEER BRICK MASONRY
27. 1 1/2" AIR SPACE
28. 6" POLYISO RIGID INSULATION (R-37)
29. INTERIOR FINISH GYPSUM WALL BOARD

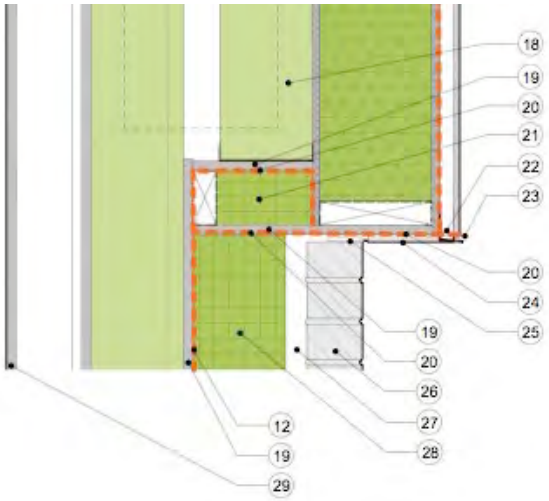
0 1" 2" 4" 8" 12"

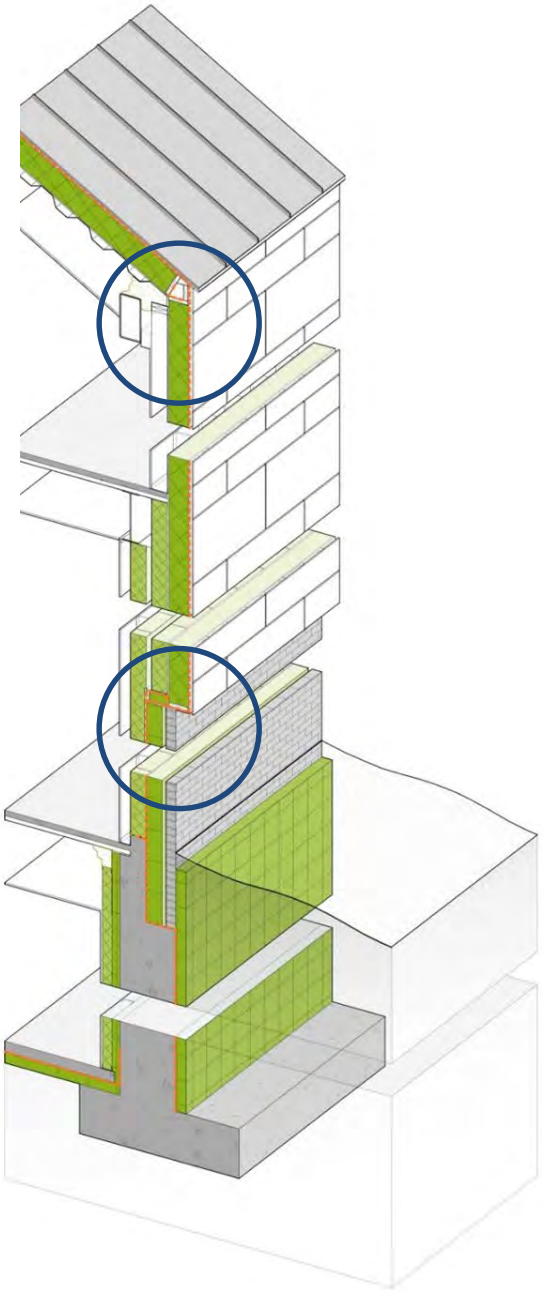
R-60

R-40+

R-57



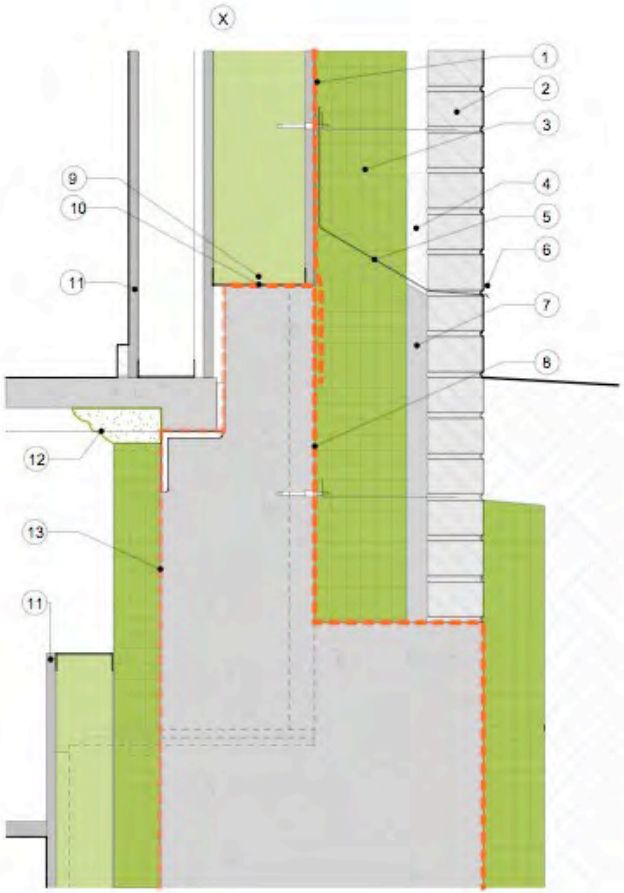


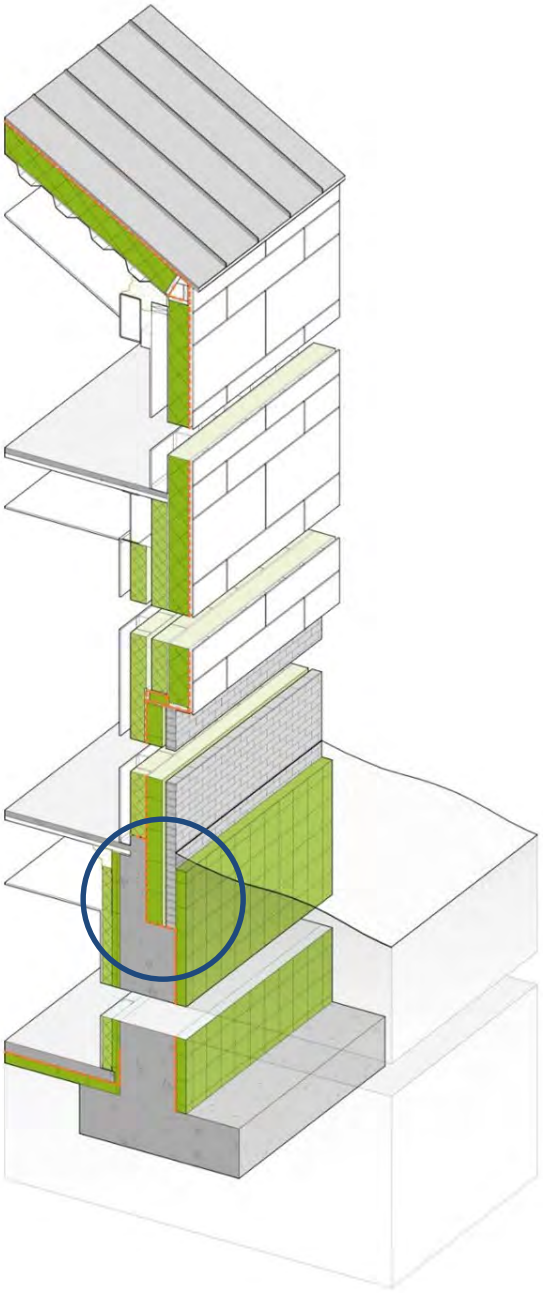


1. MECH FASTENED VAPOR PERMEABLE AIR BARRIOR
2. VENEER BRICK MASONRY
3. 6" POLYISO RIGID INSULATION (R-37)
4. MORTAR NET AT B.O. 1 1/2" AIR SPACE
5. THRU-WALL FLASHING
6. WEEPS 24" O.C.
7. GROUT SOLID
8. FLUID APPLIED WATERPROOFING
9. STRUCTURAL EPDM GASKET BELOW CFMF
10. CONT.POLYURTHANE SEALANT AT TERMINATION OF WP AND COUNTERFLASHING
11. INTERIOR FINISH GYPSUM WALL BOARD
12. SPRAY FOAM INSULATION
13. VAPOR BARRIER

0 1" 2" 4" 8" 12"

R-57



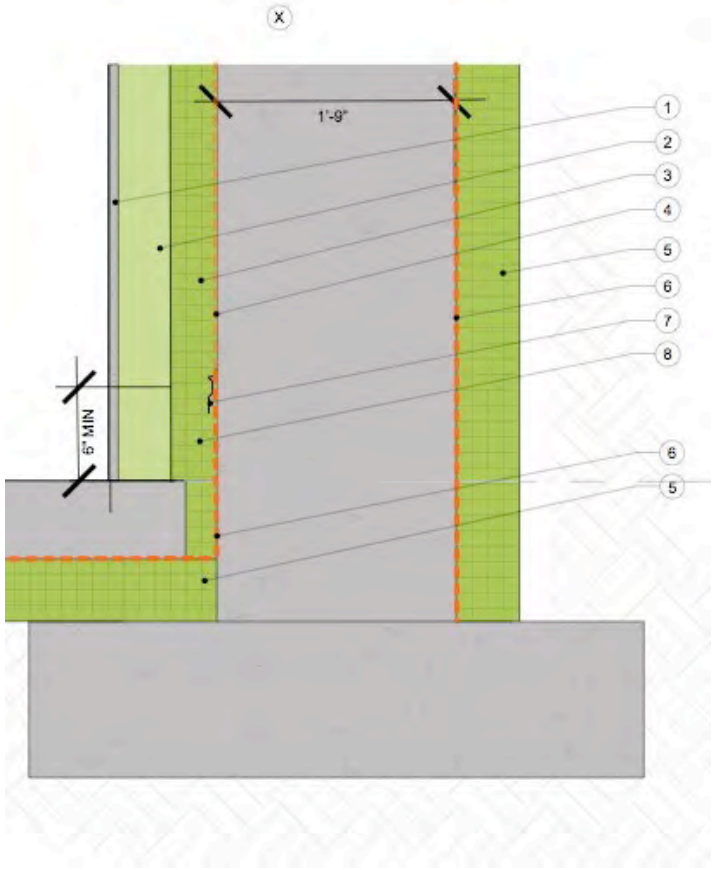


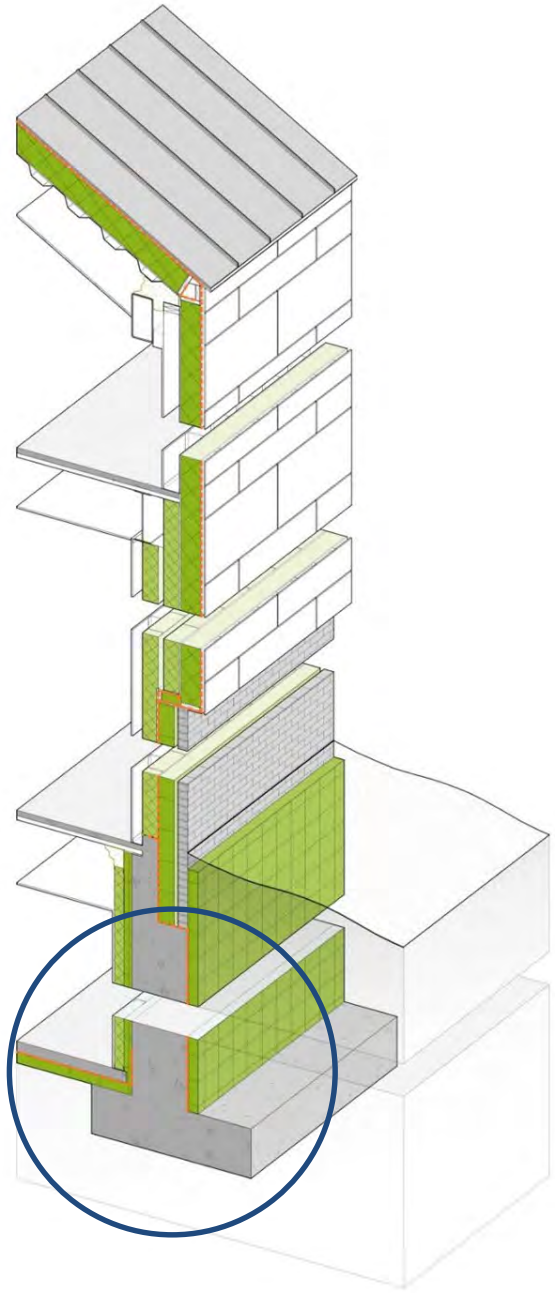
1. INTERIOR FINISH GYPSUM WALL BOARD
2. 3 1/2" OPEN CELL SPRAY FOAM INSULATION
3. 3" EXTRUDED POLYSTYRENE INSULATION (XPS)
4. VAPOR BARRIER
5. 4" EXTRUDED POLYSTYRENE INSULATION (XPS)
6. FLUID APPLIED WATERPROOFING / DAMPROOFING
7. CONTINUOUS TERMINATION BAR AND SEALANT AT EDGE OF VB, TYP.
8. 2" XPS AT SLAB EDGE

0 1" 2" 4" 8" 12"

R-51

R-20



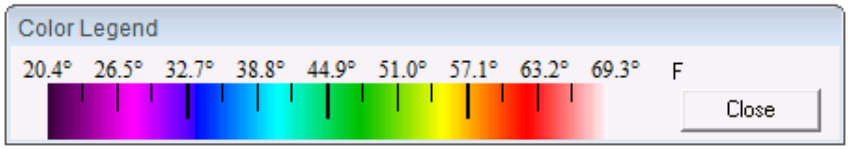



2018/01/18 13:58


JH


2018/02/01 13:30


Genie S-60X
S-60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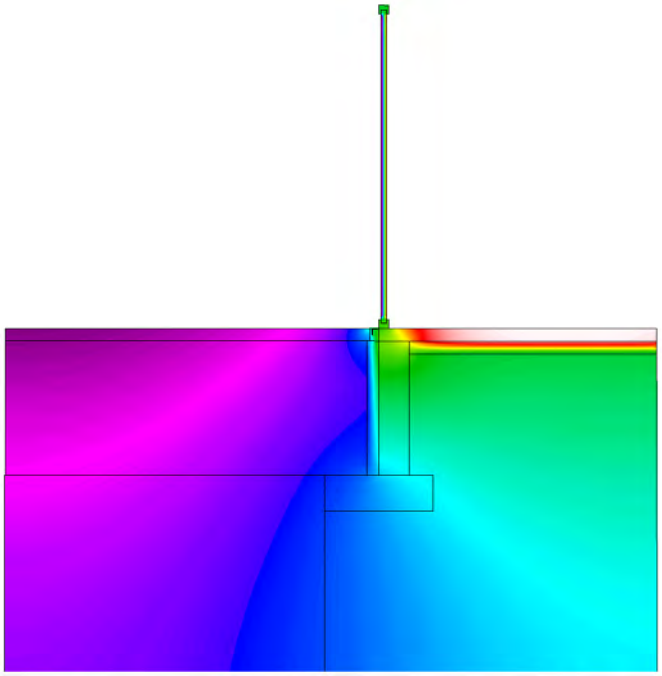
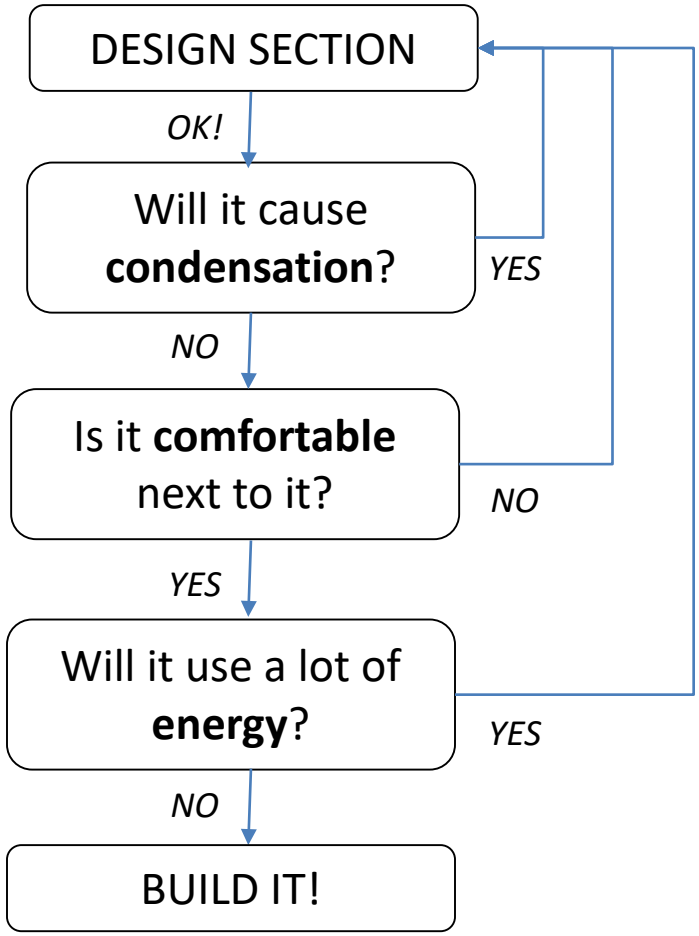
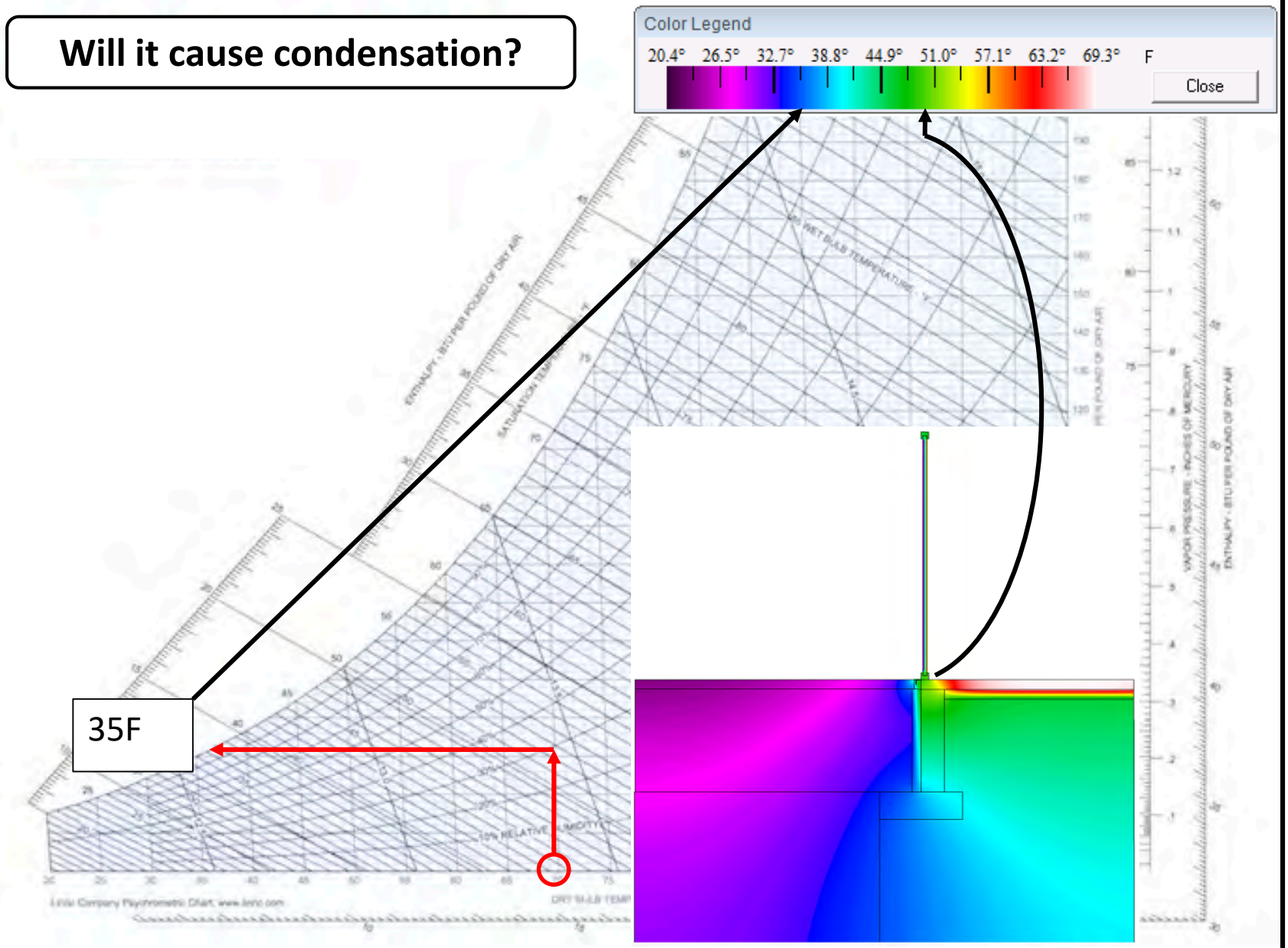
Close

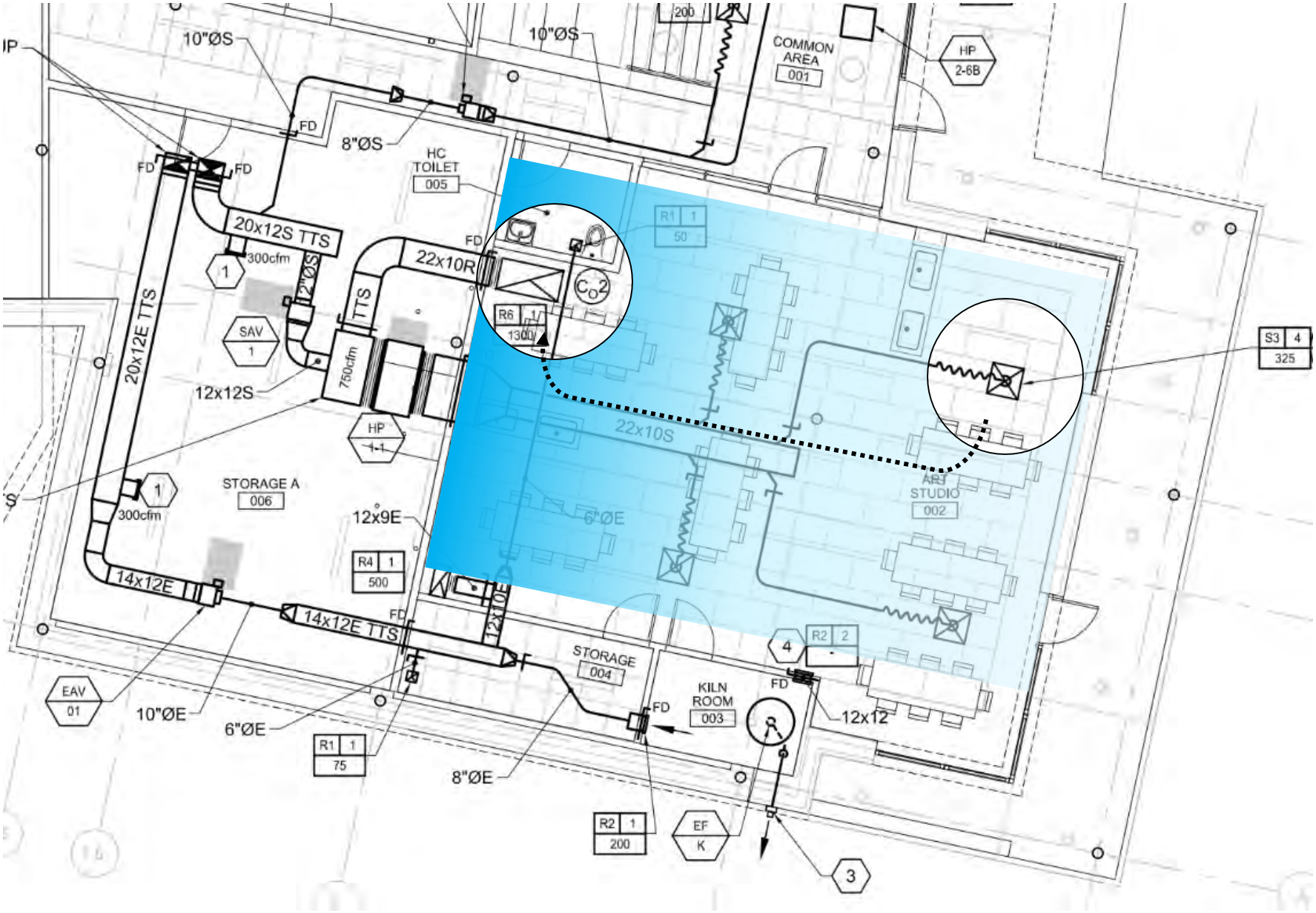




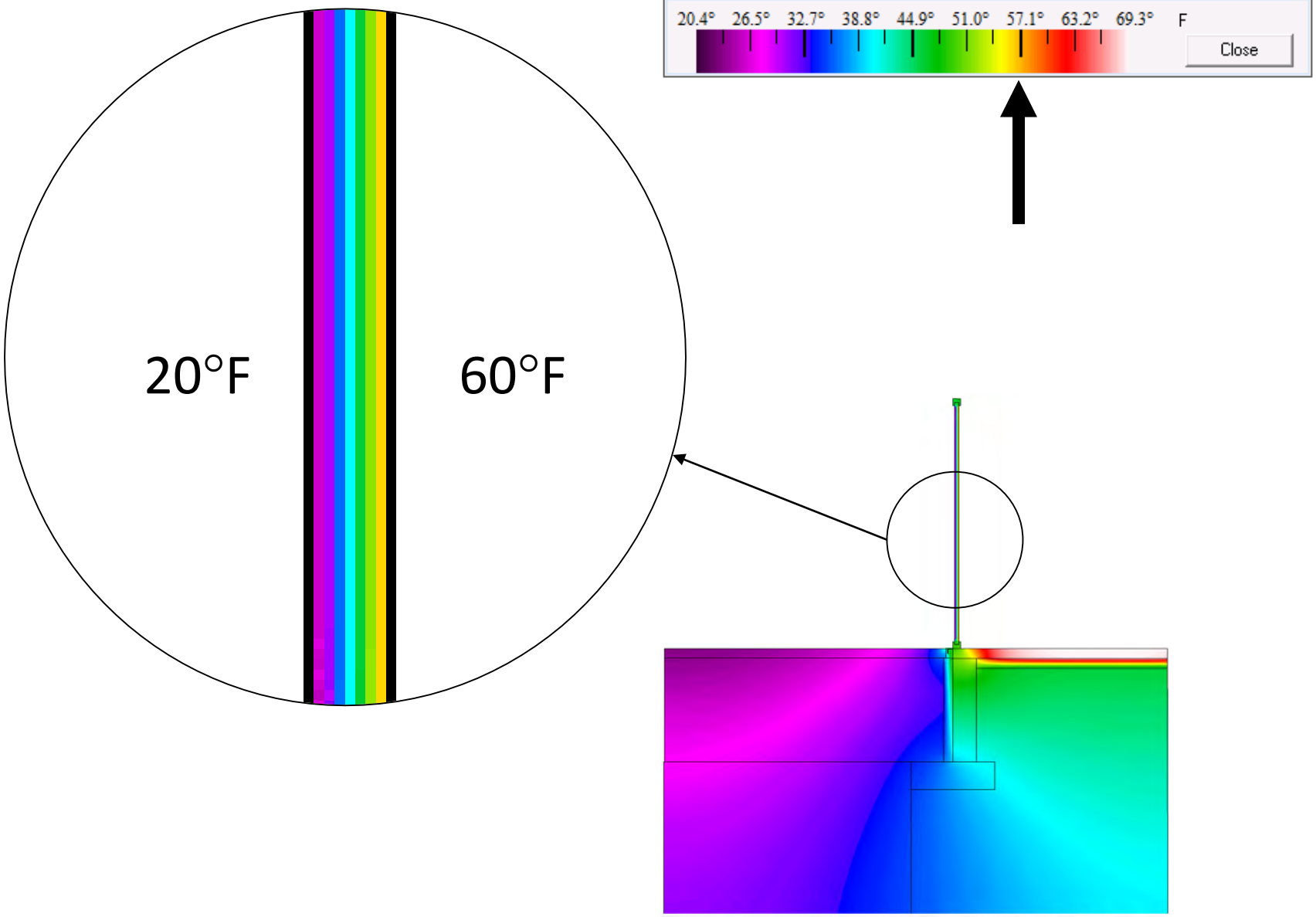
DOES MY THERMAL BRIDGE MATTER?

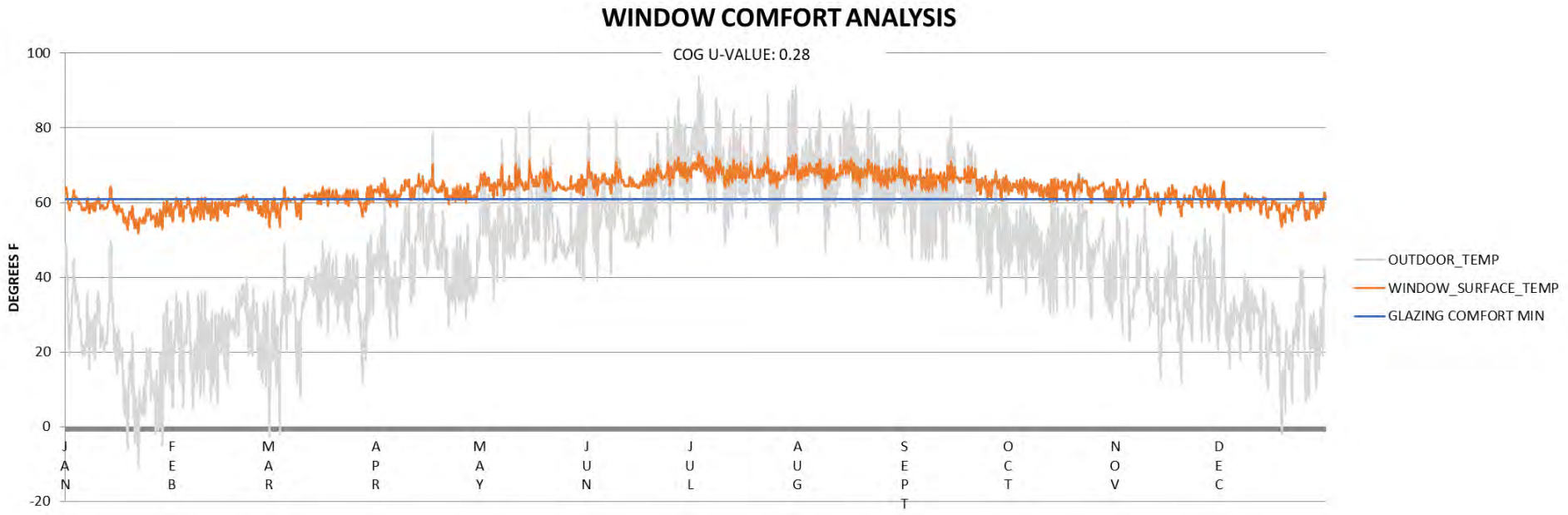
Will it cause condensation?



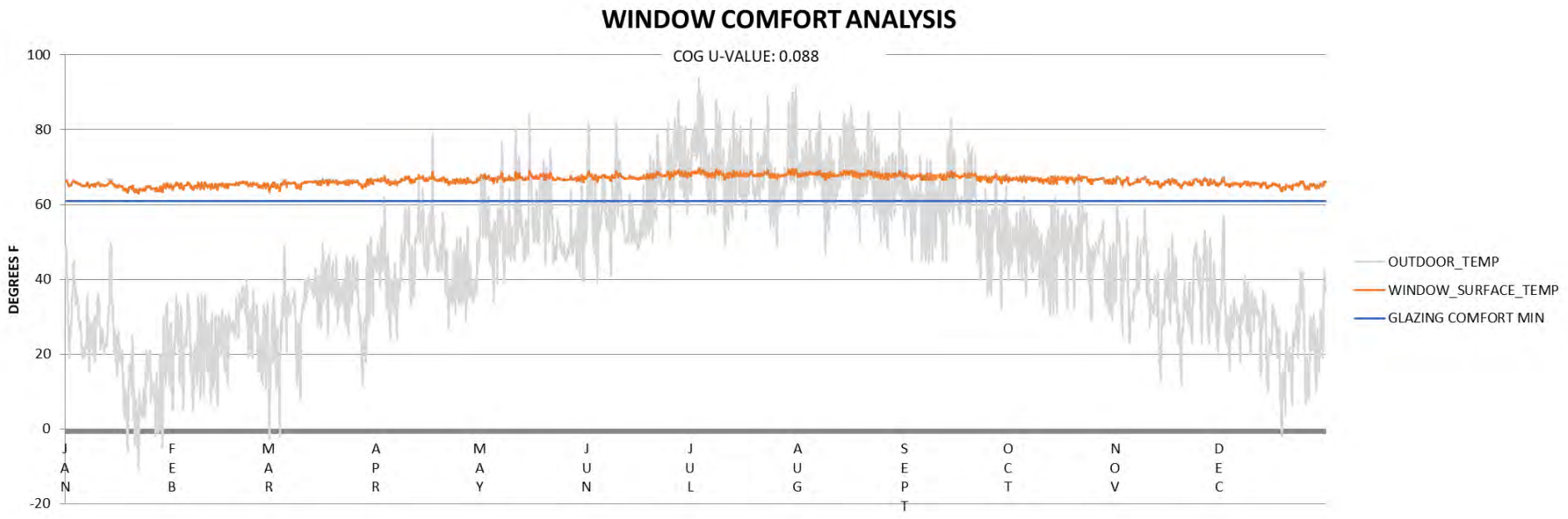

10"ØS
10"ØS
8"ØS
FD
FD
FD
HC
TOILET
005
20x12S TTS
300cfm
1
12"ØS
TTS
22x10R
FD
SAV
1
20x12E TTS
12x12S
750cfm
HP
1-1
STORAGE A
006
1
300cfm
12x9E
R4 1
500
14x12E
14x12E TTS
FD
12x10E
EAV
01
10"ØE
6"ØE
R1 1
75
8"ØE
STORAGE
004
KILN
ROOM
003
FD
FD
12x12
R2 1
200
EF
K
3
200
COMMON
AREA
001
HP
2-6B
R1 1
50
R6 1
1300
C_O2
22x10S
6"ØE
ART
STUDIO
002
4
R2 2
S3 4
325
S

Will it be comfortable?


Color Legend
20.4° 26.5° 32.7° 38.8° 44.9° 51.0° 57.1° 63.2° 69.3° F
Close
20°F
60°F

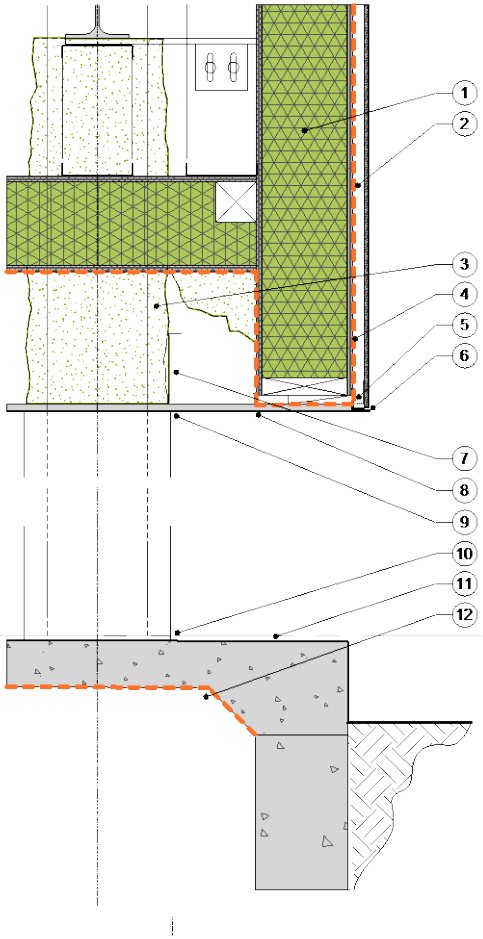


(~ CODE WINDOWS)

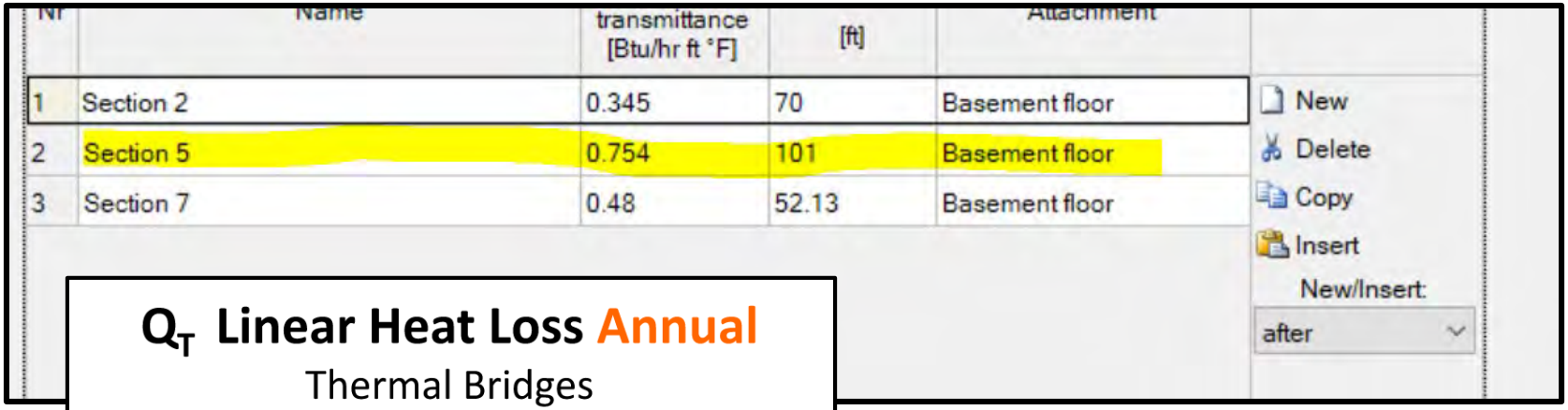

WINDOW COMFORT ANALYSIS
COG U-VALUE: 0.088
DEGREES F
100
80
60
40
20
0
-20
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEPT
OCT
NOV
DEC
OUTDOOR_TEMP
WINDOW_SURFACE_TEMP
GLAZING COMFORT MIN

YES!

1. SIP PANEL - SEAL PENETRATIONS WITH SPRAY FOAM INSULATION
2. FLUID APPLIED BARRIER
3. CONTINUE COLUMN INSULATION THROUGH SIP PANEL
4. SELF ADHERED MEMBRANE FLASHING
5. REVEAL VENT SCREEN
6. REVEAL DRIP SILL
7. CEILING FRAMING
8. EXT GYPSUM SHEATHING W/ DIRECT APPLIED FINISH
9. COLUMN COVER, SEAL TO CEILING
10. COLUMN COVER, SEAL TO SLAB
11. SLOPE SLAB TO DRAIN
12. UNDERSLAB VAPOR BARRIER



Will it use a ton of energy?



Nr	Name	transmittance [Btu/hr ft °F]	[ft]	Attachment
1	Section 2	0.345	70	Basement floor
2	Section 5	0.754	101	Basement floor
3	Section 7	0.48	52.13	Basement floor

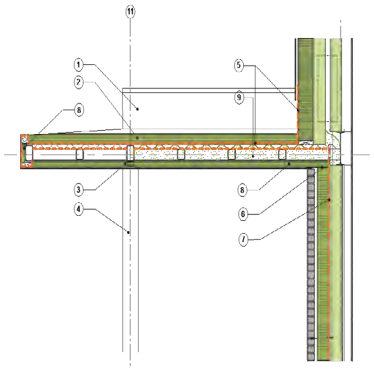
New
Delete
Copy
Insert
New/Insert:
after

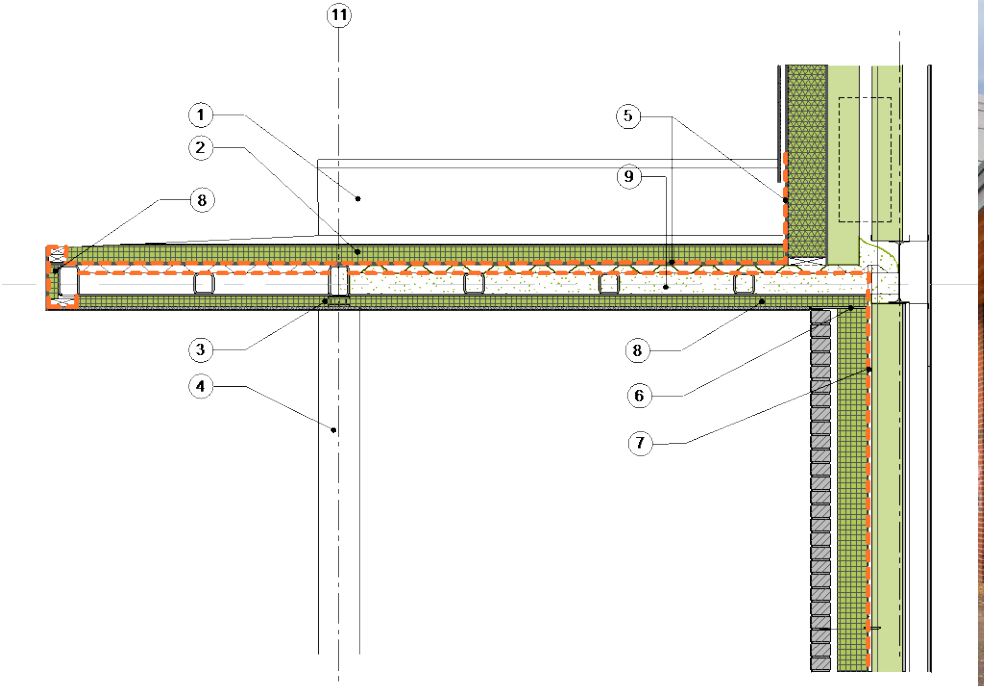
Q_T Linear Heat Loss Annual

Thermal Bridges

$$Q_T = L * \Psi * f_T * G_T$$

= 101 * 0.754 * 1 * 3264 * .024
=5,965 kBtu
=5,965 kBtu * COP3 * source factor (3.1)
= 5,965 kBtu
TOTAL ENERGY USE
886,426 kBtu
=0.6% of annual energy use



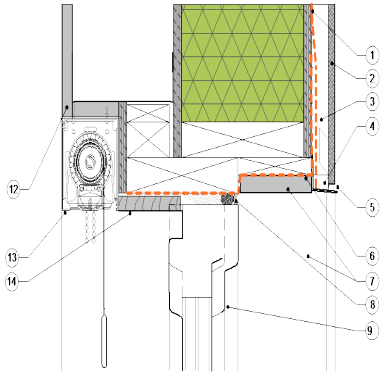


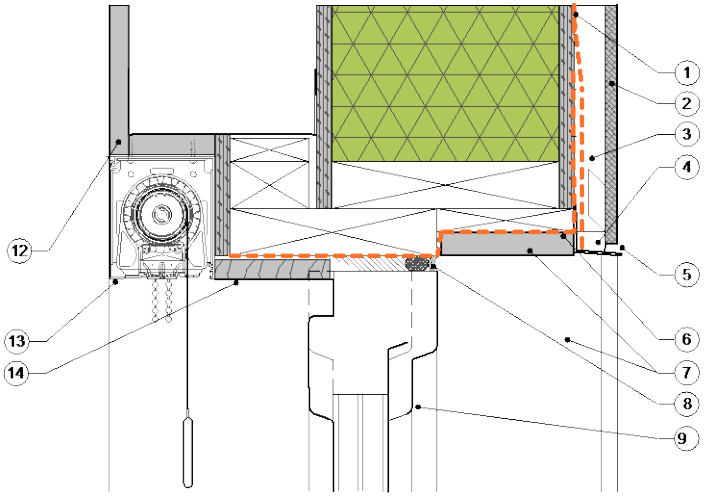
0 6" 1' 2' 3'

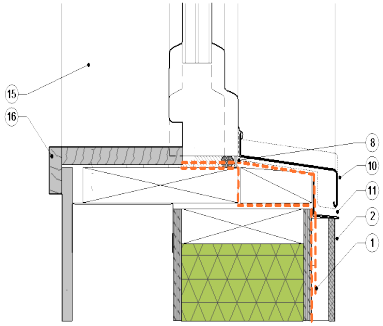
OPENINGS

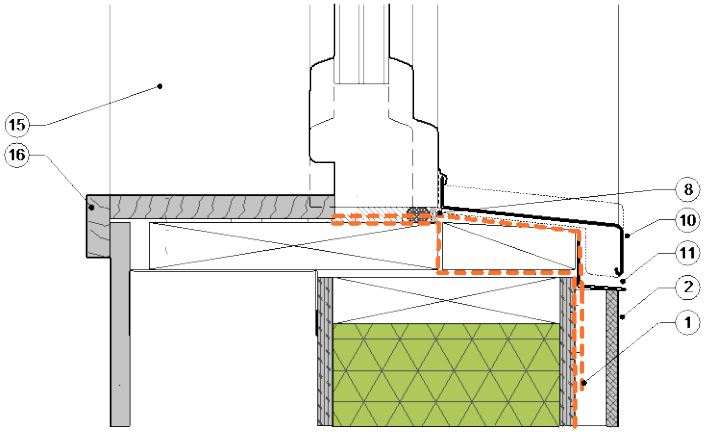
WINDOWS / DOORS / SKYLIGHTS

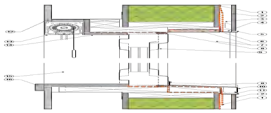
U = 0.15
SHGC = 0.35
VT = 0.53
CR = 76

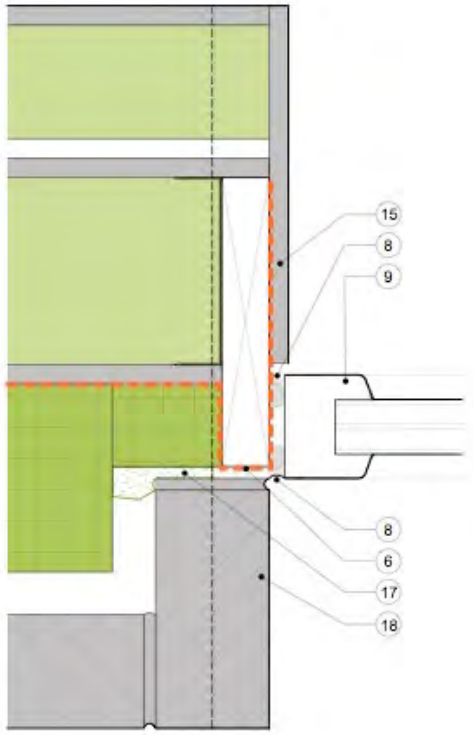






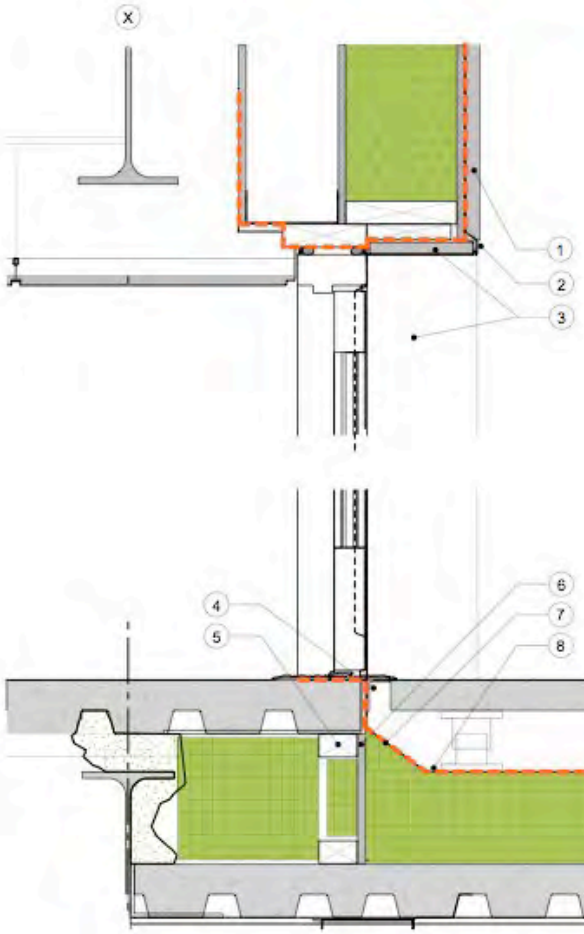






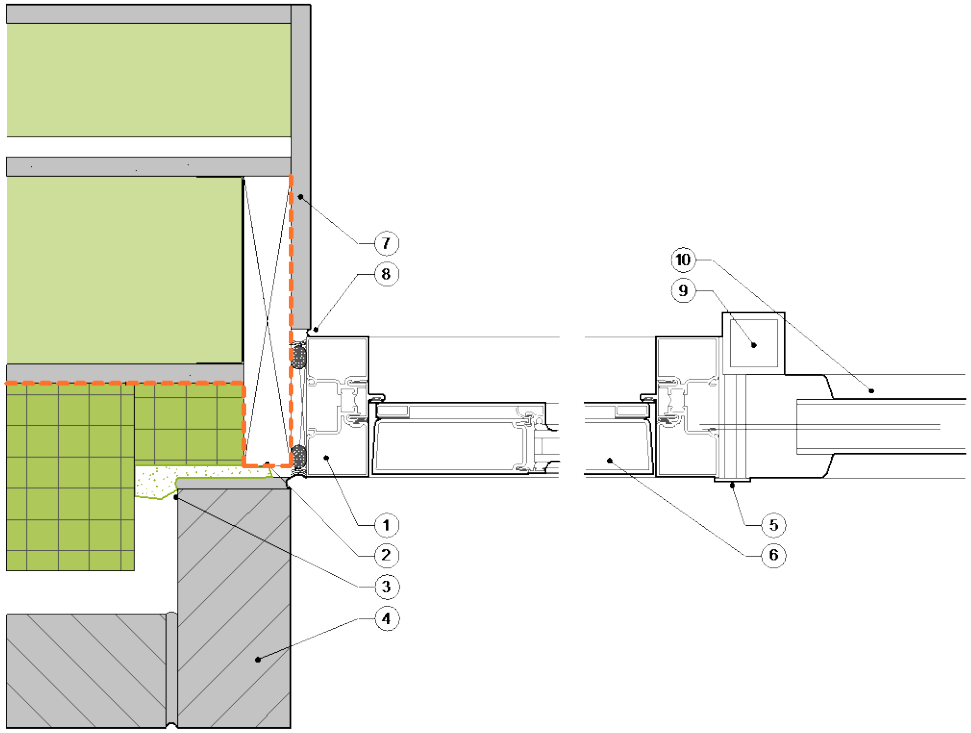
1. METAL CLADDING OVER AIR BARRIER
2. DRIP EDGE
3. METAL CLAD HEAD AND JAMB
4. FIBERGLASS ANGLE
5. PT BLOCKING
6. EXTERIOR GYPSUM WALL BOARD SHEATHING
7. SELF ADHERED FLEXIBLE FLASHING MEMBRANE
8. ROOF MEMBRANE

0 1" 2" 4" 8" 12"



1. THERMALLY BROKEN ALUM ENTRANCE DOOR FRAMING - SEAL DIRECTLY TO FLASHING
2. SELF ADHERED FLEXIBLE MEMBRANE FLASHING
3. SPRAY FOAM INSULATION
4. MASONRY VENEER CAVITY WALL W/ 1 1/2" AIR SPACE
5. UPVC MULLION COVER
6. THERMALLY BROKEN ALUMINUM ENTRANCE DOOR
7. GYPSUM WALL BOARD JAMB
8. J-BEAD AND CAULK JOINT
9. STRUCTURAL MULLION SUPPORT
10. HIGH PERFORMANCE UPVC WINDOW - FIXED ASSEMBLY

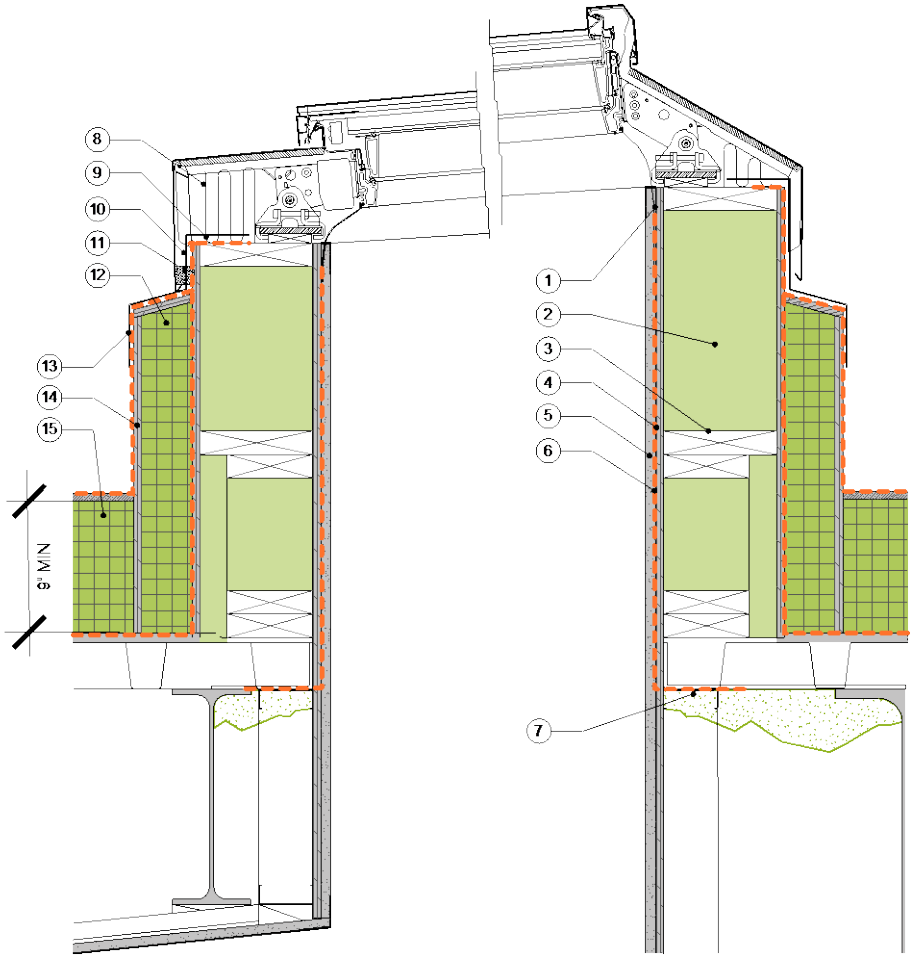
0 1" 2" 4" 6"



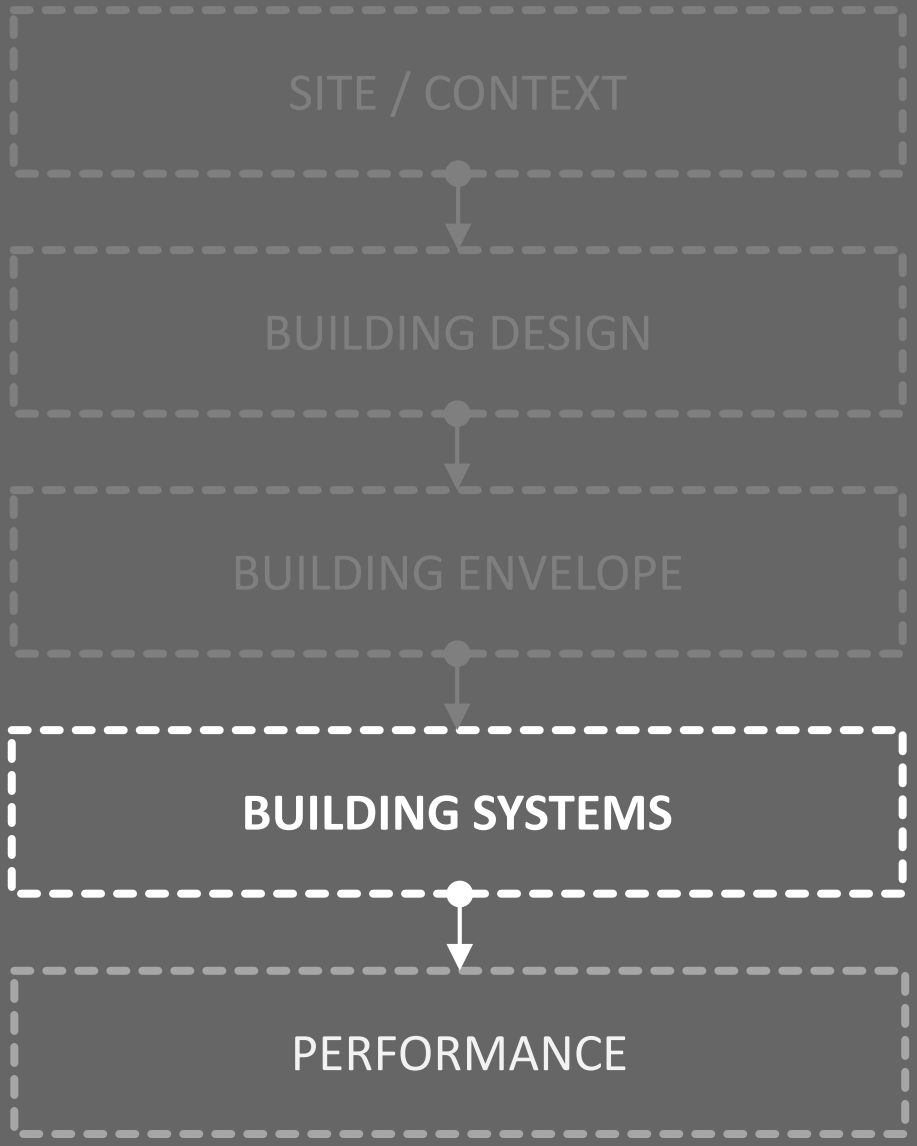
U = 0.22
SHGC = 0.26
SC = 0.30
VLT = 59%

1. VAPOR BARRIER SEALED TO VB CONNECTION STRIP
2. OPEN CELL SPRAY FOAM INSULATION
3. CURB FRAMING
4. SHEATHING
5. FINISH WALL, SEE SCHEDULE
6. VAPOR PERMEABLE AIR BARRIER
7. TERMINATE VB TO DECK, CONT. SEAL W/ SPRAY FOAM
8. SKYLIGHT ASSEMBLY AND FRAME FLASHING
9. CONT. SPRAY FOAM INSULATION, TYP.
10. METAL CONTER-FLASHING TO MATCH METAL SIDING
11. SELF ADHERED WATERPROOFING MEMBRANE, CONT. SEALED BELOW TO SKYLIGHT CURB
12. 3" POLYISO RIGID INSULATION
13. CONT. FLEXIBLE FLASHING MEMBRANE FROM T.O. SKYLIGHT CURB TO ROOF MEMBRANE
14. SHEATHING
15. PROTECTION BOARD AND TYP. ROOF ASSEMBLY

0 2" 4" 8" 1'



DESIGN CONSIDERATIONS



BUILDING SYSTEMS

ELECTRICAL + LIGHTING

HEATING, COOLING + VENTILATION

PLUMBING

RENEWABLES

ELECTRICAL + LIGHTING

MAINE COAST WALDORF HIGH SCHOOL

WAYNFLETE LOWER SCHOOL

ELECTRICAL + LIGHTING

MAINE COAST WALDORF HIGH SCHOOL

- **Maximize Natural Daylight**
- **Independent Zones of Control**
- **LED Lighting**
- **Occupancy Sensors with Switches**

WAYNFLETE LOWER SCHOOL

- **Utilize Daylighting Controls**
- **Independent Zones of Control**
- **LED Lighting**
- **Occupancy Sensors with Switches**

HEATING, COOLING + VENTILATION

STEP 1: REDUCE THE LOAD!

Super Insulated Envelope

Air Tight Construction + High Performance Windows

Energy Recovery Ventilation

Fault Detection + Diagnostics

Extra Insulation at Piping and Water Heaters

HEATING, COOLING + VENTILATION

STEP 2: KEEP REDUCING THE LOAD!

Super Insulated Envelope

Air Tight Construction + High Performance Windows

Energy Recovery Ventilation

Fault Detection + Diagnostics

Extra Insulation at Piping and Water Heaters

ADDITIONAL MEASURES:

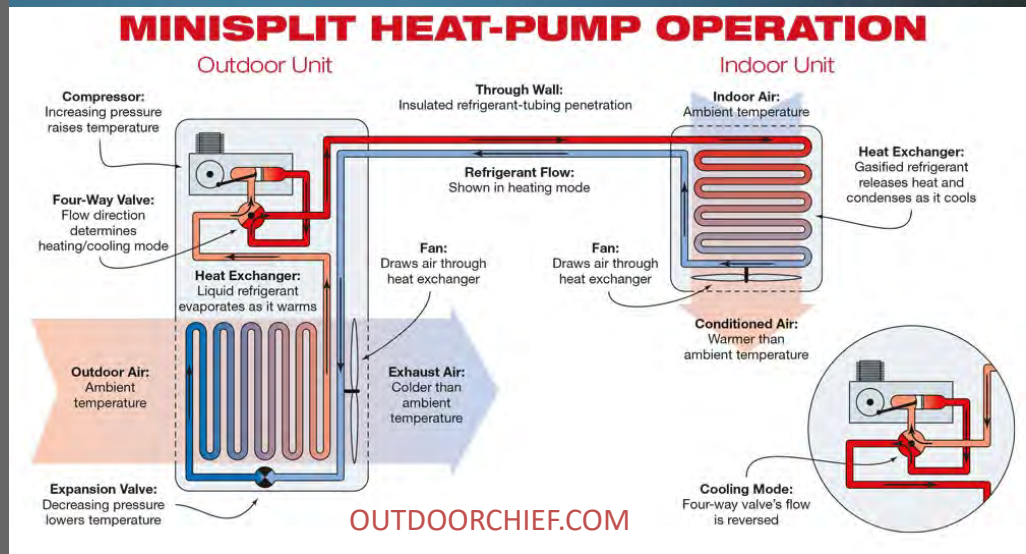
No Process Exhaust → (kitchen + science)
All HVAC Inside Thermal Envelope

HEATING, COOLING + VENTILATION

MAINE COAST WALDORF HIGH SCHOOL

little “h” and little “c”

- Mitsubishi MXZ H2i “hyper heat”
- 19.0 SEER, 3.75 COP @ 47F, 2.7 COP @ 17 °f
- Variable speed compressors
- Effective to -13°f
- 20 zones; grouped by exposure
- Wall mounted indoor units – less friction

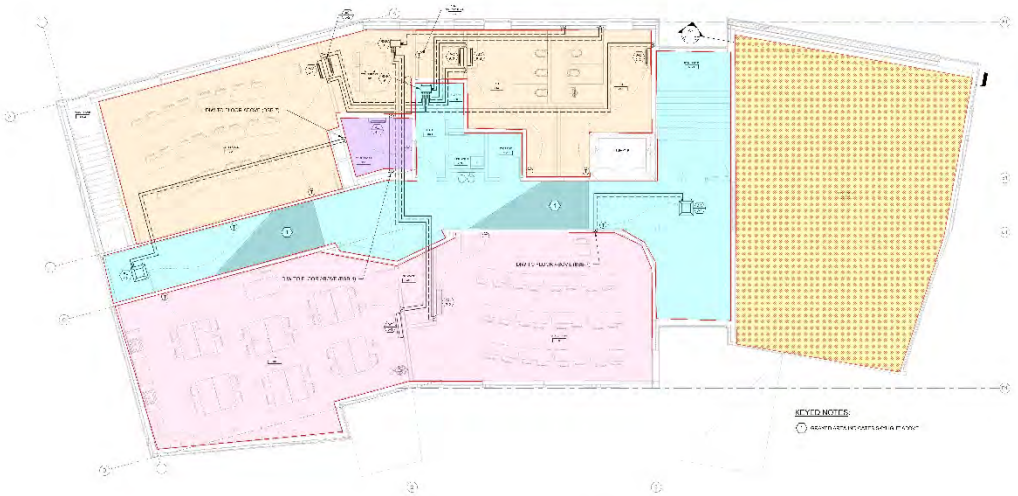


HEATING, COOLING + VENTILATION

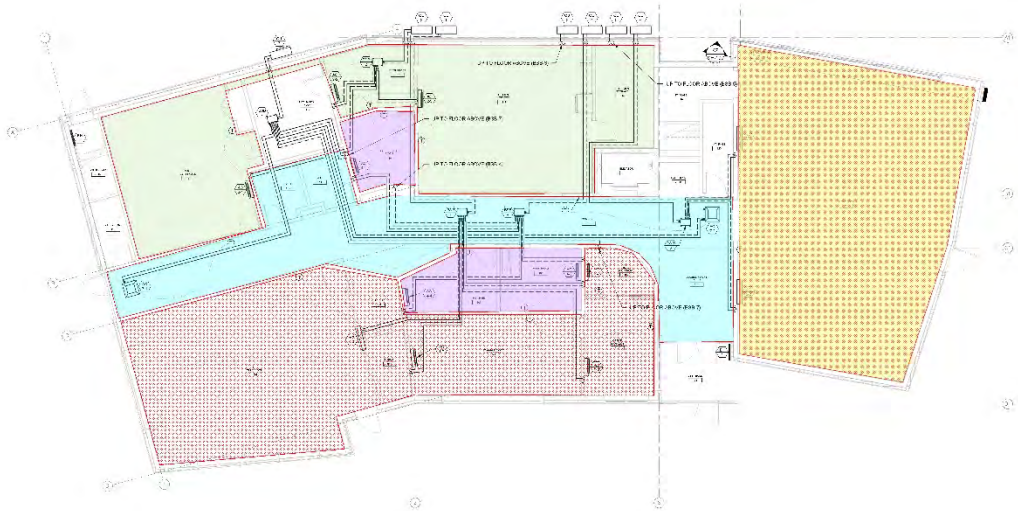
MAINE COAST WALDORF HIGH SCHOOL

HEATING, COOLING + VENTILATION

MAINE COAST WALDORF HIGH SCHOOL



ZONING DIAGRAM

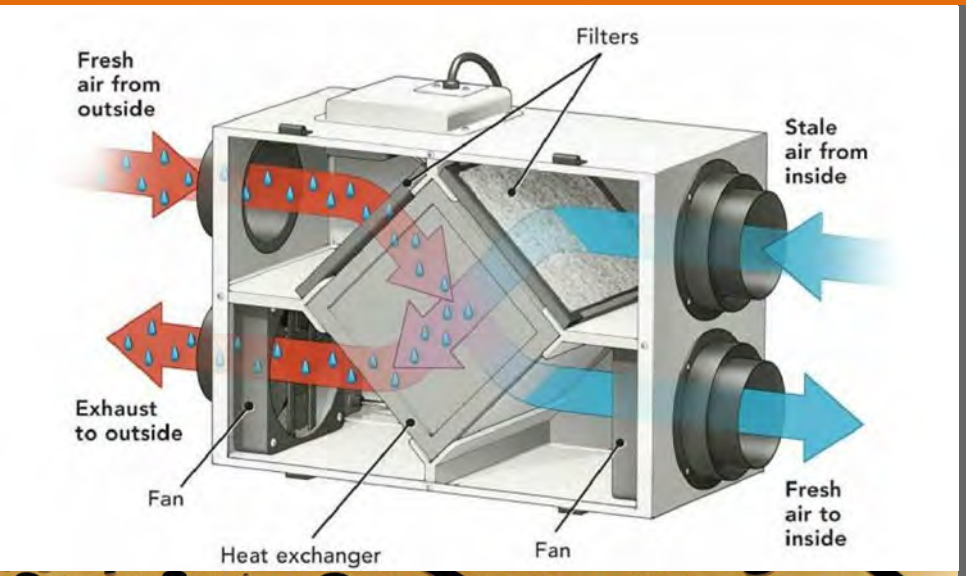


2ND FLOOR

1ST FLOOR

HEATING, COOLING + VENTILATION

MAINE COAST WALDORF HIGH SCHOOL



The big "V"

- Balanced ventilation that delivers fresh air and removes stale air
- Three zones: 1st fl, 2nd fl, & great room
- Ventilation per ASHRAE 62.1-2013
- Air diffusion – thermal core high induction – no heat in ERV system
- 3369 cfm – 1.6 ACH
- Average An. 497cfm

HEATING, COOLING + VENTILATION

MAINE COAST WALDORF HIGH SCHOOL

HEATING, COOLING + VENTILATION

MAINE COAST WALDORF HIGH SCHOOL

DIDN'T MAKE THE CUT:
IDEAS CONSIDERED BUT NOT AFFORDABLE

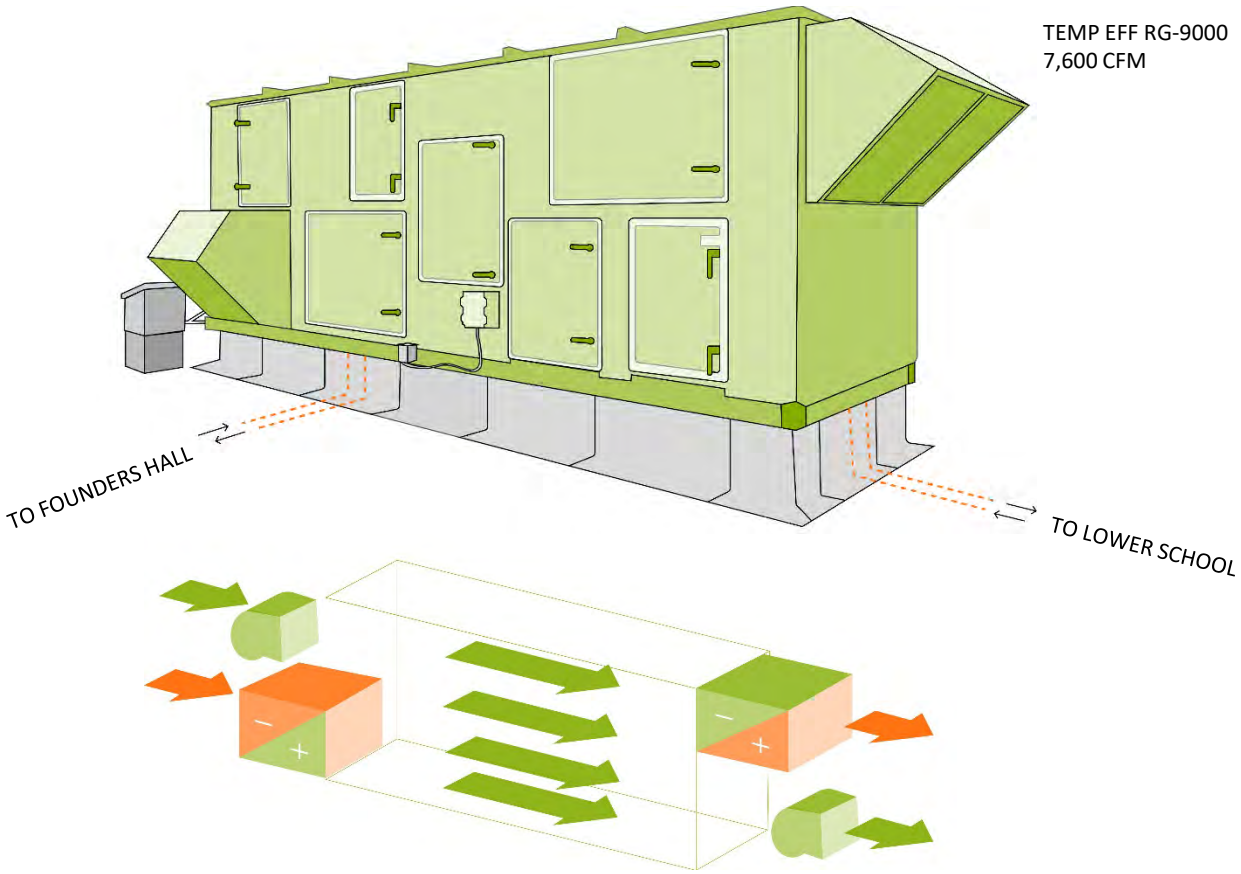
- ERU for each classroom for better demand control
- Higher efficiency ERU's, such as Zehnder
- Building automation system
- Heat recovery VRF (multi-splits were more affordable)
- Geothermal
- Daylighting controls

HEATING, COOLING + VENTILATION

WAYNFLETE LOWER SCHOOL

HEATING, COOLING + VENTILATION

WAYNFLETE LOWER SCHOOL



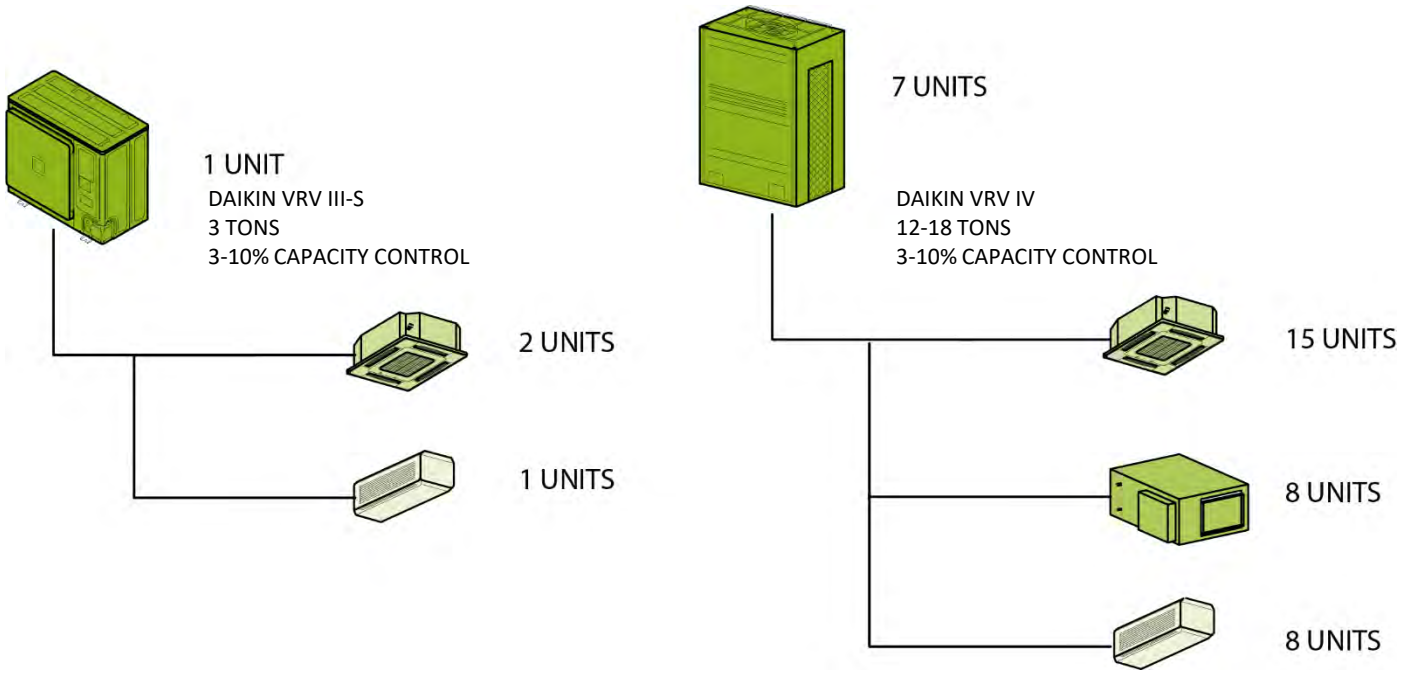
ENERGY RECOVERY VENTILATION SYSTEM

HEATING, COOLING + VENTILATION

WAYNFLETE LOWER SCHOOL

HEATING, COOLING + VENTILATION

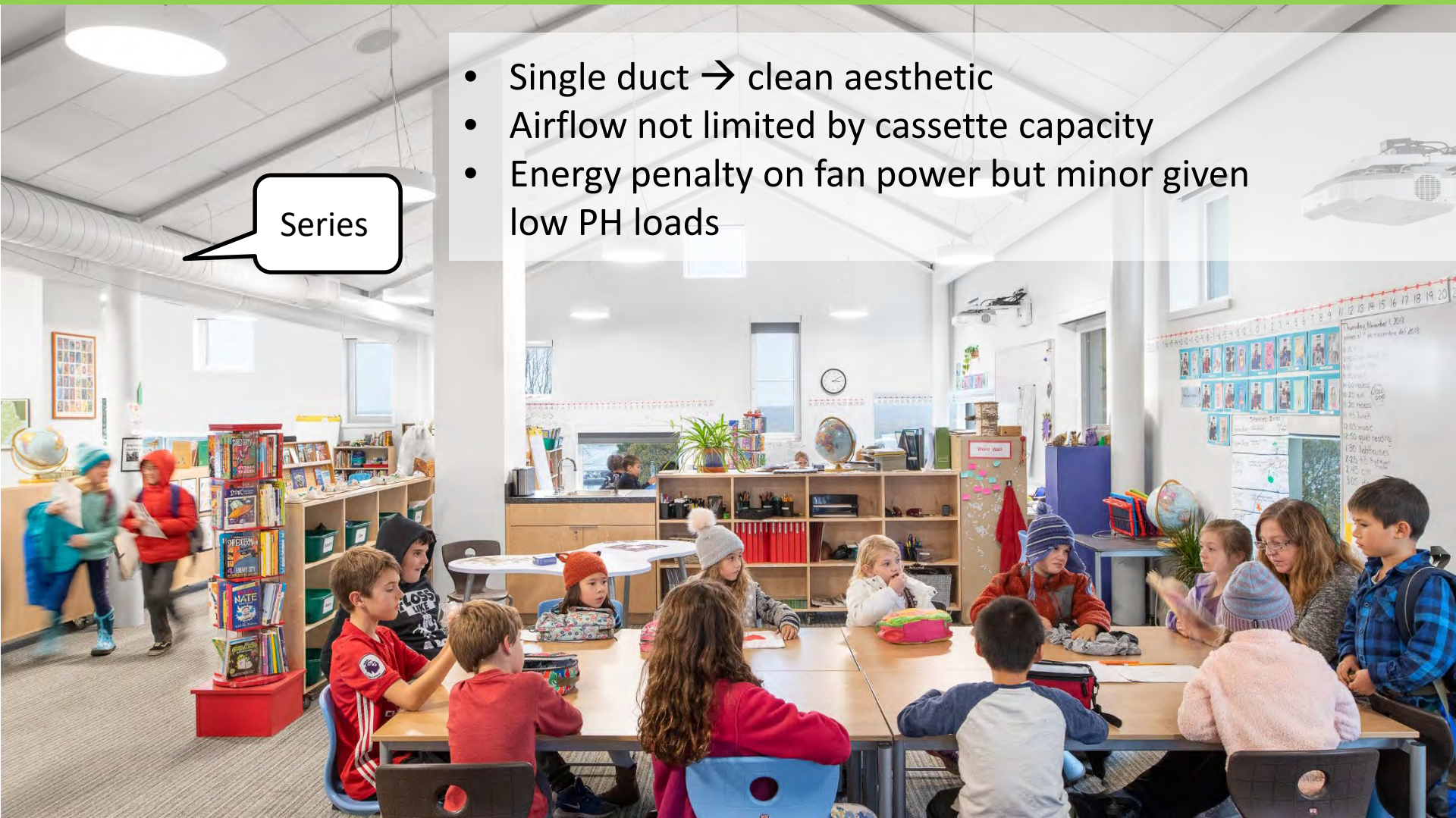
WAYNFLETE LOWER SCHOOL



VARIABLE REFRIGERANT FLOW SYSTEM
(HEAT PUMP)

HEATING, COOLING + VENTILATION

WAYNFLETE LOWER SCHOOL



- Single duct → clean aesthetic
- Airflow not limited by cassette capacity
- Energy penalty on fan power but minor given low PH loads

HEATING, COOLING + VENTILATION

WAYNFLETE LOWER SCHOOL

Parallel

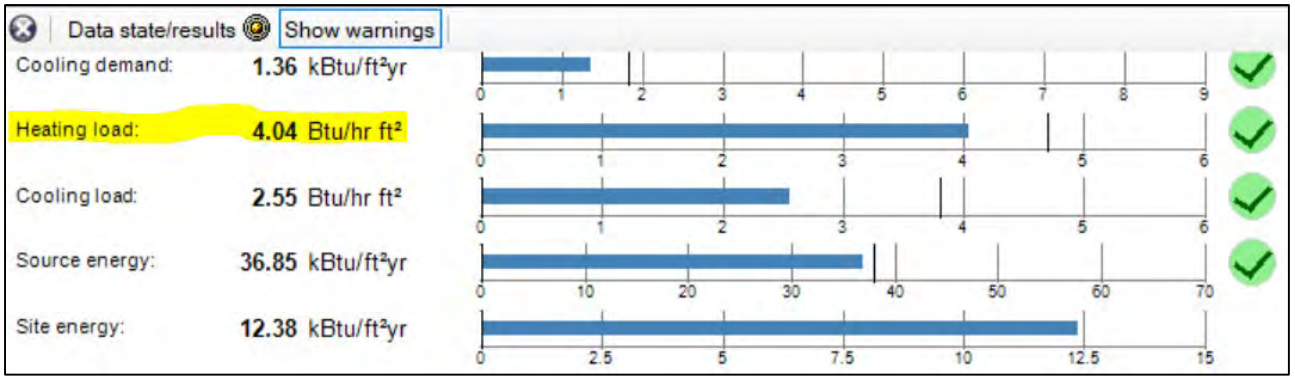
- Zone-specific
- Requires drop ceiling to hide cassette
- Energy savings with ability to turn off

HEATING, COOLING + VENTILATION

WAYNFLETE LOWER SCHOOL

BTUH	
54,000	
81,000	
81,000	
81,000	
54,000	
21,000	
21,000	
34,000	
17,500	
17,500	
21,000	
54,000	
13,500	
27,000	
21,000	
21,000	
21,000	
640,500	btuh
24,055	sf
26.63	BTUH/SF

21 btuh w 25% safety factor



Climate for		Heating load 1	Heating load 2	Cooling
Temperature	[°F]	5.4	31.1	78.3
Solar radiation North	[Btu/hr ft²]	12.7	7.9	26.9
Solar radiation East	[Btu/hr ft²]	24.7	12.7	54.5
Solar radiation South	[Btu/hr ft²]	58.6	20.9	42.8
Solar radiation West	[Btu/hr ft²]	26.3	12	61.8
Solar radiation Global	[Btu/hr ft²]	28.5	13.9	103.7

Relevant boundary conditions for heating load calculation: Heating load 1

Boundary conditions

Climate:	**Portland, ME**
Internal heat gains:	**0.8** Btu/hr ft²
Interior temperature:	**68** °F
Overheat temperature:	**77** °F

62.6 F Δ T

HP- 6	ELEV MACH ROOM	FXAQ18PVJU	1.5	WALL MOUNTED	12,000	13,500	500	0"

NOTES:
COOLING BASED ON 80/67 EAT, 95F OUTSIDE AMBIENT, 25 FT EQUIVALENT REFRIG. PIPING LENGTH.
HEATING BASED ON 70F EAT, OUTDOOR TEMP -10F, 25 FT EQUIVALENT REFRIG. PIPING LENGTH
SOUND LEVELS BASED ON ANECHOIC CHAMBER CONVERSION VALUE, MEASURED UNDER JISB8616 CONDITIONS

80 °F Δ T → *15.75 BTUhr*

HEATING, COOLING + VENTILATION

WAYNFLETE LOWER SCHOOL

OTHER CONSIDERATIONS:

CABINET UNIT HEATERS

(HYDRONIC)

Utilizing Connections to Existing Systems on Campus

SPECIALIZED VENTILATION

Kilns

Maker Spaces

Laser Cutters