ASSEMBLIES
ROOF / WALL / SLAB
more like disassemblies...
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

R-51

R-20
DESIGN SECTION

Will it cause condensation? 

Is it comfortable next to it? 

Will it use a lot of energy?

BUILD IT!

OK!

YES

NO

YES

NO

 DOES MY THERMAL BRIDGE MATTER?
Will it cause condensation?
Will it be comfortable?
WINDOW COMFORT ANALYSIS

COG U-VALUE: 0.28

(~ CODE WINDOWS)
WINDOW COMFORT ANALYSIS

COG U-VALUE: 0.088

OUTDOOR_TEMP
WINDOW_SURFACE_TEMP
GLAZING COMFORT MIN
YES!

1. SIP PANEL: SEAL PENETRATIONS WITH SPRAY FOAM INSULATION
2. FLUID APPLIED BARBER
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?

\[ Q_T = L \times \Psi \times f_T \times G_T \]

\[ = 101 \times 0.754 \times 1 \times 3264 \times 0.024 \]

\[ = 5,965 \text{ kBtu} \]

\[ = 5,965 \text{ kBtu} \times \text{COP3} \times \text{source factor (3.1)} \]

\[ = 5,965 \text{ kBtu} \]

TOTAL ENERGY USE

886,426 kBtu

\[ = 0.6\% \text{ of annual energy use} \]
OPENINGS
WINDOWS / DOORS / SKYLIGHTS
1. METAL CLADDING OVER AIR BARRIER
2. DRIP EDGE
3. METAL CLAD HEAD AND JANIB
4. FIBERGLASS ANGLE
5. PT BLOCKING
6. EXTERIOR GYPSUM WALL BOARD SHEATHING
7. SELF ADHERED FLEXIBLE FLASHING MEMBRANE
8. ROOF MEMBRANE
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/ 1/2" 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
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 VLT to Deck, Cont. Seal w/Spray Foam
8. Skylight Assembly and Frame Flashing
9. Cont. Spray Foam Insulation, TYP
10. Metal Center Flashing To Match Metal Siding
11. Self-Adhered Waterproofing Membrane, Cont. Sealed Below To Skylight Curb
12. 3" Polystyrene Insulation
13. Cont. Flexible Flashing Membrane From To Skylight Curb To Roof Membrane
14. Sheathing
15. Protection Board and TYP To Roof Assembly
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
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
MAINE COAST WALDORF HIGH SCHOOL

HEATING, COOLING + VENTILATION

ZONING DIAGRAM

2ND FLOOR

1ST FLOOR
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
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

VARIABLE REFRIGERANT FLOW SYSTEM
(HEAT PUMP)

1 UNIT
DAIKIN VRV III-S
3 TONS
3-10% CAPACITY CONTROL

2 UNITS

7 UNITS
DAIKIN VRV IV
12-18 TONS
3-10% CAPACITY CONTROL

15 UNITS
8 UNITS
8 UNITS
• 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 | 81,000 | 54,000 | 21,000 | 21,000 | 21,000 | 21,000 | 17,500 | 17,500 | 21,000 | 21,000 | 21,000 | 21,000 | 640,500 btuh | 24,055 sf | 26.63 BTUH/SF |

21 btuh w 25% safety factor

21 btuh w 25% safety factor

80 °F ΔT

15.75 BTUhr

62.6 °F ΔT
OTHER CONSIDERATIONS:

CABINET UNIT HEATERS
(HYDRONIC)
Utilizing Connections to Existing Systems on Campus

SPECIALIZED VENTILATION
Kilns
Maker Spaces
Laser Cutters