New Haven Schools:
Building for the 21st Century
Program Drivers (2000-present)

- Improve Learning Environment
- Enrollment growth—needed new capacity
- Building Age/Deferred Maintenance
- Technology Upgrades
- Code and ADA compliance
- Community/Jobs Program
- Economic Development (SBI)
- Neighborhood Revitalization
- Reduce Energy & Operating Costs
- Security /safety for schools in Urban setting
Educational Program Objectives

- Update and modernize all schools to allow for maximum flexibility for changes in educational programs as technology evolves
- Change to a Pre-Kindergarten to 8th Grade structure
- Provide for a 2 classroom/grade “model” program
- Improve facilities for core support and specialized services
- Smaller, “themed” program high schools
- Pre-school programs for all children in every neighborhood
- Diverse learning environments (hands on and lecture)
K-12 Hot Topics

- Quality of Design/Standards
- Community Centers
- LEED/Energy Efficiency
- Renovation vs. New
- New Educational “Flagships”
- Hands on education/Vo-Tech
- Academies within Schools
- Safety in Schools
- Technology ready (current and future)
Phases of a Large Rebuilding Program

★ 1-2 years Early Studies & Innovative Funding
★ 1-2 years Early Master Plan & Political Structuring
★ 4-5 years Phase 1 Implementation
  First Projects Completed, “Credibility Building,” Update Master Plan, Confirm Ph. 2 Commitments
★ 4-5 years Phase 2 Implementation
  Standardize Design, Large Volume Construction, Refine “end-game”
★ 3-5 years Phase 3
  End Game
1994: City effort
Conditions Evaluation Study

- Site & Building Conditions
  - Building Exterior & Interior Condition
  - Code/ADA Compliance
  - Building Systems – Mechanical – Security – Technology Assessment
  - Historic Significance/Fabric – Renovation?
1995-96: Innovative Funding

- Early tax lien sale generated $23 million for early city share on Phase 1
- Concentrated legislative approach obtained commitments for magnet funding, “renovate like new,” swing space funding, etc.
- ERATE funding of technology
- Gradual buildup of local support for limited property tax increases (i.e. consistent with performance)
- Funding of energy saving changes
1996-97: Necessity of Master Plan

- Enrollment Projections - City wide
- Educational Program Requirements
- Building Capacity Assessments
- Facility Condition Assessments
- Phased Implementation Plan
- Financial Plan
- Community Goals
- Swing Space availability – fit out and planning

Update Plan at Each Critical Program Phase
1998: GILBANE is hired

- By late 1997, Phase 1 program had grown to 11 schools, $170 million
- Decision to hire outside Program Management (PM) assistance: Gilbane Building Company
- Gilbane provides 1998-2000 Revision of Master Plan
- Initial projects starting construction
- Advantages of Program Manager
  - Visible evidence and responsible control of program dollars
  - Administers and interfaces with all program constituents
  - Maintains all communication and reports with State School Facilities
Updated Enrollment Projection
Updated Educational Program Requirements
Refined Capacity Assessment of Buildings
Updated facility assessment / priority list
Detailed and updated financial plan
Updated Community Goals
Swing Space Strategy implementation

★Refinement of Implementation Plan★
Why Program Management?

- Program Managers are owner advocates and staff extensions (BOE, Facilities, City entities)
- Program Managers mitigate project risk by providing an owner comprehensive project leadership in all phases of design and construction.
- Program management allows the use of experienced construction professional staff to match program design, cost and schedule requirements.
Capacity Adjustment

- “Seat” Capacity affected by:
  - Changing space standards
  - Enrollment policy
  - Mandatory code and statutory changes
  - Educational program requirements and essential core support spaces

- “Preferred” Capacity results from evaluation of facility's ability to satisfy all of above requirements
Implementation Challenges

- Realistic & Updated Master Plan
- Swing Space Plan
- Cost & Schedule Control
- Design Standards/High Performance
- Communication—Website Based
- Workforce & SBI Goals
- Field Quality Control of Unique
- Maintaining Local & State Support as Project Budgets Increase from Inflation & Economic Factors
Implementation Challenges: Need for Swing Space Strategy

- “Gut” renovation of “like-new” projects requires schools to be vacant during construction.
- 35 of 44 projects require moving into temporary swing space optimizing construction schedule and minimizing costs.
- 10 different facilities used for swing space including old schools replaced by new buildings, leased private school space and converted leased space.
# Swing Space Schedule

<table>
<thead>
<tr>
<th>SCHOOL CONSTRUCTION PROJECTS REQUIRING SWING SPACE (NO. PUPILS)</th>
<th>1/04-6/04</th>
<th>8/04-12/04</th>
<th>1/05-6/05</th>
<th>8/05-12/05</th>
<th>1/06-6/06</th>
<th>8/06-12/06</th>
<th>1/07-6/07</th>
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**Subtotal - Swing Space Needs**: 1493 1418 1418 1523 1523 1512 1514 1929 1929 1824 1824 2046 2046 1447 1447
Program Management Approach

Program Manager
- Project Development
- Pre-Design
- Project Construction
- Post-Construction

Each Project

City of New Haven
- Fire Marshall
- City Plan / Zoning
- Traffic & Parking
- Engineering
- Building
- Public Works
- Parks
- CEO
- Economic Development
- Police

Construction
- Construction Manager
- General Contractor
- Prime Contractor
- Sub Contractors

Board of Aldermen
Board of Education
Architects & Consultants
School-Based Building Advisory Committee (SBBAC)
CT Office of School Facilities (OSF)
School Building Committee (CSBC)
The Value of Community Involvement (SBBAC)

- School Based Building Advisory Committees (SBBAC)
  Community becomes **invested** in process and new school
- Each community is unique with process that allows for input and involvement, more support for each school before, during and after construction and for overall program because of buy in.
### School Construction typical Schedule in Connecticut

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration</th>
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<tbody>
<tr>
<td>File for state approval</td>
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<tr>
<td>Develop educational building program</td>
<td>2 months</td>
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<tr>
<td>Develop conceptual design</td>
<td>1 month</td>
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<tr>
<td>Develop schematic design</td>
<td>2 months</td>
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<tr>
<td>Design development</td>
<td>3 months</td>
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<tr>
<td>Construction documents</td>
<td>5 months</td>
</tr>
<tr>
<td>State and local approval process</td>
<td>2-4 months</td>
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<tr>
<td>(bidding and award of contracts by Board of Education)</td>
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<tr>
<td>Building construction (typical school)</td>
<td>14-16 months</td>
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<tr>
<td>Move-in to building</td>
<td>1-2 months</td>
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<tr>
<td>(furnishings /equipment / commissioning / turnover)</td>
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<tr>
<td><strong>Total Schedule</strong></td>
<td><strong>45-60 months</strong></td>
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</tbody>
</table>
Community Impacts

- Workforce Initiative – Jobs
- Training in Various Construction Trades
- Small and Minority Business Opportunities

★ 37 Completed and Active Projects (2013 data)★
★ Total Construction Trade Labor Hours 6,010,130 hrs. ★
Aquaculture Vo-Ag High School

- Magnet Vocational School
  Located on Long Island Sound
- 40,000 new & 24,500 renovated Square Feet for 360 students
- Marine Focused Campus features:
  - Greenhouse
  - Aquariums & Fish Farm
  - Plant & Animal Science Labs
  - Boat Restoration Workshop

**Unique Facilities**

**Dewberry Goodkind**

- Project Cost: $27 m
- State Funding: 100%
- Completion: Winter 2003
Elementary students acquire their math and reading skills through course work with an environmental science focus.

The building’s facilities support a curriculum of sustainability through interactive learning:
- Largest solar panel display in CT
- WeatherBug Station
- Two greenhouses & gardens
- West River Nature Center, connected to the main school by a pedestrian bridge over Rt. 34
- Educational kiosks

Connecticut’s 1st GOLD LEED™ Certified SCHOOL Building.

<table>
<thead>
<tr>
<th>Project Cost:</th>
<th>$43 m</th>
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<tbody>
<tr>
<td>Students:</td>
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<td>Square Feet:</td>
<td>90,000</td>
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<td>Completed:</td>
<td>Summer 2006</td>
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</table>
Master Plan included Central Kitchen to realize benefits on all levels:

- Reallocation of Kitchen space at schools
- Reduction of Kitchen Staff
- Uniform quality and nutrition standards
- Energy Savings
Unique Facilities

Hillhouse High School & District Wide Field House

- One of 2 large comprehensive high schools
- 1,200 students
- Multi-phase renovation/addition while occupied

- New 92,000 sf District Field House

*S/L/A/M Collaborative*

Project Cost: $86 m
Completed: 2002
New Educational Flagships:

Cooperative Arts & Humanities High School

- Pelli Clarke Pelli Architects
- 145,000 GSF on 1.5 acres in the heart of New Haven’s Theater District.
  - Performance & Black Box Theaters
  - Full Support; including Scene Shop
  - Studio Spaces for:
    - Dance
    - Theater
    - Film
    - Music
    - Video Labs

Project Cost: $66 m
Construction Cost: $47 m
Completion: Fall 2008
Central Utility Plant designed to service 2 schools in adjacent campuses

Implementation of Fuel Cell technology for electricity, heating and cooling

CUP allowed a more efficient system integration and minimize first cost for separate mechanical building systems at each school.
Defining Expectations
Building Program Standards

- Programming Guidelines
  - Space programming
  - Best practices - lessons learned
- Material Standards
  - Level of quality - life cycle
  - Format consistency
- High Performance Guidelines
  - Sustainable design strategies
  - Student performance
  - Health of occupants
  - Cost effectiveness/operation/maintenance
  - Environmental stewardship
  - Energy Efficiency
## Design Guidelines

- Space programming

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### New Haven School Construction Program

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<th>Space</th>
<th># staff/stu</th>
<th>Area/stu</th>
<th>NSF/m²</th>
<th># ms</th>
<th>Total NSF</th>
<th>stu capacity</th>
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<th>Remarks</th>
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<td><strong>Administrative, Guidance &amp; Student Support (incl. Faculty &amp; Parents Areas)</strong></td>
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<tr>
<td>Conference Room (Admin)</td>
<td>8</td>
<td>25</td>
<td>200</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
<td>Locate remotely from main administrative office area, typically in area of older students.</td>
</tr>
<tr>
<td>Security Office</td>
<td>1</td>
<td>100</td>
<td>1</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td>Locate adjacent to Assistant Admin. Office</td>
</tr>
<tr>
<td>Parent Room</td>
<td>1</td>
<td>150</td>
<td>1</td>
<td>150</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staff Toilet (Admin)</td>
<td>60</td>
<td>1</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Guidance &amp; Student Support</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reception/Waiting Area (Guidance)</td>
<td>150</td>
<td>1</td>
<td>150</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work/Storage Room (Guidance)</td>
<td>200</td>
<td>1</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guidance Counselor Office</td>
<td>150</td>
<td>1</td>
<td>150</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Worker Office</td>
<td>120</td>
<td>1</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speech Pathology</td>
<td>120</td>
<td>1</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bilingual/ESL/Migrant</td>
<td>120</td>
<td>1</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychologist Office</td>
<td>120</td>
<td>1</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Testing Room</td>
<td>60</td>
<td>1</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign Language Office</td>
<td>150</td>
<td>1</td>
<td>150</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>May be located near or adjacent to Foreign Language Classroom</td>
</tr>
</tbody>
</table>
School Construction Design Standards

Space Programming

Net Required Area: 55,140 sf
Maximum Enrollment: 540
Required Gross Area: 76,138 sf
Owner Expectations

- Design Guidelines
  - Space programming
  - Best practices – lessons learned
- Material Standards
  - Level of quality
  - Format consistency
Material Standards

- Design Guidelines
  - Space programming
  - Best practices – lessons learned
- Material Standards
  - Level of quality
# Gilbane High Performance Building Plan

## 3.0 BUILDING ENERGY USE: GOALS AND PROCESS

<table>
<thead>
<tr>
<th>Goals</th>
<th>LEED NC v2.2</th>
<th>LEED v4.1</th>
<th>3.1 Building Sustainability and Energy Efficiency Goals &amp; Consumption</th>
<th>Initial Performance Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Establish a minimum performance goal of 75 by the project.</td>
<td>1. Earning 50 points</td>
<td></td>
<td></td>
<td>1. Earn 50 points</td>
</tr>
<tr>
<td>2. Use LEED’s online Project Finder tool to calculate the building’s performance versus similar buildings.</td>
<td>2. Earning 50 points</td>
<td></td>
<td></td>
<td>2. Earn 50 points</td>
</tr>
<tr>
<td>3. Plan site energy consumption at 50% or lower.</td>
<td></td>
<td></td>
<td></td>
<td>3. Plan site energy consumption at 50% or lower.</td>
</tr>
<tr>
<td>4. Plan site energy consumption at 50% or lower.</td>
<td></td>
<td></td>
<td></td>
<td>4. Plan site energy consumption at 50% or lower.</td>
</tr>
<tr>
<td>5. Ensure building performance meets target by the project.</td>
<td></td>
<td></td>
<td></td>
<td>5. Ensure building performance meets target by the project.</td>
</tr>
</tbody>
</table>

### 3.1 Building Sustainability and Energy Efficiency Goals & Consumption

#### EA01: Optimize Energy Performance

<table>
<thead>
<tr>
<th>EA01: Optimize Energy Performance</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1. Plan energy consumption at 50% or lower.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2. Plan energy consumption at 50% or lower.</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

#### EA02: Optimize Energy Performance

<table>
<thead>
<tr>
<th>EA02: Optimize Energy Performance</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1. Plan energy consumption at 50% or lower.</td>
<td>1</td>
</tr>
</tbody>
</table>

#### EA03: Optimize Energy Performance

<table>
<thead>
<tr>
<th>EA03: Optimize Energy Performance</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1. Plan energy consumption at 50% or lower.</td>
<td>1</td>
</tr>
</tbody>
</table>
Gilbane High Performance: When does it start?

**CONCEPTUAL DESIGN**
- All hands design charrette
- Performance plan developed
- Design continues using plan as guide

**SCHEMATIC DESIGN**
- Design continues
  - Groups discuss ECM’s as they are analyzed
  - Plan updated at 100% SD charrette

**DESIGN DEVELOPMENT**
- Energy Modeler analyzes design
  - Life Cycle Cost Analysis prepared
  - Commissioning Agent reviews Project
  - Design is optimized to findings
  - Plan updated at 100% DD Charrette

**CONSTRUCTION DOCUMENTS**
- Design is optimized and finalized
- Final Energy Model Report prepared
  - Life Cycle Cost Analysis is tool for VE
  - CxA prepares Cx Plan
  - Plan is updated at 50% CD Charrette

Sooner Better Than Later!
DESIGN TEAM & CONSULTANTS
Architect
MEP, Structural & Civil Engineers
Lighting, Interiors & Other Consultants

ENERGY MODELER

OWNER’S TEAM
Operations & Maintenance Personnel
LEED Consultant
End Users, if appropriate

CONSTRUCTION MANAGEMENT TEAM
Gilbane Team:
PM, PE, HPB COE Staff
(estimating, SME’s)
Commissioning Agent

LOCAL UTILITIES
To discuss rebates & incentives

Everyone!
### Gilbane High Performance Approach

<table>
<thead>
<tr>
<th>Existing Building Energy Consumption Survey</th>
<th>Full Life Cycle Cost Analysis including Utility Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Project &amp; Program-wide Performance Plans</td>
<td>Grant &amp; Rebate Application Management</td>
</tr>
<tr>
<td>LEED Documentation of Energy Credits</td>
<td>Measurement &amp; Verification and O &amp; M Readiness</td>
</tr>
<tr>
<td>Energy Modeling Peer Review</td>
<td>Program-wide Energy Modeling</td>
</tr>
<tr>
<td>Energy Audits (Level I &amp; II)</td>
<td>Energy Efficiency Measure Consulting</td>
</tr>
<tr>
<td>Whole Building Energy Modeling</td>
<td>Renewable Energy Analysis</td>
</tr>
</tbody>
</table>
Gilbane High Performance Building

EXISTING FACILITIES
- Model Existing Buildings to determine where savings exist
- Review current energy consumption through utility bill analysis
- Level I and Level II Energy Audits

PRE-CONSTRUCTION
- Create the energy model for review, analysis and design optimization
  - Review an existing model (prepared by another party) to confirm savings and provide a fresh eyes approach
- Research and develop proper documentation to submit for rebates, grants and incentives from government and utilities.
  - Run Life Cycle Cost Analysis on proposed equipment
- Develop Energy Modeling Documentation for ‘like’ LEED submission
  - Full ‘like’ LEED Project Administration

CONSTRUCTION
- Confirm energy efficiency of submittal documentation
  - Work with utility companies and others to verify grants & rebates

POST CONSTRUCTION
- Implement real time energy monitoring to report real time building efficiency and sustainability information
  - Comprehensive video training on HPB systems/continuous commissioning
High Performance

1: Goals

- Energy Efficiency
  - Energy Star Targets & Savings over Code
  - Lighting Power Density
  - Renewable/On Site Power
  - Energy Modeling
  - Commissioning
  - Passive Heat & Light Strategies
  - Occupant Comfort

- Environmental Sustainability
  - Water Use
  - Site Selection
  - Landscaping & Building Placement
  - Materials Selection Standards
  - Occupant Productivity
  - Architectural Considerations
  - Policy Goals

2: Design

- Energy Efficiency
  - MEP and HVAC Selection
  - Envelope Design
  - Controls and Monitoring

- Environmental Sustainability
  - Materials and Fixture Selection
  - Architectural and Landscaping Policies and Details to Support Sustainability Goals

3: Policy

- Operations & Maintenance
  - Construction Waste, IAQ, Site, other
  - Building O&M Policies, Practices
Gilbane High Performance BENEFITS
Why Adopt Good Management Principles

PREVENTATIVE MAINTENANCE
can save an average of 15% on O&M costs

Preventative Maintenance – Manufacturer’s Requirements

PREDICTIVE MAINTENANCE
can save an additional average of 10% on O&M costs

Predictive Maintenance – Facility Manager’s Expertise
Gilbane High Performance – Post Construction

- Operations and Maintenance Readiness

**BENEFITS**

- Design & Construction Costs: 20%
- Operation & Maintenance Costs: 80%
**Gilbane High Performance Benefits**

- Evaluation of actual building performance:
- Actual Energy consumption versus Energy Model
- Effect of occupants on the Energy Model – computers and miscellaneous equipment used.
- Light loads
- Effect of Preventive Maintenance Program
# Gilbane High Performance Actual Benefits

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Used</td>
<td>74</td>
<td>60</td>
<td>20%</td>
</tr>
<tr>
<td>Energy Saved</td>
<td>29</td>
<td>43</td>
<td>47%</td>
</tr>
<tr>
<td>Energy Saved</td>
<td>28%</td>
<td>42%</td>
<td>47%</td>
</tr>
</tbody>
</table>
Benefits

- Post construction monitoring is in progress for all completed schools for additional validation of energy cost savings.
- Before implementing High Performance Building Design, the City was experiencing at an average of 190 kBtus/sf/yr (no AC). Currently, the City is under 70 kBtus/sf/yr, and we are currently modeling under 40 kBtus/sf with the recent implementation of LED lighting in the latest buildings with AC.