Carver Elementary School

Carver School Building Committee Meeting

July 20th, 2015

PMA Consultants

Site

SITE ISOMETRIC

Site Plan – Option 1

Carver Elementary School
Carver Ma
7/20/2015

VEHICULAR CIRCULATION AND SPORT FIELDS LAYOUT
- OPTION 1

HALVORSON DESIGN PARTNERSHIP
LANDSCAPE ARCHITECT, PLANNING + URBAN DESIGN
25 KINGSTON STREET, 5TH FLOOR
BOSTON, MASSACHUSETTS 02111
(617) 536-0080

0' 50' 100' 150' 200' 300'

Site Plan – Option 2

Carver Elementary School
Carver Ma
7/20/2015

VEHICULAR CIRCULATION AND SPORT FIELDS LAYOUT
- OPTION 2

HALVORSON DESIGN PARTNERSHIP
LANDSCAPE ARCHITECT, PLANNING + URBAN DESIGN
25 KINGSTON STREET, 5TH FLOOR
BOSTON, MASSACHUSETTS 02111
(617) 536-0380

0' 50' 100' 150' 200' 300'

Site Plan – Option 3

Carver Elementary School
Carver Ma
7/20/2015

VEHICULAR CIRCULATION AND SPORT FIELDS LAYOUT
- OPTION 3

HALVORSON DESIGN PARTNERSHIP
LANDSCAPE ARCHITECT, PLANNING + URBAN DESIGN
25 KINGSTON STREET, 5TH FLOOR
BOSTON, MASSACHUSETTS 02111
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0' 50' 100' 150' 200' 300'

HVAC Systems Overview

For Carver Elementary School

Carver, MA

GARCIA • GALUSKA • DESOUSA
Consulting Engineers Inc.

Life Cycle Cost Analysis HVAC System Options

HVAC System Options Overview

1. **Baseline: VAV System (ASHRAE Baseline)**
2. **Option 1: Induction Unit System with DOAS**
3. **Option 2: Dehumidification Displacement System with DOAS**
4. **Option 3: Fully Air-Conditioned Displacement System with DOAS**
5. **Option 4: Dehumidification Displacement System with DOAS and Geothermal Plant**

HVAC System Comparison

Mixing vs. Displacement Systems

AIR CONDITIONING

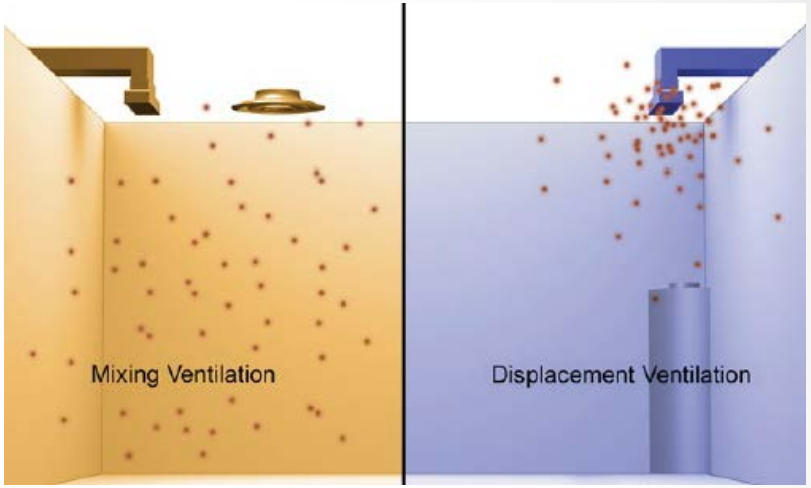
- VENTILATION AIR COOLED AND SUPPLIED AT 55 DEG F. TO SPACE
- MAINTAINS SPACE TEMP. AT 75 DEG F.
- ADDITIONAL EQUIP. REQD. WITH INCREASED CAP. TO MAINTAIN 75 DEG F.
- INCREASED DUCT SIZES OR NEED FOR ADDITIONAL PIPING SYSTEM
- INCREASED CONSTRUCTION COST BY 20-30% (Dependent upon AC System)
- INCREASED OPERATIONAL COST BY 25-30% (APPROX. $1.90/SF)

DEHUMIDIFIED AIR

- VENTILATION AIR COOLED BY DEHUMIDIFICATION AND REHEATED BY HOT GAS HEAT RECOVERY TO 68 DEG F.
- TEMP. FLOATS IN SPACE WITHIN COMFORT ZONE
- REDUCED DUCT SIZES OR NEED FOR SECONDARY EQUIPMENT
- REDUCED CONSTRUCTION COST WHEN COMPARED TO CONVENTIONAL NON-CONDITIONED BUILDINGS
- SIMILAR OPERATIONAL COST WHEN COMPARED TO CONVENTIONAL NON AIR CONDITIONED BUILDINGS (APPROX. $1.40/SF)

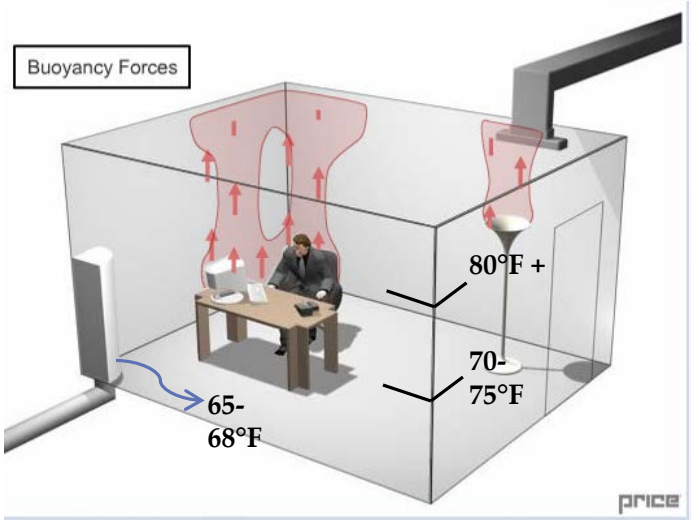
Displacement System (Classrooms, Cafeteria, Gymnasium, Corridors)

- Ventilation air is provided from high efficiency packaged gas-fired heat/DX cooling RTU w/ ERV
- Air is delivered at low velocity and at low levels within the space
- The system uses naturally occurring buoyant forces within the space to create a vertical rise of the air throughout the space.
- 2-4˚ F differential supply air to space
- Supply air rises when heat source is contacted
- Displaces room air upward
- Air rises with pollutants to ceiling
- Air returns at ceiling back to air handling unit



Mixed Systems
E_c= 0.8

DV Systems
E_c=1.2 - 1.4



Displacement System

Pros:

- Excellent pollution removal
- Very low noise levels
- Very low air velocity
- Low moisture levels
- Reduced cooling loads
- Reduced initial cost
- Variable volume reheat is not required
- High ventilation effectiveness

Displacement Diffuser Options

Cons:

- Requires Perimeter Radiation Heating
- Dehumidification Only Design (Options 2 & 4) does not provide Cooling Setpoint temperature control

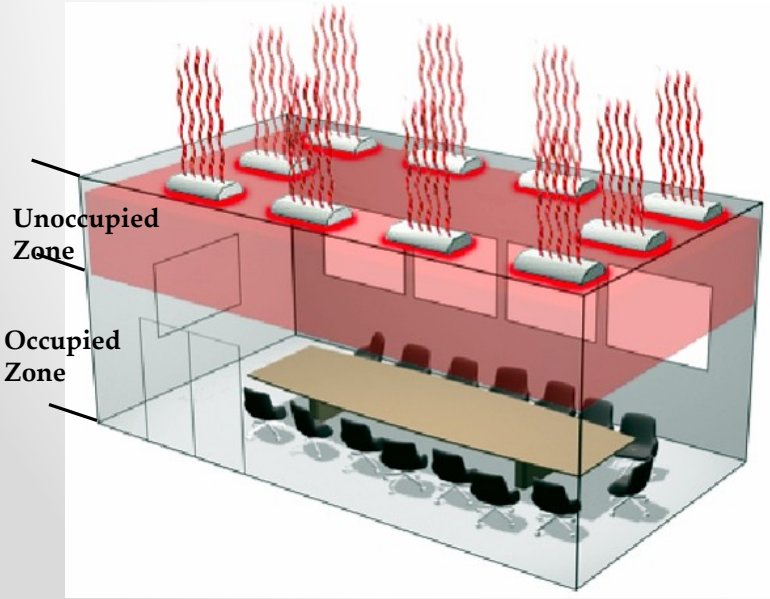
Displacement System – Energy Conservation

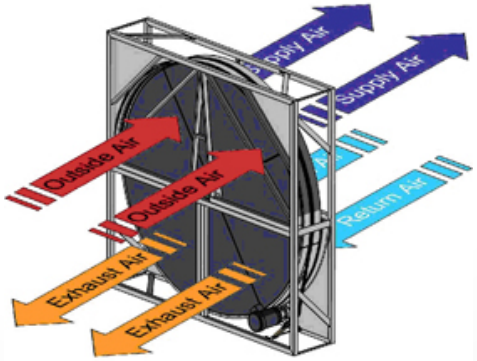
Load Calculation Reductions

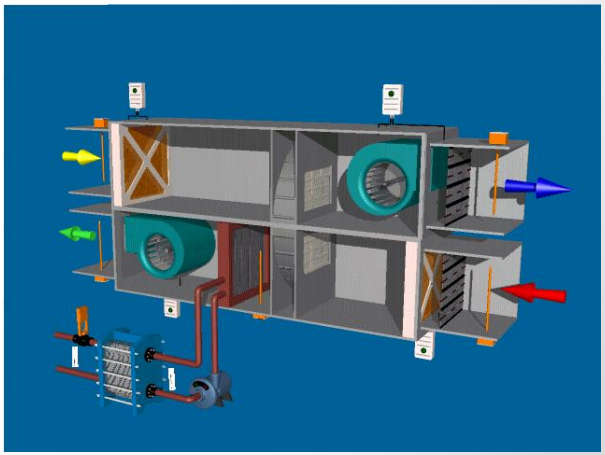
- Conventional System: All heat generated in room is included in air flow calculation since all airflow is mixed.
- Displacement System: Only loads which occur in the Occupied Zone are factored
- Results in: Smaller equipment & systems and lower installed and operating costs for Displacement Systems

Additional Energy Efficiency Measures

- Energy Recovery: Transfers energy from the return air stream to the supply air stream to pre-heat or pre-cool the outside air.
- Variable Air Volume w/ CO2 Demand Control Ventilation: Modulates the airflow to large single zone areas in accordance to space mounted thermostat and CO2 sensors reducing energy consumption due to reduced air changes.

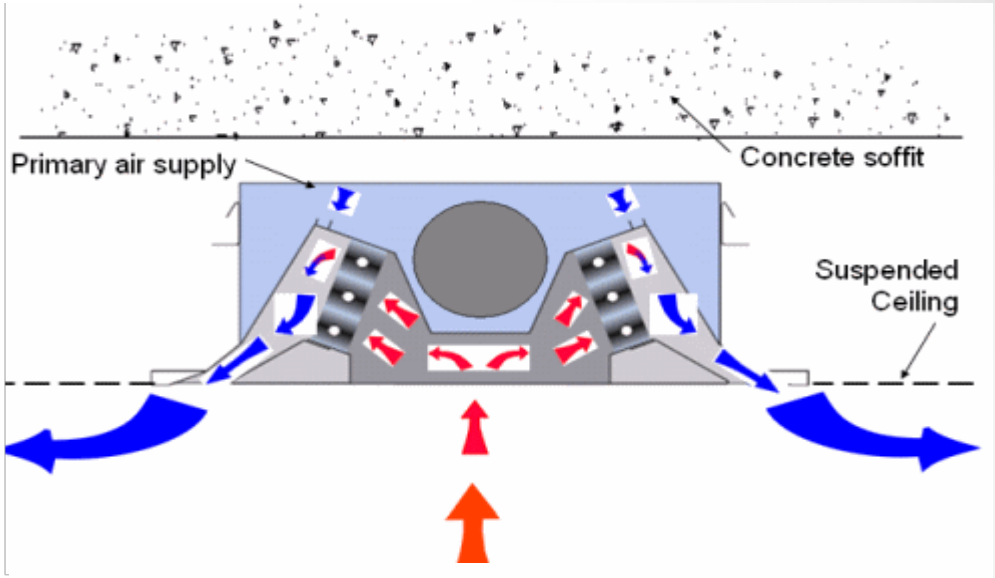


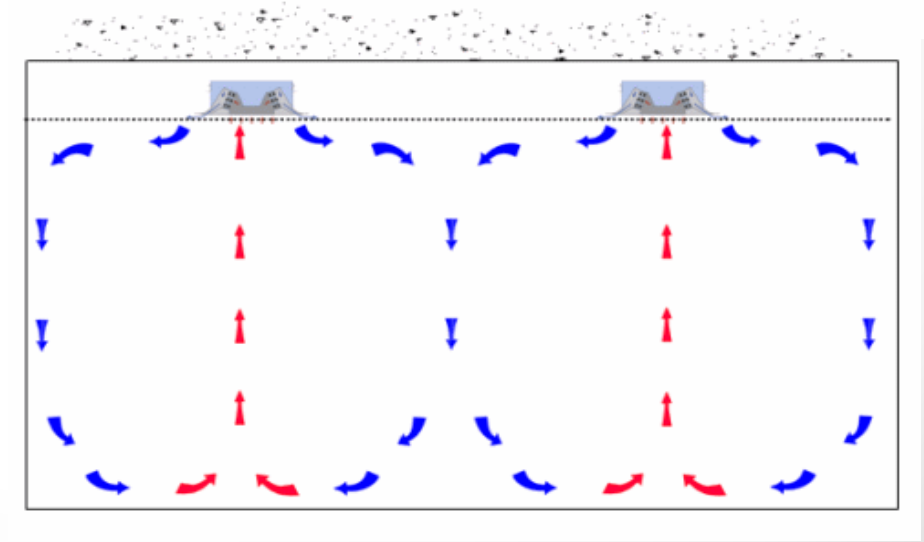




Induction Units (Administration)

- Ventilation air is provided from high efficiency packaged gas-fired heat/DX cooling RTU w/ ERV
- Primary (Ventilation) Air is supplied to plenum and discharges through nozzles
- Room air is induced through the heating/cooling coils
- Mixture of Primary and Room air is delivered to room through diffuser slots.
- Condensate drain pans and piping system for condensate removal





Induction Units

Pros:

- Energy efficient
- Low Noise Levels
- Flexibility of Installation
- Moderate first cost
- Simplified Controls (No Fans)
- Lower Maintenance (No Terminal Filters)

Cons:

- Requires increased coordination with "ceiling" system. (e.g. additional piping, HW, CHW & condensate piping)
- Requires additional ventilation air in some cases
- Increase Energy Consumption vs. Dehumidified Air System

High Efficiency Heating Hot Water and Chilled Water Plant

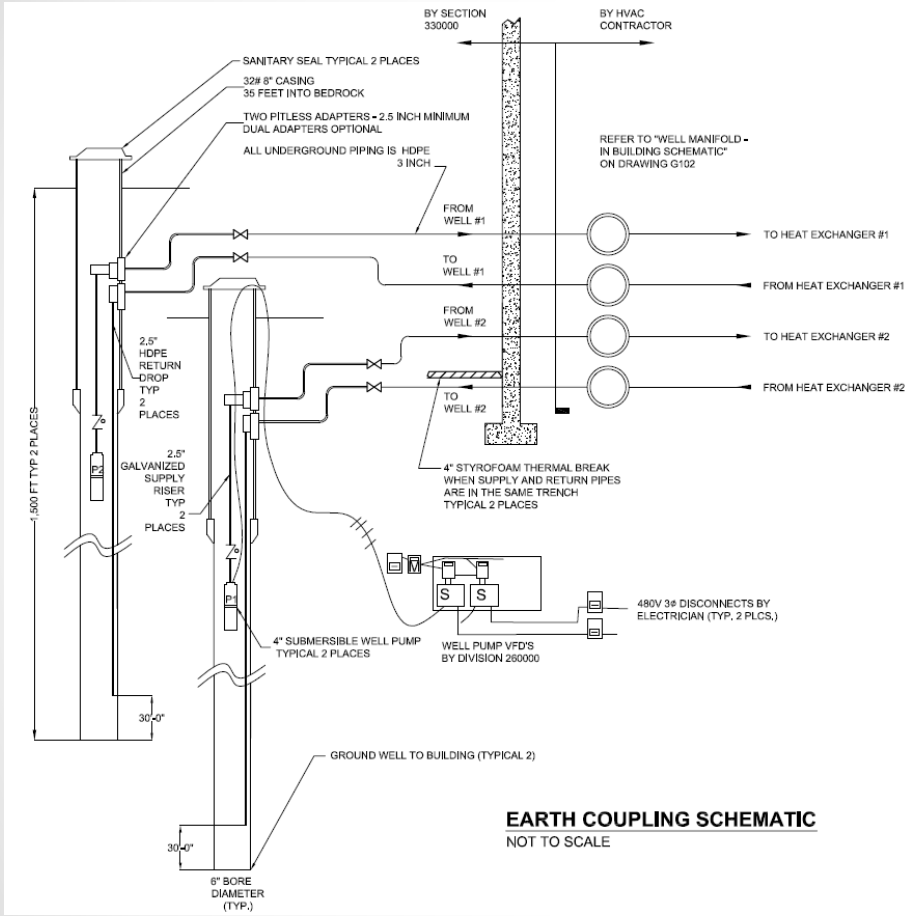
Boiler Plant

- High efficiency (90%+) gas-fired condensing boilers
- Boiler temperature reset controls
- Variable speed pumps with VFD's

Chiller Plant

- High efficiency air-cooled chiller
- Chilled water temperature reset controls
- Variable speed pumps with VFD's

Geothermal Heat Pump Plant



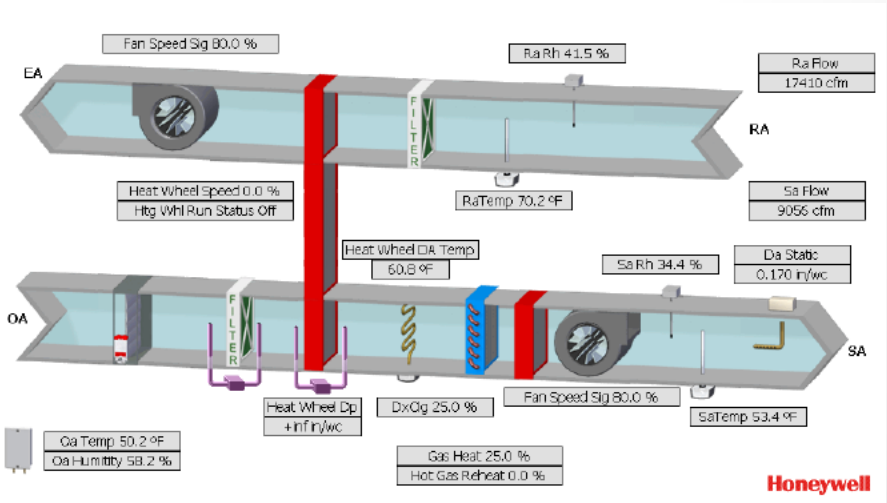
- Water-to-water source heat pump chillers
- Plate and frame heat exchanger

- Standing column geothermal wells

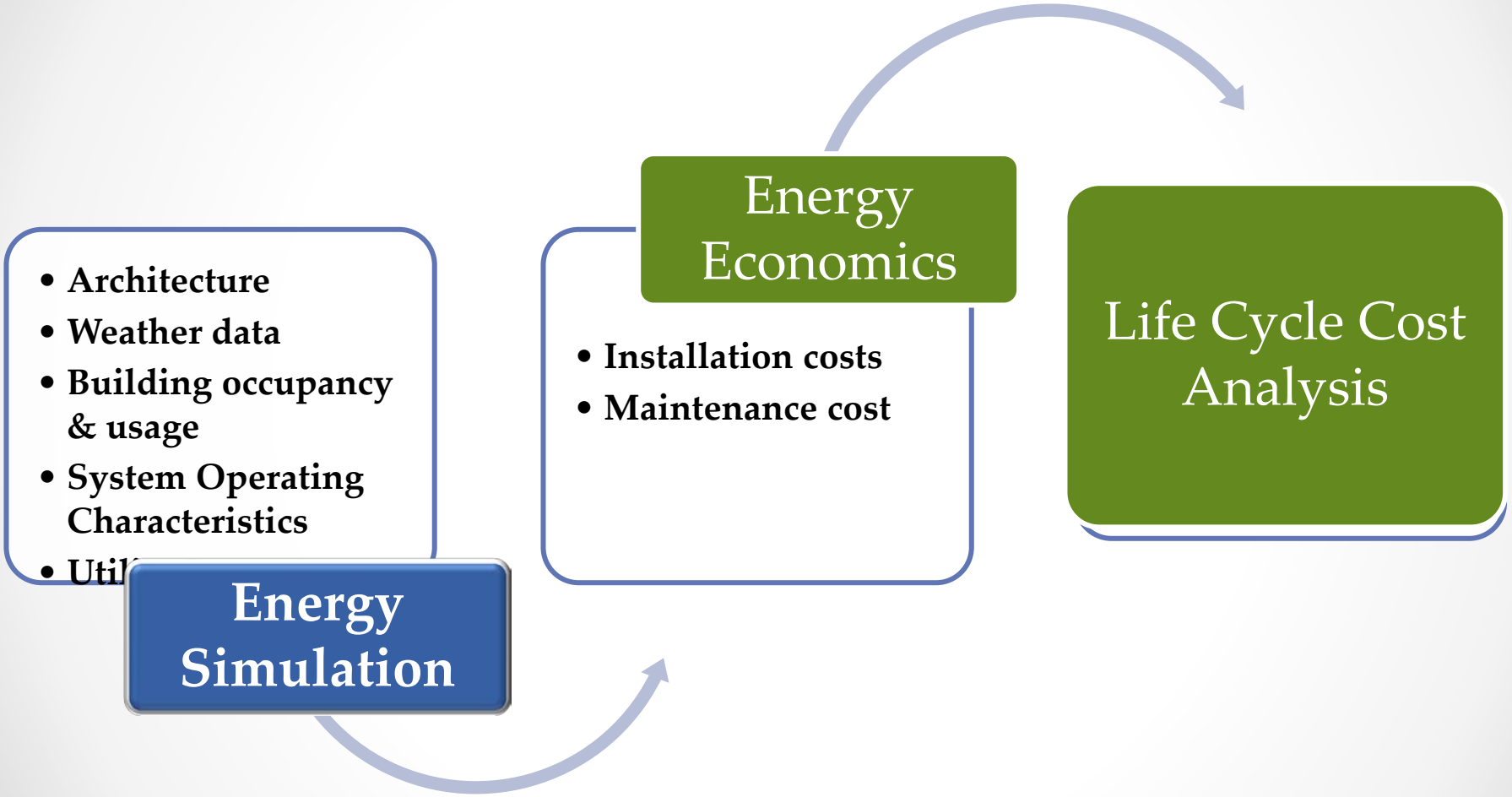
Building Automation and

Energy Management System

- System (Zone) Scheduling
- Occupied-Unoccupied Control
- Night Setback Operation
- Lighting Control System Integration
- Increased Energy Savings
- Integrate with Preventative Maintenance Scheduling



Energy Economics Methodology



Energy Model Methodology

- Computer Simulation of Building Energy Usage using Department of Energy (DOE-2)/eQuest.
- Model consists of project specific:
- Architectural features (geometry, orientation, envelope)
- Local Weather Data
- Occupancy, Lighting, Equipment schedules
- HVAC System Data (specific to each system option)
- Local Utility Rates

Energy Economics Methodology

- Computer calculation of HVAC System economics utilizing NIST BLCC 5.
- Calculation factors:
  - HVAC System and Maintenance Cost Estimates
    - Prepared in house using recent project cost data and industry standard estimating references.
  - Standard Industry Discount, Inflation and Interest Rates

Example Summary of Results

Baseline	System	GROSS CAPITAL INVESTMENT*	ANNUAL ELEC. CONS. (KWH)	ANNUAL GAS CONS. (MBTU)	ANNUAL ELECTRIC COST	ANNUAL GAS COST	COMBINED UTILITY COST	ANNUAL UTILITY $/S.F.	ANNUAL MAINT. COST	COMBINED ANNUAL EXPENSE	COMBINED EXPENSE SAVINGS**	TOTAL LIFE-CYCLE SAVINGS***	DISCOUNTED PAYBACK (YEARS)****
-	1. Hot water coil heating/chilled water coil cooling VAV RTU system with terminal VAV boxes with hot water reheat coils 2. Standard efficiency gas-fired boiler plant 3. High efficiency water-cooled chiller plant with cooling towers	$7,109,100	1,048,000	8,877.4	$173,976	$106,858	$280,834	$1.43	$40,200	$321,034	-	-	-

Option	System	GROSS CAPITAL INVESTMENT*	ANNUAL ELEC. CONS. (KWH)	ANNUAL GAS CONS. (MBTU)	ANNUAL ELECTRIC COST	ANNUAL GAS COST	COMBINED UTILITY COST	ANNUAL UTILITY $/S.F.	ANNUAL MAINT. COST	COMBINED ANNUAL EXPENSE	COMBINED EXPENSE SAVINGS**	TOTAL LIFE-CYCLE SAVINGS***	DISCOUNTED PAYBACK (YEARS)****
1	1. Hot/chilled water coil induction units 2. Hot water coil heating/chilled water cooling 100% O.A. ventilating units with energy recovery serving fan coil units 3. Hot water coil heating/chilled water cooling RTU's with demand ventilation 4. High efficiency gas-fired condensing boiler plant 5. High efficiency air-cooled chiller plant	$7,208,800	1,324,000	4,666.6	$219,776	$56,172	$275,948	$1.41	$31,300	$307,248	$13,786	$330,775	8
2	1. Displacement ventilation diffusers and perimeter hot water radiant heating panels 2. Gas-fired heating/dx cooling VAV ventilating units with energy recovery and demand ventilation 3. Gas-fired heating/dx cooling 100% O.A. ventilating units with energy recovery with terminal chilled/hot water coil induction units 4. High efficiency gas-fired condensing central boiler plant 5. High efficiency air-cooled chiller plant	$5,828,420	1,098,000	5,827.6	$182,271	$70,147	$252,418	$1.29	$34,575	$286,993	$34,041	$2,124,599	N/A*****
3	1. Displacement ventilation diffusers and perimeter hot water radiant heating panels 2. Hot water coil heating/chilled water coil cooling VAV ventilating units with energy recovery and demand ventilation 3. Hot water coil heating/chilled water coil cooling 100% O.A. ventilating units with energy recovery with terminal chilled/hot water coil induction units 4. High efficiency gas-fired condensing central boiler plant 5. High efficiency air-cooled chiller plant 6. Geothermal well with water-to-water source heat pump chillers with water-to-water heat exchangers	$7,617,300	1,315,000	2,990.1	$218,294	$35,992	$254,286	$1.30	$33,275	$287,561	$33,473	$410,446	17

Thank You

HVAC Questions and Discussion

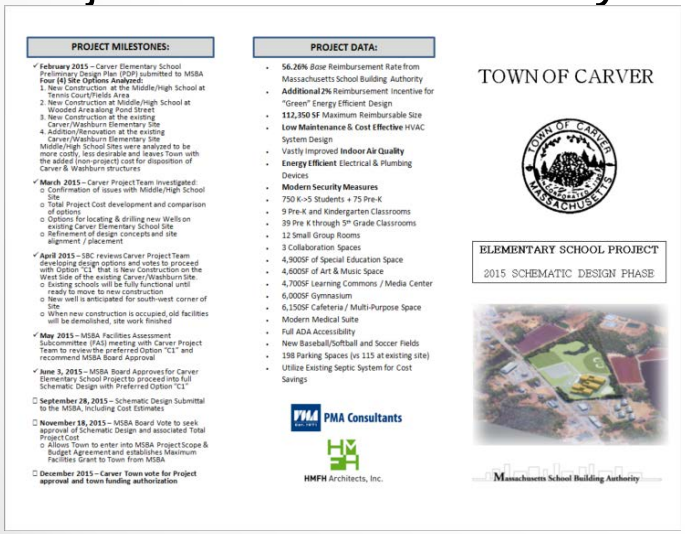
Next Steps:

- ***3/25/15*** *– SBC Approve Preferred Option*
- ***4/13/15*** *– SBC Approve Preferred Schematic Report for Submission to MSBA*
- ***5/13/15*** *- MSBA Facilities Assessment Subcommittee*
- **6/3/15** – MSBA Board Approval to Proceed into Schematic Design (Conditional Approval*)
- **6/30/15** – FAS PSR Supplemental Info Due*

- **8/3/15, 8/17/15** – SBC Meetings (Design Presentations)
- **8/24/15** – Schematic Design sent to Estimators
- **8/31/15** – SBC Meeting, Design Briefing & VM Option Discussion
- **9/8/15** – SBC Meets to Review Estimates & Approve VM Options
- **9/17/15** – Schematic Estimates/Budget Due to MSBA
- **10/1/15** – Schematic Design Submittal to MSBA
- **11/18/15** – MSBA Board Approval of Schematic Design
- **TBD** – Carver Town Meeting/Vote on Project Funding

Community Outreach:

- **Old Home Day – July 25th, 2015**
- Mobile Home Park Presentation to Board of Directors
- Local Cable Project Updates
- Chance Court Outreach – (after Design more detailed)
- Farmers Market (September)
- Project Informational Flyer (draft):



PROJECT MILESTONES:

✓ **February 2015** – Carver Elementary School Preliminary Design Plan (PDP) submitted to MSBA
Four (4) Site Options Analyzed:
1. New Construction at the Middle/High School at Tennis Court/Fields Area
2. New Construction at Middle/High School at Wooded Area along Pond Street
3. New Construction at the existing Carver/Washburn Elementary Site
4. Addition/Renovation at the existing Carver/Washburn Elementary Site

Middle/High School Sites were analyzed to be more costly, less desirable and leaves Town with the added (non-project) cost for disposition of Carver & Washburn structures

✓ **March 2015** – Carver Project Team investigated:
- Confirmation of issues with Middle/High School Site
- Total Project Cost development and comparison of options
- Options for locating & drilling new Wells on existing Carver Elementary School Site
- Refinement of design concepts and site alignment / placement

✓ **April 2015** – SBC reviews Carver Project Team developing design options and votes to proceed with Option "C1" that is New Construction on the West Side of the existing Carver/Washburn Site.
- Existing schools will be fully functional until ready to move to new construction
- New well is anticipated for south-west corner of Site
- When new construction is occupied, old facilities will be demolished, site work finished

✓ **May 2015** – MSBA Facilities Assessment Subcommittee (FAS) meeting with Carver Project Team to review the preferred Option "C1" and recommend MSBA Board Approval

✓ **June 3, 2015** – MSBA Board Approves for Carver Elementary School Project to proceed into full Schematic Design with Preferred Option "C1"

☐ **September 28, 2015** – Schematic Design Submittal to the MSBA, including Cost Estimates

☐ **November 18, 2015** – MSBA Board Vote to seek approval of Schematic Design and associated Total Project Cost
- Allows Town to enter into MSBA Project Scope & Budget Agreement and establishes Maximum Facilities Grant to Town from MSBA

☐ **December 2015 – Carver Town vote for Project approval and town funding authorization**

PROJECT DATA:

- **56.26%** Base Reimbursement Rate from Massachusetts School Building Authority
- **Additional 2%** Reimbursement Incentive for "Green" Energy Efficient Design
- **112,350 SF** Maximum Reimbursable Size
- **Low Maintenance & Cost Effective** HVAC System Design
- Vastly Improved **Indoor Air Quality**
- **Energy Efficient** Electrical & Plumbing Devices
- **Modern Security Measures**
- 750 K->5 Students + 75 Pre-K
- 9 Pre-K and Kindergarten Classrooms
- 39 Pre K through 5th Grade Classrooms
- 12 Small Group Rooms
- 3 Collaboration Spaces
- 4,900SF of Special Education Space
- 4,600SF of Art & Music Space
- 4,700SF Learning Commons / Media Center
- 6,000SF Gymnasium
- 6,150SF Cafeteria / Multi-Purpose Space
- Modern Medical Suite
- Full ADA Accessibility
- New Baseball/Softball and Soccer Fields
- 198 Parking Spaces (vs 115 at existing site)
- Utilize Existing Septic System for Cost Savings

PMA Consultants

HMFH Architects, Inc.

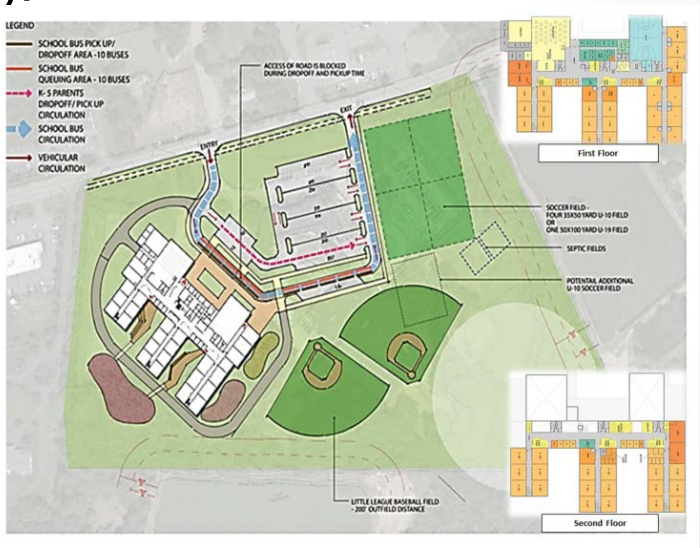
TOWN OF CARVER

TOWN OF CARVER MASSACHUSETTS INCORPORATED

ELEMENTARY SCHOOL PROJECT

2015 SCHEMATIC DESIGN PHASE

Massachusetts School Building Authority



Discussion / Questions?

Carver School Building Committee Meeting

July 20th, 2015

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