Capuano Early Childhood Center

Presented by:
Doug Sacra, LEED AP
HMFH Architects, Inc.
Cambridge, MA
High Performance Green Facilities

• Improved Learning and Working Environment
• Costs less to maintain and operate
• Sensitive to the Environment
Capuano Early Childhood Center
Somerville, MA

- Grades Pre-K to 1
- 80,000 square feet, 2 story
- 400/560 students
- Fully air conditioned
- Built on Public Park
- MTC Green School Program
- LEED Registered
- Occupied September 2003
Green Metrics

- NESEA Green Building Award – 2004
- 18 energy efficiency enhancements
- 47% electricity reduction
- 24% natural gas reduction
- 41% overall energy cost reduction ~ $60,000 annually
- Water conservation – 56% site, 26% building
- Construction Recycling – 600 tons
- $793,260 grant funding
Design Process - In the beginning

Green for non-green clients

- Improve the learning environment
- Decrease maintenance
- Decrease energy usage

Shhh - Don’t use the word “Green”
Design Process

Edgerly original client H. P. goals:

• Maximize daylighting in teaching spaces
• Reduce energy usage if payback reasonable
• Deliver fully functioning HVAC system
• Use materials that reduce maintenance/replacement
Decrease Environmental Impact

Site Strategies:
- Bought land to replace recreational area 1:1
- Removed PCB, lead, & mercury contaminated soils
- Net decrease in site drainage run-off –
- Roof run-off re-absorbed in underground retention / infiltration area
Decrease Environmental Impact

Site Strategies:
- Native plantings with low water requirements
- Drip irrigation in lieu of spray heads in non-play field spaces
- Replaced tall sports lights with low light pollution pedestrian level lights
- Reduced parking, broke down lots, shaded to reduce heat island effect
Improving The Learning & Working Environment

Example: Daylighting
What HMG found in Capistrano

Students with the **most** daylighting in their classrooms (compared to least in classrooms):
- progressed 20% faster in math tests
- progressed **26% faster** on reading tests

Students with **poorly designed** daylighting in classrooms:
- declined **21%** on reading tests

➢ **Net 47%** swing in performance good to bad

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Capuano School Daylighting Goals

Circulation Spaces
• Add daylight for orientation/differentiation/pleasant feel
• OK to have some direct light for “sparkle”

Teaching Spaces, Offices
• Provide excellent daylighting
• On sunny days – enough daylight to shut off lights
• On densely cloudy days – fill in with artificial light
• Minimize direct light
• Views to exterior at kid-appropriate heights
Daylighting

Edgerly School Classroom Section
Daylighting - Physical Model

Up on the roof - testing the model
Daylighting - skylights

2nd floor - with skylights
Equinox at noon - south side

2nd floor - without skylights
Equinox at noon - south side
Daylighting - Analysis Graph

2nd floor - with skylights
south side

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Daylighting - skylights
Multi-purpose Materials

Fiberglass acoustic ceiling tile in lieu of mineral fiber tile (multi-tasking material):

- Washable
- Stain resistant
- Does not sag
- Does not support mold or mildew growth
- 70 % NRC improvement
- 88 % light reflectance – increases lighting efficiency
ECM-4: Daylight Dimming Control

**Strategy:**
- Dim lights near windows and skylights & then shut them off when daylight is sufficient

**Base Case:**
- Lights on in rooms whenever occupied

**Upgrade:**
- Add photocell at windows, skylights
- Add dimming ballasts to linear fluorescents
- Assumes extra daylighting provided - skylights, clerestories, light shelves....

<table>
<thead>
<tr>
<th>ECM</th>
<th>Savings Per Year</th>
<th>Increment U. Payback</th>
<th>NSTAR Incentive</th>
<th>Cost After Incentive</th>
<th>Util. Inc.</th>
<th>Owner</th>
<th>Include in Project</th>
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<tbody>
<tr>
<td>No.</td>
<td>kWh</td>
<td>MMBtu</td>
<td>Utility $</td>
<td>Owner $</td>
<td>Cost</td>
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<td>$2,744</td>
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<td>41,404 (83)</td>
<td>(83)</td>
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<td>$6,002</td>
<td>$11,691</td>
<td>1.8</td>
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Improve Thermal Building Envelope

Architectural Enclosure:
• Continuous air barrier
• Add Icynene to exterior wall, R12 upgraded to R23
• Increase roof rigid insulation from 4” to 5 1/2” R20 upgraded to R27.5
• Provide R5 rigid insulation under entire slab-on-grade
• Upgrade window glazing to 1 1/2” heat mirror R4.5
• Glazing tuned to different exposures
Icynene Expanding Foam Insulation

First large commercial building to use it

- 3” applied, R3.6/in.
- Fills all gaps, holes
- Never falls down
- No odor – CO$_2$ only
- ~$.80 - $1.00/s.f.
- Reduces leakage – need for pressurization
Renewable Energy

- 34.96 kWp Photovoltaic System on roof
- 400-watt Wind Turbine
- Submeter Gas, Electric, Water
- Environmental Curriculum
## H.P. Incremental Construction Costs

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
<th>sf Cost</th>
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<tbody>
<tr>
<td>Base Building Construct’n Cost</td>
<td>$12,220,000</td>
<td>$152.33/sf</td>
</tr>
<tr>
<td>Base Incremental H.P. Constr. Cost</td>
<td>$420,000</td>
<td>$5.23/sf</td>
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<tr>
<td>Renewable Energy/Submetering</td>
<td>$416,000</td>
<td>$4.69/sf</td>
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<tr>
<td>Additional Design/Energy Analysis Fees</td>
<td>$165,000</td>
<td>$2.06/sf</td>
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<tr>
<td>Subtotal Incremental Costs:</td>
<td>$1,001,000</td>
<td>$12.48/sf</td>
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<tr>
<td>Total Building Construction Cost</td>
<td>$13,221,000</td>
<td>$164.85/sf</td>
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### H. P. Incremental Funding

**Massachusetts Technology Collaborative:**
- **Renewable Energy – Construction:** $320,000
- **Energy Efficiency – Construction:** $150,000
- **Green Consulting Fees:** $130,000
- **Green Curriculum Development:** $30,000

  **Subtotal:** $630,000

**NSTAR Electric, Keyspan Gas:**
- **Electrical Efficiency Construction Incentives:** $99,000
- **Natural Gas Efficiency Construction Incentives:** $14,000
- **Commissioning:** $15,000
- **Design and Analysis Fees:** $35,000

  **Subtotal:** $163,000

**Total from Utility and MTC:** $793,000 ($9.89/sf)
### H. P. Net Cost

<table>
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<tr>
<th>Description</th>
<th>Amount</th>
<th>Cost per sf</th>
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<tbody>
<tr>
<td>H.P. Incremental Cost</td>
<td>$1,001,000</td>
<td>$12.48</td>
</tr>
<tr>
<td>H.P. Incremental Funding</td>
<td>$793,000</td>
<td>$9.89</td>
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<tr>
<td>Net Increase</td>
<td>$208,000</td>
<td>$2.59</td>
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- **Increase As Percent of Total:** $2.59/ $164.85  1.6%
- **Payback based on energy alone:** $208,000/ $58,060  3.6 yrs
What can you do to help?

- Educate building inspectors – ie. Waterless urinals, greywater systems
- Lobby Utility Companies for renewable energy intertie simplification, higher threshold for retail sale back to grid
- Incentivise clients - $ works in public sector
- Fund in-depth case studies – Concrete info allows conservative public clients to adopt new technologies
- Get high performance requirements into codes ie – MA Green School regulations for SBA
Contact Information

Doug Sacra
HMFH Architects, Inc.
617.492.2200 p
sacra@hmfh.com