Better By Design

Energy Efficiency in Needham's Public Construction Projects

Green Needham

Monday, November 26th, 2012

7:00PM – Needham Public Library

Energy Efficiency in Town Projects

Presenters tonight Include:

Overview

- **Hank Haff**, Project Manager – PFD - Construction

High Rock School

- **Rick Rice,** Project Architect, with the DiNisco Design Partnership

Public Services Administration Building (PSAB)

- **Mike Fields,** Project Architect, with Winter Street Architects, Inc.

Discussion Topics tonight

- **Who** – Participants in decision making process
- **How** - Design & Construction process
- **What** - Examples in recent New Buildings
  - High Rock School
  - Public Services Administration Building (PPBC)
- **When** – New buildings and repair, renovations and upgrades to existing buildings and other town infrastructure
  - 2011 Energy Audit and response
  - Investments in Energy Savings

Acronyms - Definitions

CHPS – Collaborative for High Performance Schools
http://www.chps.net

ECM – Energy Conservation Measures

EMCS - Energy Management & Control System

LEED – Leadership in Energy and Environmental Design
https://new.usgbc.org/leed

MSBA – Massachusetts School Building Authority
http://www.massschoolbuildings.org/programs/green_schools

PPBC – Permanent Public Building Committee

PV – Solar Photo Voltaic

RTS – Recycle Transfer Station

Needham's Public Building Design Process (Who)

- Permanent Public Building Committee (PPBC) – responsible for oversight on all public building projects in Needham over $500,000
- PPBC is a volunteer Town Committee with Engineers, Architects, Lawyers, Accountants, and Contractors
- George Kent, P.E., Chairman
- 2 User Group Members for each project
- Public Facilities Department
  - Steve Popper, P.E., Director Design & Construction
  - Chip Laffey, Director of Operations Division
- PPBC members here tonight please raise your hand

Green Design is integral to the PPBC Design Process (How)

- Starts with Architect Selection – Qualifications Based selection process (per M.G.L.ch7 section38A1/2-O)
- State Energy Code – Now 8th Edition is based on International Building Code (IBC-2009)
- School projects with MSBA funding - minimum standards that exceed State Building code in Indoor Air Quality and Natural Daylight
- PPBC process requires:
  - Lifecycle Cost analysis for Building & Systems
  - Cost Benefit analysis on "Green" enhancements

Energy Efficiency – Building Design Considerations (What)

- Energy Efficiency – Design Criteria
  - Building Site – orientation, natural light & shade,
  - Envelope Design - Roof, Walls, windows, foundation
  - Heating System & Cooling Systems – type, efficiency, controls and operation
  - Lighting – fixture efficiency and controls
  - Alternative Energy Systems
  - Commissioning - Operations and Maintenance
- Other Environmental Issues

(Indoor Environmental Quality, Water, Materials & Waste Mgmt)

MSBA Sustainable Building Design Guidelines and Policies

- The minimum standards constantly being revised & upgraded by the MSBA
- MSBA funds commissioning of school buildings
- 2% additional reimbursement of eligible costs if:
  - "Leader" rating using MA-CHPS (2009 edition) or,
  - "Silver" using LEED-S (Schools – 2009 edition)

High Rock School

Rick Rice – DiNisco Design Partnership

High Rock School

Green Design Features

- 25% more energy efficient than “code”
- Reuse, renovation & addition – no demolition
- Improved envelope design – walls, roof & windows
- Daylight design – Natural lighting
- Hi efficient lighting
- HVAC Systems – Hi efficiency and enhanced controls

High Rock School
Green Design Features

High Rock School
Energy Efficient Envelope

- Roof System – R-25 minimum – rigid insulation
- Windows – Double pane, low-E, with thermally broken aluminum frames
- Walls – Existing exterior walls insulated
- Doors – Vestibules at main entrances
  - glass doors similar to windows
  - Insulated Solid Doors

High Rock School

Energy Efficient Envelope

High Rock – HVAC

Heating Ventilation & Air Conditioning

- High efficiency condensing boilers (90%+)
- Occupancy sensors in room – control heating and provide “on-demand ventilation”
- Multiple HVAC zones allow shut down in unoccupied areas of building
- Hi performance windows – low-E glass & exterior sunscreens reduce heat gain in summer
- Operable windows
- Commissioning of systems and equipment

High Rock – HVAC

Multiple HVAC zones allow shut down in unoccupied areas of building

High Rock – HVAC

Multiple zones/nighttime use

High Rock School

Efficient Lighting Design

- Maximize use of Natural Light
  - Sunscreens on south facing windows reduce glare
  - Skylights on upper floor
- High efficiency lighting (T5 lamps)
  - Daylight controls turn off lights if daylight sufficient
  - Occupancy sensors turn off lights in unoccupied space
- Result: reduction of lighting loads to .94 watts/SF vs. 1.5 watts/SF required by code (over 35%)

High Rock School

Reduction of lighting loads to .94 watts/SF vs. 1.5 watts/SF

High Rock School

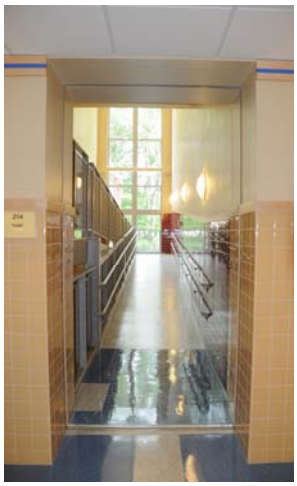
Daylight controls turn off lights if daylight sufficient

High Rock School

Borrowed light

High Rock School

Maximize use of natural light



High Rock School

Energy Conservation Measures (ECM)- Analysis

Potential Energy Upgrades
Needham High Rock
13 May 2008

DiNisco Design Partnership
architects and planners
87 Summer Street Boston, MA 02110

Item	Benefits	Estimated Construction Cost	Estimated Design Fee	Comments
Glazing Upgrade #1 Upgrade glazing to 1 1/2" "double" Heat Mirror (U=0.16) (Quad Glazing)	• Reduced Energy Costs • Increased comfort	$215,000	TBD	• Save $1,418 / Year • 152 Year Payback
Glazing Upgrade #2 Upgrade glazing to 1 1/2" Heat Mirror (U=0.21) (Triple Glazing)	• Reduced Energy Costs • Increased comfort	$125,000	TBD	• Save $466 / Year • 268 Year Payback
Increase Roof Insulation Add additional 1.5" of insulation	• Reduced Energy Costs	$75,000 - $125,000	TBD	• Save 383 / Year • 196 Year Payback
Increase Wall Insulation Add 2" spray-in insulation in metal stud backup wall at new construction	• Reduced Energy Costs	$35,000	TBD	• Save $193 / Year • 181 Year Payback

06494.0 CorConsEnrgyModel/!!FinalReport/06494.0 PotentialEnergyUpgrades.xls

Computer energy modeling of ECM alternatives with Cost Benefit analysis by Andelman and Lelek Engineering showed that certain ECM enhancements were not recommended due to long payback period

High Rock School

ECM Enhancement Analysis

High Rock School - Summary

- Project maximizes existing resources of the High Rock School to aid in energy efficiency.
- Energy efficient flexible occupancy: school day/vacation/off hours.
- Energy conservation is part of a comprehensive green design approach: site, maintenance, indoor air quality, energy, construction practices.

Public Services Administration Building (PSAB)

Mike Fields – Winter Street Architects

Project Goals

- Design to LEED Standard (but without certification process)
- Explore and Implement Energy Savings Alternatives
- **TCO Analysis**

  Total Cost of Ownership = Initial Cost + Operational Costs *over the anticipated life of the building*
- Since the Town owns the building, operations play a major role.

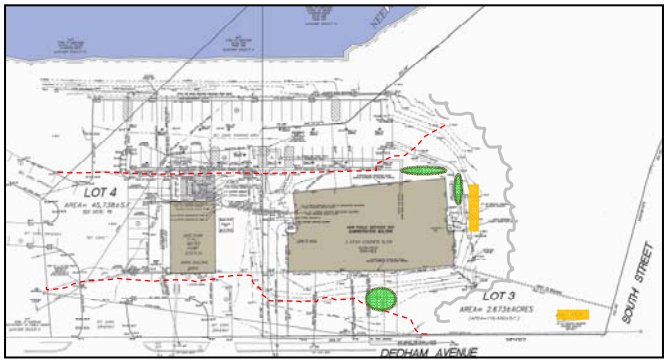
Public Services Administration Building (PSAB)

Green Design Features – Start LEED

Public Services Administration Building (PSAB)

Site Design

- Building footprint informed by wetland setbacks
- Stormwater reclaimed on site in underground cisterns
- Water-efficient native plantings; food bearing for wildlife
- Built tightly to existing grove to reduce # of trees removed



Public Services Administration Building (PSAB)

Envelope Enhancements

Roof

- ***Colors*** *- uses lightly-colored aggregate to reduce heat load in summer.*
- ***Solar Ready*** *– Sloped on south side and structure increased to allow future panels.*

Walls

- ***Insulation –*** *Continuous to four (4) feet below grade*

Windows

- ***Shading-*** *overhangs and "box-outs"*
- ***Efficient -*** *Thermally broken window frames & Low-E glass*

Public Services Administration Building (PSAB)

Building Materials

Recycled –

- *Aluminum siding and steel structure are both highly recycled and highly recyclable*

Low VOCs –

- *Interior materials and furnishings chosen to prevent "sick building syndrome".*

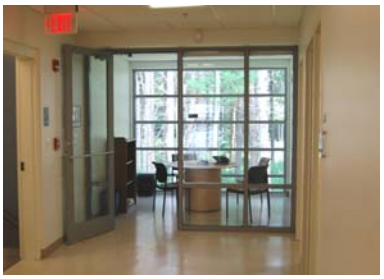
'Green' Certified –

- *Furniture selection favored LEED certified or other sustainably certified products.*

Public Services Administration Building (PSAB)

Lighting and Power

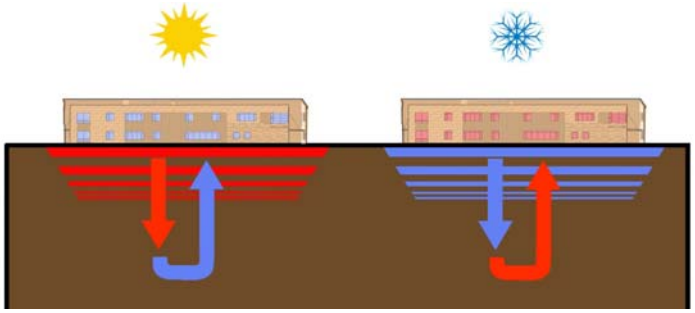
- All office spaces receive natural daylight and views
- Pine Grove filters south light
- Energy Efficient lighting controlled by motion sensors
- Building Automation System (BAS) monitors building energy and provides active control of systems.



Public Services Administration Building (PSAB)

Ground Source Heating and Cooling

- "Geothermal" (Ground Source Heating and Cooling) has no direct fossil fuel consumption and is carbon neutral apart from electrical load.
- Improvements to grid contribute to sustainability of the system.
- Onsite generation would be carbon free.



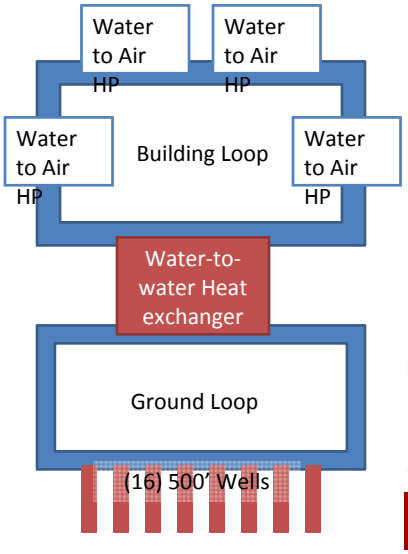
Public Services Administration Building (PSAB)

How the system Works

- Heat sink installed under parking lot
- Heat is transferred to or from the building loop
- Water to air heat pumps use refrigerant cycle to add or reject the room heat
- (Resistance heat backup was added in heat pumps, but not needed)

- No cooling tower needed
- No space needed for boiler
- ***All of the heat gained and lost is free, the only energy required is the transfer***

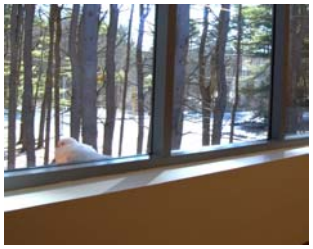
- Also, an Enthalpy Recovery Unit tempers incoming makeup air by exchanging energy with exhaust air



Public Services Administration Building (PSAB)

Summary

- Building came in under budget
- TCO evaluation triggered Ground Source system
- System has been functioning without backup
- ***More info at***:
  http://winterstreetarchitects.wordpress.com/2010/04/02/digging-geothermal/



2011 Needham Energy Audit

- Included Ten (10) Public Buildings
- Performed by EMG
- Identified energy and cost savings opportunities
- Helps prioritize energy saving investments

2011 Energy Audit of 10 Town Buildings
Summary of Results

Total Baseline Energy Consumption (10 buildings audited)	63,394	MMBtu
Total Baseline Energy Consumption for remaining town buildings	21,927	MMBtu
Total baseline non-building Energy Consumption (street lights, traffic lights, etc)	9,648	MMBtu
Total Baseline Energy Consumption for all town buildings	**94,969**	**MMBtu**
Total Estimated Annual Energy Savings:	*12,199*	MMBtu
Estimated Total Percentage Energy Savings	***12.85%***	

Energy Audit - Implementation

- **No/Low Cost measures: (under $1,000)**
  - maintenance related items and relative low investment
  - E. G. standalone HAVC controls, temperature set-backs and lighting controls special areas.
- **Capital Cost measures: (over $1,000)**
  - building wide lighting retrofit,
  - lighting controls for entire building or zones
  - exterior lighting,
  - upgrade/replacement of old HVAC system,
  - installation of VFD,
  - building retro-commissioning,
  - envelope upgrade and insulation including new thermal windows and,
  - appliance replacement.

Energy Audit- Actions

- The town has already implemented some energy conservation measures during summer of 2011 that included:
  - Installing new heating plant at Fire Station #2
  - Installing new Chiller at Public Safety building
  - Installing new water heater at Hillside Elementary School
  - Installing lighting occupancy sensors at Mitchell & Hillside Elementary Schools
  - Installing new energy star roof for Pollard Middle School
- *All the above measures collectively have an estimated annual savings potential of 1,696 MMBtu.*

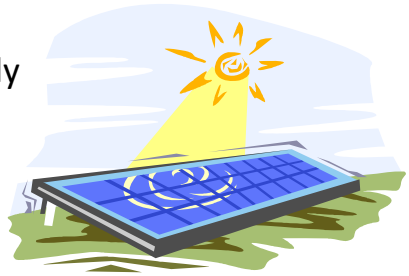
Other Energy & Cost Savings Opportunities

- Pollard School
  - √ Green Roof Project – 2011 (complete)
  - – Boiler Replacement – 2013
- √ Newman School – (2011-12) (Complete)
  - – √ New Roof
  - – √ Energy Efficient Boilers
  - – √ Energy Efficient Domestic Hot Water
  - – √ Roof Top units
  - – √ Commissioning

Alternative Energy Opportunities

Needham Solar Advisory Committee

- Solar Photo Voltaic (PV)
- RTS @ Central Ave
  - On capped landfill
  - Salt Shed Roof – Solar ready
- Other Town locations



Summary

Better By Design

Energy Efficiency in Needham's Public Construction Projects

»Who

»How

»Where

»When

(Because we think you know Why)

Thank you

Questions