

Centerville Elementary School, Beverly

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1.Site

- All trees removed from site were taken to a paper mill for reuse
- Additional trees planted at North side of the building to protect from winter elements
- Additional trees planted at South side of the building to reduce unwanted solar glare, heat gain, and reduce heat island effect.
- Construction and Demolition reuse
- Original asphalt driveway recycled and re-used in new driveway
- Brick and concrete from original structure re-used as structural fill.
- Existing structural fill to be reused
- Minimized disruption of site by protecting wetlands and as many existing trees as possible.
- Replication of wetlands adjacent to existing wetlands in an effort to manage storm-water runoff
- Storm water management. Building's gutter system channels storm water to the rear of the building and into a retention pond (capacity unknown). In the retention pond there is a overflow device that regulates the flow of water to adjacent re-created wetlands.
- Green spaces on site are being preserved
- Outside benches are constructed out of recycled Wisconsin plastic milk cartons

2. Interior Surfaces & Finishing's

- Low VOC finishes
- The carpet specified is sole sourced, Collins and Aikman mold-resistant backing, peel and stick, low VOC and fully recycled

3. Electric Lighting & Controls

- **Portfolio**, C7032-7000, 26 & 32 W Compact Fluorescent, Low brightness 7 3/8" aperture reflector for use with either 26W or 32W Triple tube 4-pin lamps.
- **Triad**, B232I120L-A, High frequency electronic ballast for 1 or 2 F32T8 lamps
- **Metalux**, 2EP3GAX 340 & 332, 18 cell, 2' x 4' parabolic, 3 lamp, semi-specular or specular louver, Paralux III Recessed Static or Air Supply Troffer
- **Metalux**, 2GC 240, 232, 440, 432, 2' x 4' Troffer, 2 or 4 lamps, Specification Recessed Static Troffer
- **Metalux**, GCASF 140, 132, 240, 232, 1' x 4' Troffer, 1 or 2 lamps, Specification Recessed Air Supply Troffer
- **Metalux**, 2GC 340, 332, 2' x 4' Troffer, 3 lamps, Specification Recessed Static Troffer
- **Rondalite**, 7 Series, FS2, Thermally protected Class "P" instant start 265ma T8 electronic ballast
- **SportLite**, LX800-SERIES, provides versatile, natural up-lighting that is perfect for large open spaces
- **Neoray**, Triad, Series 17IP/3T8, Luminous Indirect, Pendant
- **UNENCO**, CUI5002000, CUI8001500, Dual Technology Ceiling Mount Sensors, combine an ultrasonic transducer with a dual element pyro-electric detector to provide optimum motion detection
- **Mytech**, The Light Owl DT Occupancy Sensor, Dual Technology Corner Sensor
- **Mytech**, MP Power Pack a Series, can power up to 3 sensors. The internal relay can control up to 20 amps at either 120, 230, or 277, and 15 amps at 347 VAC ballast load
- **UNENCO**, Passive Infrared Wall Switch, turns lighting systems on and off based on occupancy and ambient light levels

4. Daylighting & Fenestration Design

Light Monitors, incorporated with PV system in an effort to bring natural light deep within the classrooms. Constructed out of copper roofing and siding, steel structure, insulated steel stud walls with a plaster and veneer finish. Windows @ light monitor alternate between fixed and operable units. The operable units are remote controlled

motorized window systems. All electric lighting in classrooms are controlled by photosensors.



Windows:

- 1” overall width
 - (2) ¾” clear glass panes separated by ½” air space
 - Soft low-e coating
 - Shading Coefficient = 0.67
 - Daylight Transmittance = 74%
 - R-value = 3 or better
- Windows located close to perpendicular walls allowing light to penetrate deeper within spaces and eliminate dark corners

Alternate#1	
Add Light monitors	
Steel	\$69,000.00
Rough Carpentry	\$25,000.00
W, D, & C	\$4,500.00
Insulation	\$3,500.00
Roofing	\$90,000.00
Aluminum Windows	\$24,293.00
Plastering	\$30,500.00
Gypsum Board	\$60,000.00
Signage	\$3,000.00
Shades	\$12,000.00
Solar Panels	\$89,200.00

Fire Protection	\$15,250.00
HVAC	\$30,000.00
Electrical	\$51,960.00
Subtotal	\$508,203.00
P&O	\$50,820.30
Bond	\$976.70
Total	\$560,000.00

5. Building Enclosure & Insulation

Single story construction lends itself to being more efficient (easier to heat & cool).

Curtain wall construction:

- Brick façade
- Continuous air barrier
- Vapor barrier
- Gypsum sheathing
- 6” of batt insulation
- ¾” rigid foil faced polisoocyanurate insulation
- 5/8” plaster system



Roof construction:

- Steel decking
- Polyethylene vapor barrier
- 3” of rigid insulation
- ½” of recovery board
- Adhered membrane roofing system

* Light colored roof membrane to reflect rather than absorb heat from sun and allows PV to operate more efficiently by keeping the panels at a cooler temperature.

* Single story construction conducive to a buildings efficiency (less volume to heat & cool).

* Re-use of existing building.

* Window area in existing building to be reduced.

* Removal of interior partitions affected by mold



** In the location shown above, partitions affected by mold were removed, track installed on the concrete slab illustrates where those KD'd partitions were located. Mold was the result of roof leaks providing moisture to the space between the partitions where the cellulose GWB backing provided a food source.*

6.HVAC

Controls, A building control system (BCS) will be used to control all mechanical systems in the building; the system will utilize direct digital controls (DDC).

Individual Unit Ventilators ranging in size from 750 to 2,000 CFM of supply air. Most units will have heating and ventilation capabilities and will include an air filter, fan, and a hot water heating coil.

(2) Units serving SPED classrooms will include DX cooling coils (4-ton capacity each) with remote condensers on the roof.

Gymnasium and cafeteria will be served by (2) rooftop heating, ventilation, and air exchange units. Each unit will include supply and return fans, an air filter, and a hot water heating coil. The units have no cooling capacity other than an outside air economizer. Unit controlled by BCS.

Administrative offices and media center will be served by (2) packaged, constant volume air conditioning rooftop units. Each unit includes a supply and return fan, an air filter, a hot water heating coil, and a DX cooling coil (approx. 93 ton capacity) with a remote condensing unit. The unit is equipped for an airside economizer operation. It includes supply fan and a separate (installed outside the unit) return and exhaust fan. Unit controlled by BCS.

7.Renewable Energy Systems

Bergey BWC EXCEL Wind Turbine

- 7 meter (23') 3 blades, upwind turbine
- 10 kW rated output when connected to a grid
- 100' Guyed Lattice Tower
- Auto Furl (High Wind Speed Protection)
- Inverter located in Science Storage Room
- Monitored via. Building Management System
- Located in southwestern corner of site (see photo below).



WindCad Turbine Performance Model

Inputs	
Ave. Wind (m/s) =	6.7
Weibull =	2
Site Altitude (m) =	0
Wind Shear Exp. =	0.143
Anem. Height (m) =	50
Tower Height (m) =	37
Turbulence Factor =	10.0%

Results	
Hub Average Wind Speed (m/s) =	6.42
Air Density Factor =	0%
Average Output Power (kW) =	2.33
Daily Energy Output (kWh) =	55.9
Annual Energy Output (kWh) =	20,413
Monthly Energy Output =	1,701
Percent Operating Time =	79.0%

Alternate#2	
Wind Energy System	
Earthwork	\$7,040.00

Concrete	\$9,900.00
Wind Energy	
Submittals	\$6,200.00
Tower	\$16,800.00
Wind Inverter	\$10,700.00
10kW Bergey Turbine	\$17,200.00
Misc. Material Wind	\$3,500.00
Wind Labor	\$11,292.00
HVAC (FSB)	\$17,698.00
Electrical (FSB)	\$9,670.00
Total	\$110,000.00

Photovoltaic System

- 10 kW solar array
- Intended Design, Rooftop Monitor System (Monitor would span distance of 7 classrooms)
- Panels mounted with “Grid Galvanized Unit-Struts” which allow air to flow around panel, keeping the panels cooler and more efficient.
- Inverter located in Science Storage Room
- Array is anticipated to generate 17,023 kWh per year at a savings of \$2,042.76.
- Monitored via. Building Management System.
- Teaching & Monitoring Station

PV WATTS AC Energy & Cost Savings

Station Identification	
City	Boston
State	MA
Latitude	42.37 deg. N
Elevation	5m
PV System Specifications	
AC Rating	10.9 kW
Array Type	Fixed Tilt
Array Tilt	33.0 deg.
Array Azimuth	166.0 deg.
Energy Specifications	
Cost of Electricity	12.0 cents/kWh

Energy Production		
Month	Energy (kWh)	Energy Value (\$)

1	1057	126.84
2	1255	150.60
3	1559	187.08
4	1562	187.44
5	1714	205.68
6	1648	197.76
7	1752	210.24
8	1728	207.36
9	1511	181.32
10	1408	168.96
11	924	110.88
12	907	108.84
Year	17023	2042.76

8.Other Equipment & Systems

Water Efficiencies:

- A re-created wetlands will effectively manage all storm water in a useful manner, located on site and adjacent to existing wetlands, the re-created wetlands will serve a useful purpose as well a providing a “hands on “ learning tool.
- Design landscape and ornamental water use budget to conform to local ordinance
- Reduce water consumption for irrigation by 50%.
- Reduce water consumption for site irrigation by 50%.

9.Load Management

Need Information

10.Motors & Equipment

Need Information

11.Materials

- Concrete removed from existing structure taken to facility where it will be crushed and reused in concrete products with recycled content
- Re-use of equipment, materials, etc. deemed to be in acceptable condition from existing structure.
- Building/School shall meet requirements for recycling space
- Re-use and maintain large portions of the existing structure as well as the shell

12.Measurement & Verification

Power DOE Modeling & Results

Buildings annual energy consumption: 329,100 kWh/yr.

Annual \$ Savings: \$38,800 yr.

- 52kW during summer vacation
- 139kW during winter
- 161kW during early summer
- 51% lights
- 12% non-HVAC electric powered equipment
- 37% HVAC equipment
- Fuel oil consumption – 14,900 gallons per year or \$17,100/yr

Table 1 (baseline energy consumption)			
Energy Source	Energy Consumption	Energy Cost	% Of Total Energy Cost
	<i>unit/year</i>	<i>\$/year</i>	<i>%</i>
Electricity	329,100 kWh	\$38,800	69%
Fuel Oil #2	14,900 gallons	\$17,100	31%
Total	N/A	\$55,900	N/A

Energy Modeling Results (PowerDOE):

Electric Energy Use: 329,100 kWh/year

Monthly Peak Electric Demand: Summer Vacation = 52kW, Winter = 139kW, Early Summer = 161kW

Total Electric Energy Consumption: 51% consumed by lights, 12% consumed by miscellaneous (non-HVAC) electric powered equipment, 37% consumed by HVAC equipment.

Fuel Oil Consumption: 14,900 gallons/year at a cost of \$17,100/year

13.Commissioning & Maintenance

Need Information