

Bringing Savings to Life: Net-Zero Design and Performance

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BBBD – 2010

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**Putney Field House
and
NRG Addition**

NRG Addition

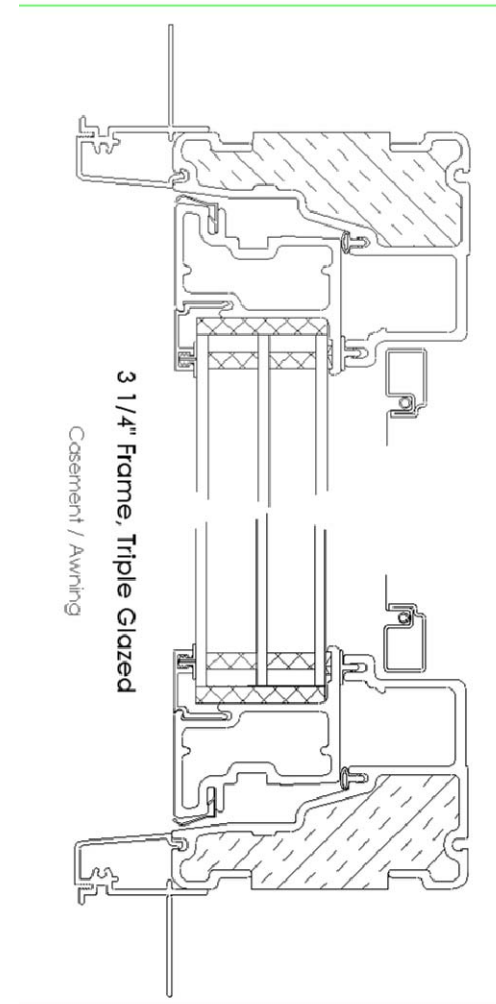
Learn from NRG – 1:

Improve Performance and Simplify Systems



NRG Addition - Enclosure

- High efficiency R-5 windows, SHGC-0.26 and R-2.5 skylights
- Super-insulated structure, walls, roof, R/20/40/60
- Very tight construction ---
0.092 cfm50/sq.ft
0.42 ACH-50



NRG Addition - Daylighting

- Diffused daylighting
- In almost all occupied spaces
- Desks near south-facing windows



NRG Addition - Daylighting

- Overhead + sidelight in warehouse



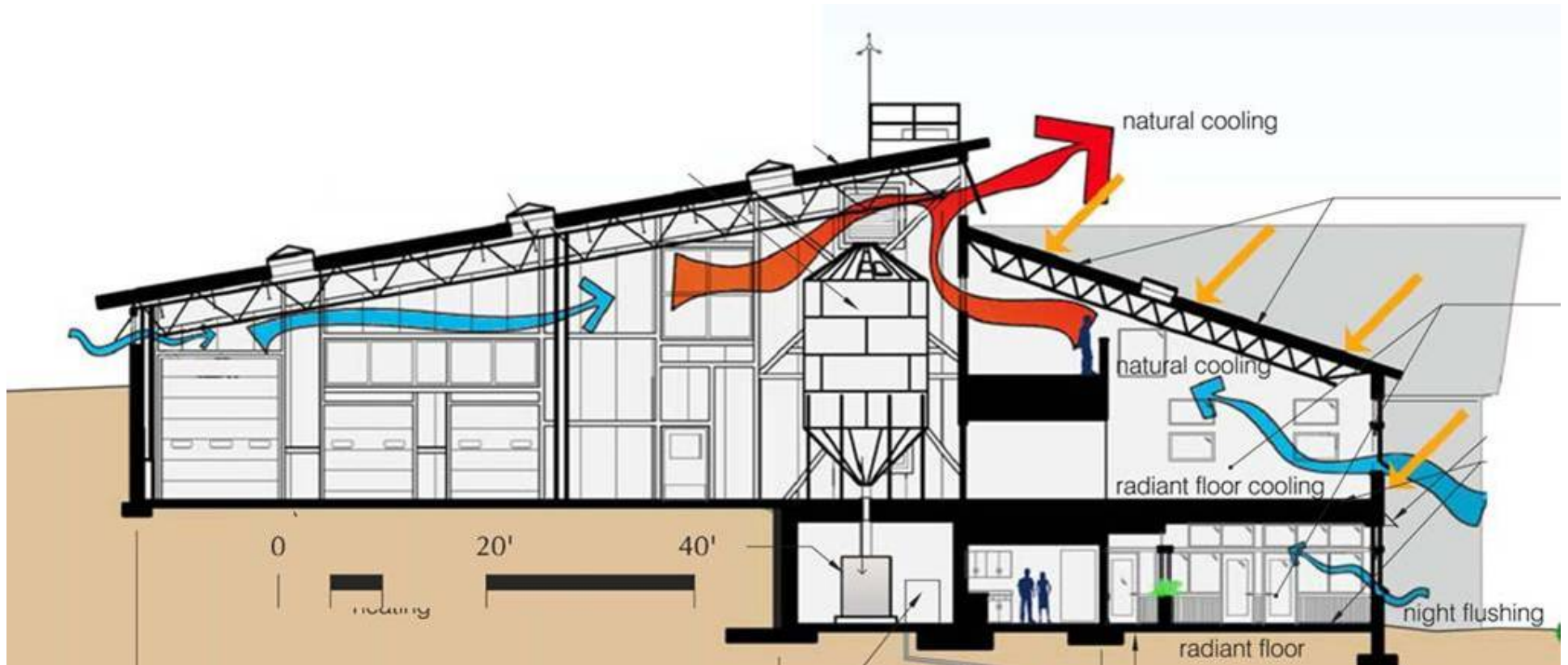
NRG Addition - Lighting

- High efficiency lighting
- Automatic daylight harvesting controls
- Occupancy sensors everywhere



NRG Addition - Controls

- Networked building automation system
- Windows automated for natural cooling



Ventilation Load Reduction

- Supply/exhaust ramp
up/down to meet
load
- Push-button
boost in
conference rooms



Ventilation Load Reduction

- Operable windows
- CO₂ and RH based control
- Ventilation schedule during occupied hours only



Ventilation load reduction

- SEMCO sensible + latent energy recovery wheel with purge section and selective Dessicant – 70+% effectiveness



Energy sources

- PV electricity production
- Wood pellet-fired boilers
- Direct well-water cooling
- Solar hot water system for domestic hot water
- High efficiency backup propane boiler

NRG Addition PV

Installed watts

Roof	27,788
Awning	6,800
Bike Rack	7,200
Trackers (12)	28,800
Total watts	70,588
Expected kWh/yr	78,000



Space heating

- 2 Tarm high efficiency wood pellet boilers
- Backup condensing propane boiler



Space cooling

- Direct well-water cooling through radiant floor and coil in ventilation air
- Design COP = 11
(EER = 37)
- Dumps in pond for building 1 to improve COP of building 1 heat pumps
- ***LN Consulting – mechanical engineers***

Hot water

- **Low flow fixtures**
 - 0.5 gpm aerators
 - 2.0 gpm showers
 - E-Star dishwasher
- **Solar hot water**
 - 4 @ 3x6 collectors
 - 120 gallons storage



Putney Field House

Goal: Net Zero!



Putney Field House - Enclosure

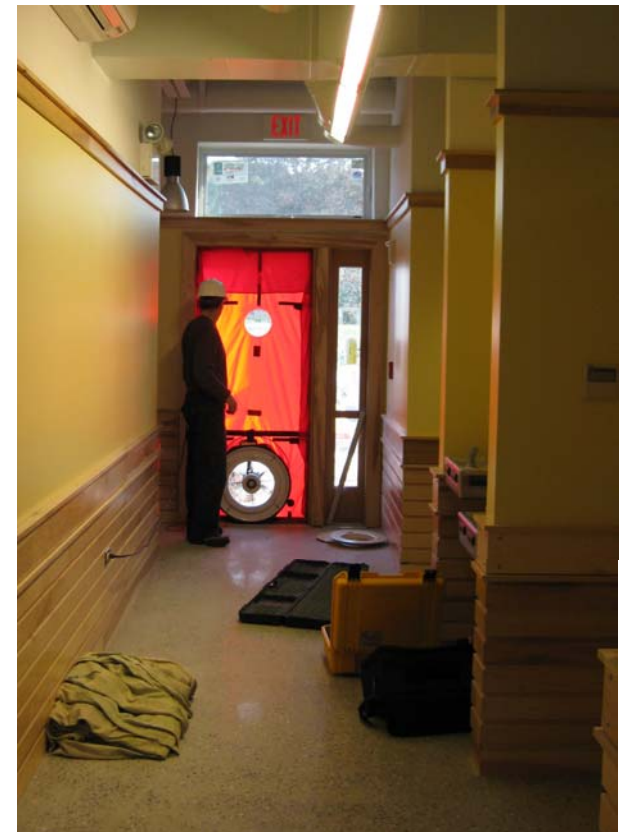
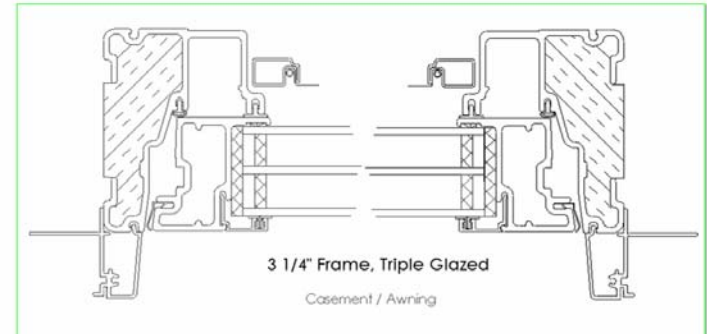
- High efficiency R-5 windows, SHGC-0.26 and R-2.5 skylights

- Super-insulated structure, walls, roof, R/20/45/60

- Very tight construction ---
0.065 cfm50/sq.ft

0.37 ACH-50

0.024 ACH natural estimated



Putney Field House - Daylighting

- Overhead + sidelight in gym

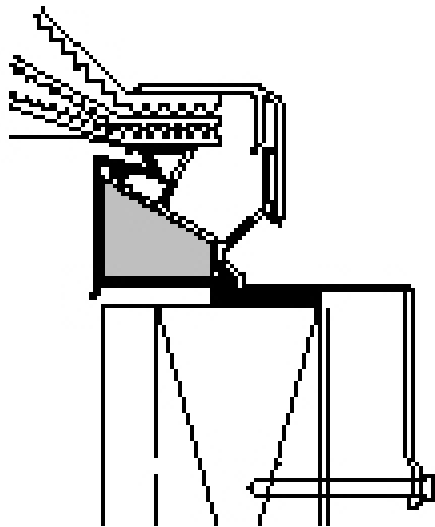


Putney Field House - Daylighting

- Overhead + sidelight “Light Louvers” in gym



- “Light Louvers”
- Sun-Optics
clear prismatic
skylight

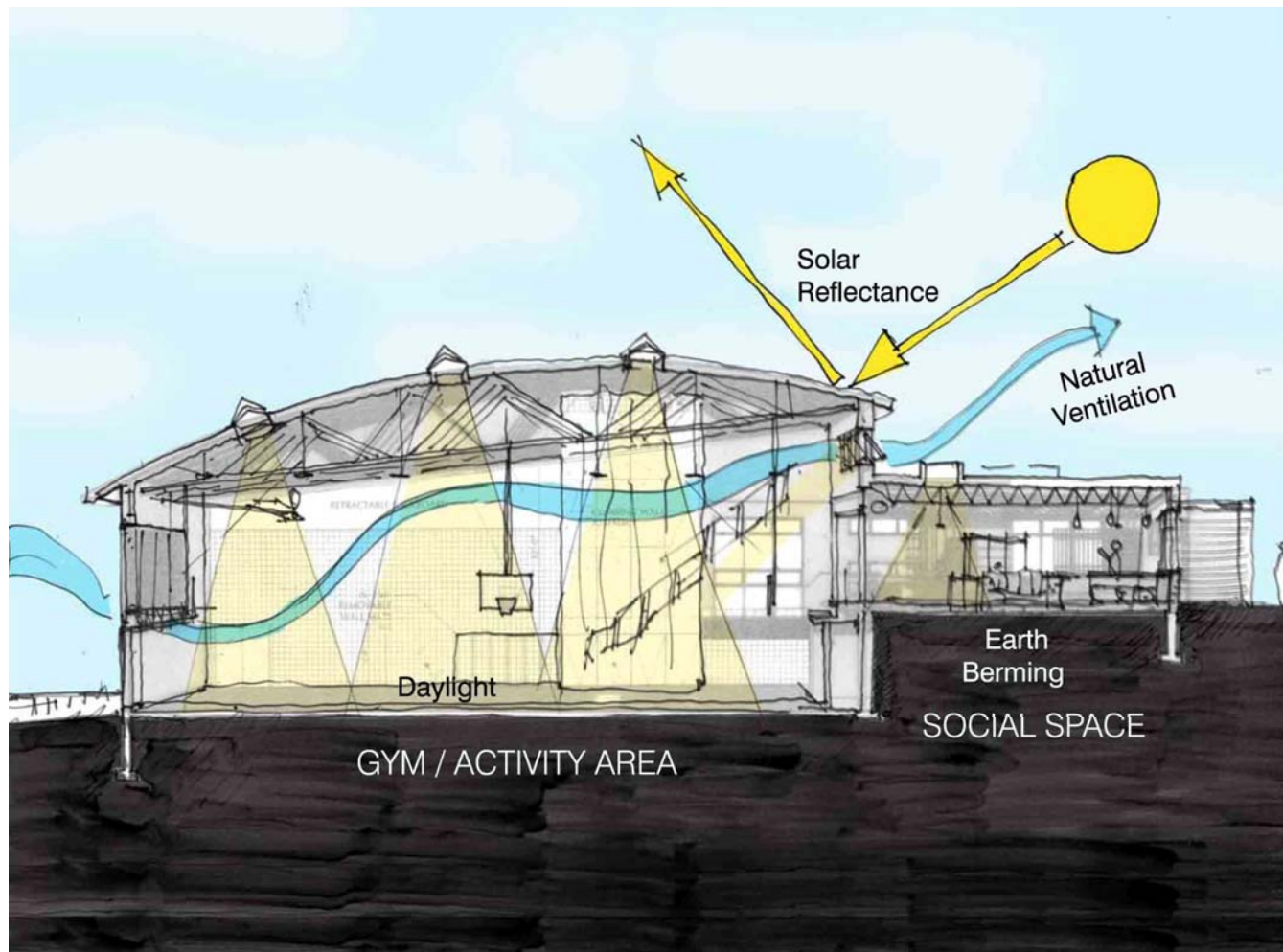


Putney Field House - Lighting

- High efficiency lighting
- Automatic daylight harvesting controls
 - Three step auto dimming in gym
- Occupancy sensors everywhere



Putney Field House - Natural Cooling



Putney Field House - Controls

Building automation system

- Rooms go to set-back temperature when unoccupied
- Demand-controlled ventilation
- “Periscope” for easy viewing of performance



Putney Field House

LEED Platinum

Excellence in indoor air quality,
materials, site, energy and water use

Putney Field House LEED Platinum

But our approach still has a way to go....

.....6x annual energy consumption.....



Ventilation Load Reduction

- Operable windows
- CO2 based control
- Ventilation only when occupied and only when CO2 rises above setpoint
- Exhaust from locker and toilet rooms on occupancy sensor

Ventilation load reduction

- SEMCO sensible + latent energy recovery wheel with purge section and selective Dessicant – 70+% effectiveness

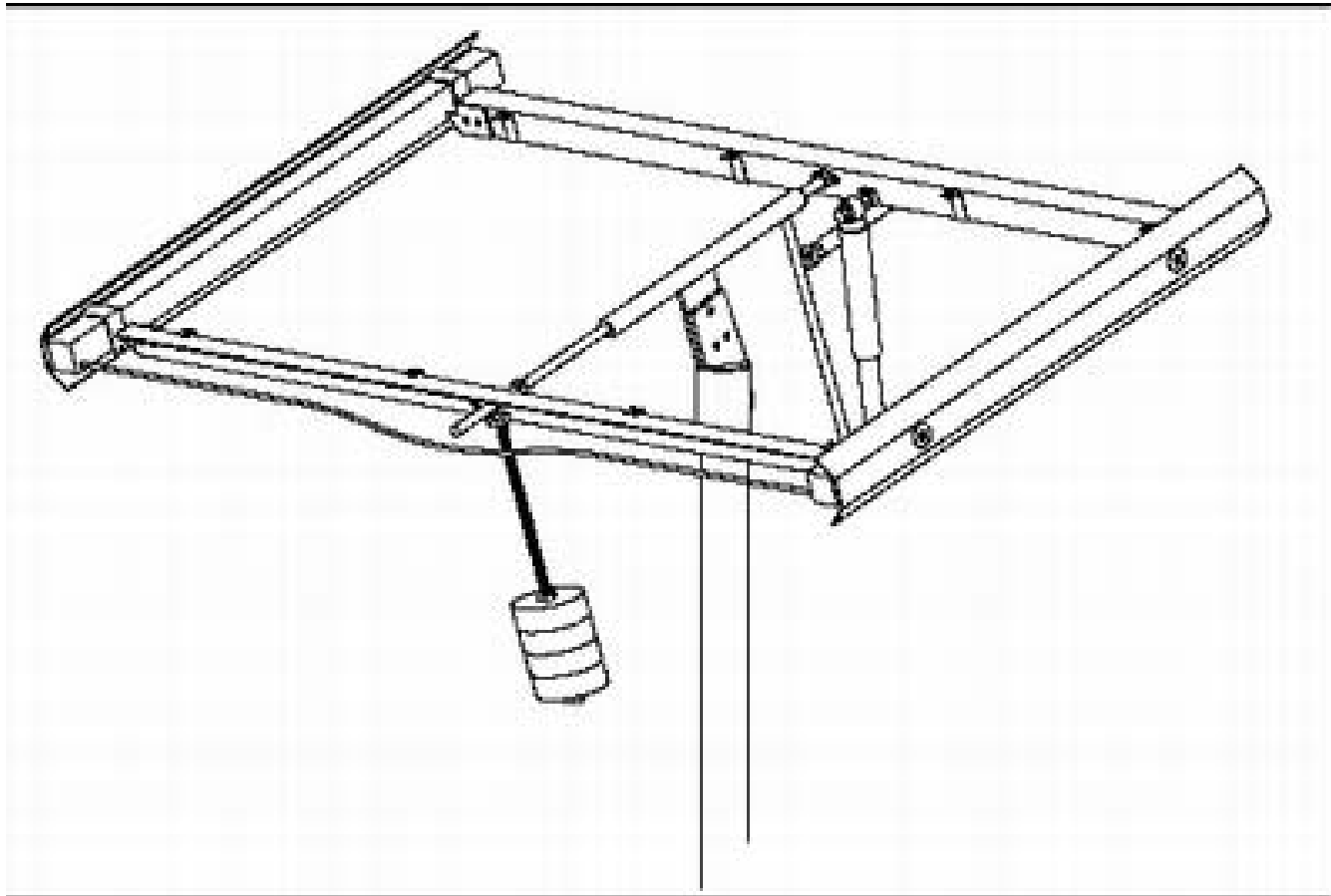


Energy sources

- PV electricity production!
- 16 Zomeworks 2.3 kW tracking arrays
- 36.8 kW / Expect ~avg of 45,000 kWh/yr



Energy sources



Heating System

Daikin Variable Refrigerant Volume (VRV)
Air-Source Heat Pump

- Estimated Heating Season COP 2.5



Heating System

Why not ground source heat pump for lower energy use for a net zero building?

Heating System

Why not ground source heat pump for lower energy use for a net zero building?

Projected heat load	42,824	kWh/yr
Electricity at ASHP COP = 2.3	18,619	kWh/yr
Electricity at GSHP COP = 3.5	12,235	kWh/yr
Added for ASHP	6,384	kWh/yr

Heating System

Why not ground source heat pump for lower energy use for a net zero building?

kWh/yr per tracker	2,875
Added trackers needed	2.2
Cost per tracker	\$ 17,250

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Cost per tracker	\$ 17,250

Added cost for GSHP	\$ 100,000
Cost for added tracker for ASHP	\$ 38,000

Putney Field House – Composting Toilets

