Lessons in Green: Sustainable School Design

Brad A. Hastings, AIA, LEED AP
Agenda

• Background
• Defining High Performance
• Design Principles & Strategies
  • Holistic Approach
  • Project Examples
• Conclusion
• Becker Morgan Group, Inc.
  • Salisbury, MD; Dover, DE; Wilmington, NC
  • 65 Personnel
  • Architecture, Interiors, Civil Engineering, Surveying, Graphics

• Market Sector Based
  • Education, Commercial, Residential, Healthcare, Engineering, Hospitality, Government

• Educational Market Sector
  • Planned & Designed over 4.18M sq. ft. of Educational Facilities worth over $479M since 1994
Why is Sustainable a concern?

BUILDINGS CONSUME
- 30% of total energy consumption
- 60% of electricity consumption
- 14% of potable water consumption
- 30% of raw materials

BUILDINGS CONTRIBUTE
- 39% of landfill waste
- 38% of CO2 emissions in the U.S.

• Why Schools?
  - Over 126,000 schools in the U.S.
  - 50 Million children in school each day
  - Over $20B spent annually since 2000 on school construction, modernization, and expansion
Defining High Performance/Green/ Sustainability

**Sustainability**
- Development that meets the needs of the present without compromising the ability of future generations to meet their own needs

**Green**
- To significantly reduce or eliminate the negative impact of buildings on the environment and on the building occupants

**High Performance**
- When a building, its systems and the occupants are operating effectively and efficiently

**Green School**
- A school building or facility that creates a healthy environment that is conducive to learning while saving energy, resources and money
Defining High Performance/Green/ Sustainability

- HP/Green Design Concepts apply to all building types
- LEED-NC initially applied to all
- Now – Building types having LEED documents
  - LEED for New Construction
  - LEED for Core & Shell
  - LEED for Commercial Interiors
  - LEED for Schools (K-12)
    - Classroom Acoustics
    - Environmental Site Assessment
    - Mold Prevention
  - LEED for Existing Schools (in development)
- CHPS (Collaborative for High Performance Schools) – Now adopted by several states
Life Cycle Cost vs. First Cost

- All of the decisions affecting the building's entire life cycle cost are made in the smallest portion of the building life cycle cost — “design”.
- High performance design must be incorporated from the start!
- Design Phase is critical

Green Schools
- Use 33% less energy
- Consume 32% less water
- Reduce solid waste by 74%

Increase Student Performance
- Studies indicate 10-21% improvement in learning rates and test scores
- Lower absenteeism and teacher turnover
Design Principles & Strategies

- Acoustics
- Commissioning
- Daylighting
- Energy Efficient building envelope
- Green materials / Low VOC’s
- Storm water management
- Preservation of natural areas
- High efficiency HVAC equipment
- High performance lighting
- Renewable energy
- Superior indoor air quality
- Reduce transportation impacts
- Thermal comfort
- Visual comfort
- Water efficiency
- Site Selection
James M. Bennett High School

- Geothermal HVAC Systems
- Daylight Harvesting
- High Performance Glazing
- Digital Lighting Controls
- Low VOC Materials
- Storm Water Irrigation
- Upgrade Insulation
James M. Bennett High School

- Responsible Planning
  - Low Impact Siting
  - Reuse of existing developed sites
James M. Bennett High School

- Geothermal HVAC Systems
  - 600 Wells
  - No Boiler
  - Heat recovery
  - High efficiency fans
  - 50 year plant life

PER FEDERAL EPA:
“GEOTHERMAL HEAT PUMP SYSTEMS ARE THE MOST ENERGY EFFICIENT SYSTEM CURRENTLY AVAILABLE.”
James M. Bennett High School

- Natural Lighting
  - Sun Control
  - Operable Windows
- Building Orientation
  - Classrooms on East-West axis
DOE defines spectrally selective as glass with a LSG ratio of 1.25 or higher.
James M. Bennett High School

- Building Envelope Upgrades
- Spray Foam Insulation
  - Closed-Cell polyurethane system (R=6.1/in.)
  - Integral Air Infiltration Barrier
James M. Bennett High School

- Brick / Block Wall R-Value = 17.4
- Stud Wall R-Value = 22.7
James M. Bennett High School

- Material Use Reduction
  - Polished Concrete Floors
    - Recycled aggregates
James M. Bennett High School

- Visual Comfort
  - Daylighting with skylights or clerestories

- Acoustics
  - Acoustically absorbent materials lower reflected noise levels
James M. Bennett High School

• Material Durability
  • Masonry walls for both interior and exterior applications require no application of finish
  • Prefer materials sourced and manufactured within the local area

• Digital Lighting Controls
  • Monitor natural light and control light levels
Pocomoke High School

• Renovation / Addition
  - Natural Lighting / High Performance Glazing / Acoustics
  - Geothermal HVAC / Low VOC materials / Minimize Finish Materials
South Dover Elementary School

- Green Strategies
- Natural Light
- Durable Materials
- Building Orientation
- Low Impact Siting

- Sunshades
- Glazed CMU
- Exposed Structure
- Operable Windows
South Dover Elementary School

- Responsible Planning
- Minimize Environmental Footprint
Surface Water Management

- Bioretention Systems
- Underground Infiltration Chamber Systems
- Surface Water Biofiltration Swales
- Rainwater Collection
- LEED Impacts:
  - Sustainable Sites
  - Water Efficiency
  - Innovation and Design
  - Regional Priority
- Pervious Paving
Milford Central Academy
Milford Central Academy

Geothermal Closed Loop System consisting of 300 vertical wells
SOLAR PANELS

- 743 solar voltaic (PV) panels
- 180,739 Kwh/year
- Anticipate a 15-25% offset in electrical use
- Eco-Education - Learning Opportunity
Abundant Natural Light provided by proper building orientation
Conclusion

Does a High Performance Building = Energy Efficient Building?

NO!

- Buildings don’t operate themselves, people do.
- Energy awareness and proper operations are the keys to success in energy efficient operation.
Available Resources

**Dept. of Energy**  
www.energysmartschools.gov

**Council on High Performance Schools**  
www.chps.net

**U.S. Green Building Council**  
www.greenschoolbuildings.org

**National Clearinghouse for Educational Facilities**  
http://www.edfacilities.org/

**GreenSource Magazine**  
http://greensource.construction.com/

Brad A. Hastings, AIA, LEED AP  
bhastings@beckermorgan.com  
410.546.9100