JOHNSON ROBERTS ASSOCIATES INC. ARCHITECTS

Essex Public Safety Building
Essex, Massachusetts

Design Presentation May 22, 2019

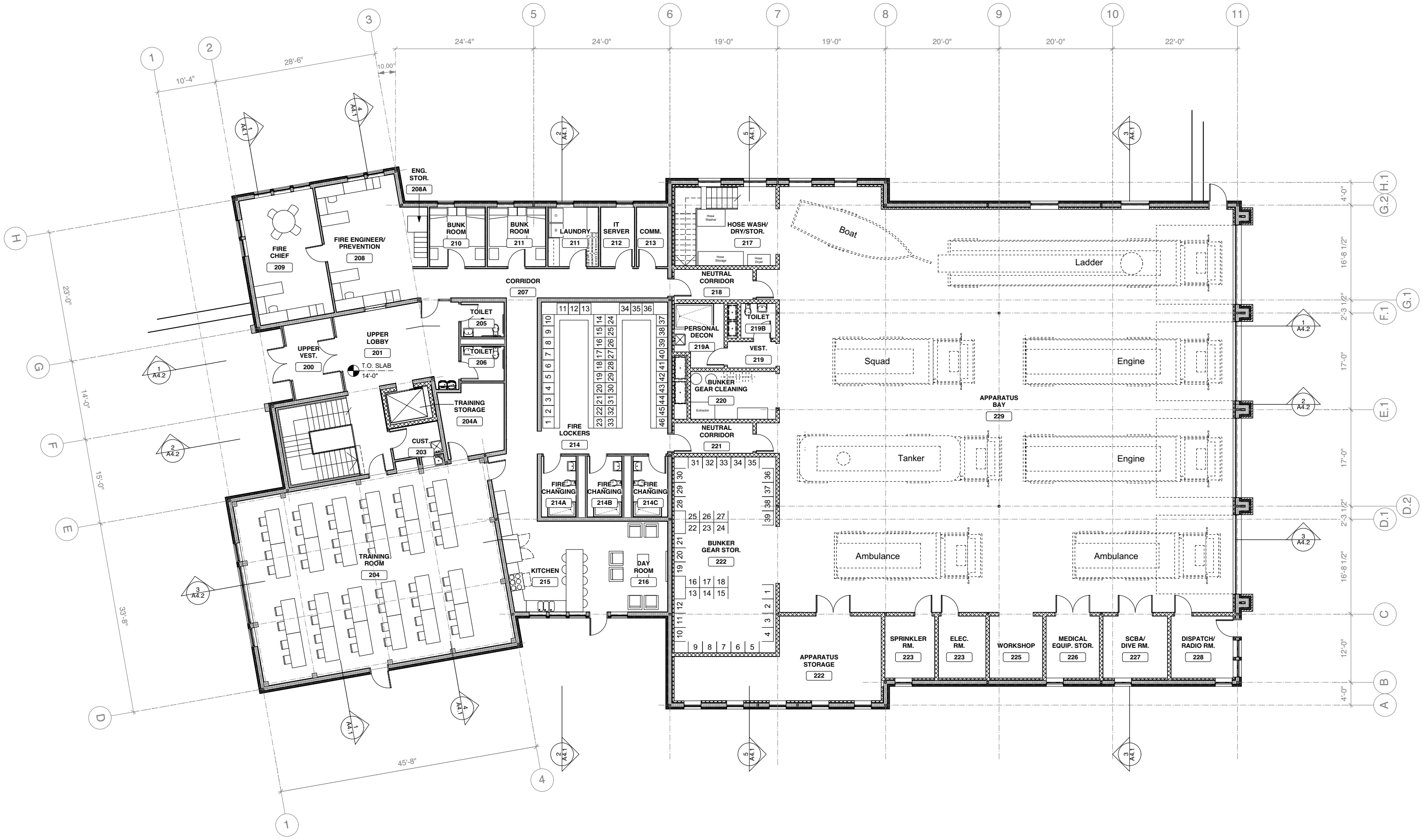
Essex Public Safety Building Project

Site Plan

Lower Level	8,050 SF
Upper Level	14,800 SF
Total	**23,850 SF**

Essex Public Safety Building Project

Upper Level Plan



Lower Level	8,050 SF
Upper Level	14,800 SF
Total	**23,850 SF**

Essex Public Safety Building Project

Lower Level Plan

Lower Level	8,050 SF
Upper Level	14,800 SF
Total	**23,850 SF**

Essex Public Safety Building Project

Aerial View from John Wise Ave

Essex Public Safety Building Project

View of Main Entrance

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Essex Public Safety Building Project

Rear View

HVAC System Options

for

ESSEX

MASSACHUSETTS

Essex Public Safety

Essex, MA

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Overview

1.Goal of Economic Analysis

2.HVAC System Option Overview

- Option 1 : VAV System w/ High-Efficiency Boilers
- Option 2 : CHW Induction Unit System with DOAS
- Option 3 : VRF System with DOAS

3.Economic Analysis Methodology

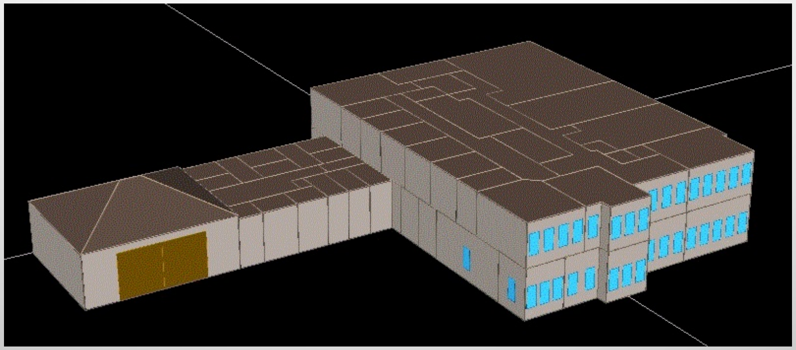
1.Questions and Discussion

Goal of LifeCycle Economic Analysis

The goal of the mechanical lifecycle engineering economic analysis is to assess the performance of various mechanical systems in comparison to a baseline mechanical system.

Each option is compared to the baseline system to determine the lowest combined savings over a 30 year cycle to determine the most advantageous system considering electrical costs, gas costs, maintenance costs, and initial construction costs.

By comparison of each option to the baseline system, the option with the greatest total life-cycle savings is generally recommended. To further enhance controllability and overall system performance, additional options should be considered that will enhance year round temperature control and comfort at a possible marginal increase in capital cost.



Baseline & Option 1 - VAV System

Pros:

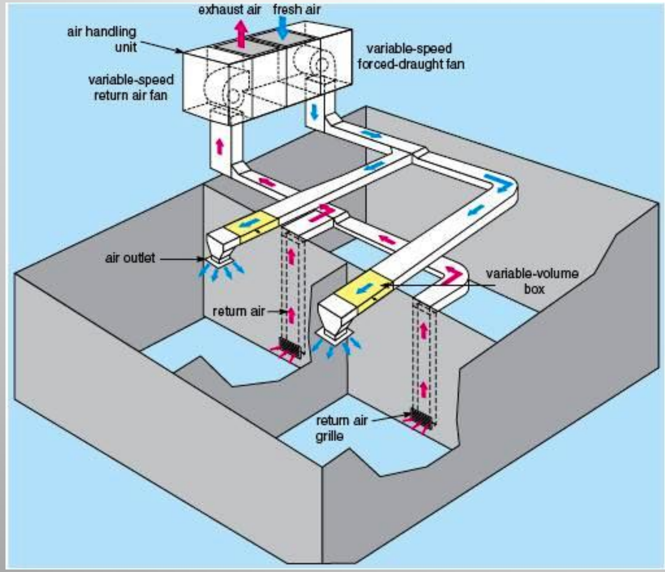
•Lower piping installed costs due to two-pipe system as chilled water piping is not required

•Moderate to high overall installed costs

•Chiller plant and distribution systems not required

•Low maintenance; no condensate drains, fans, or filters at terminal units

•Reduced automatic temperature controls installed costs resulting from reduced control components



Cons:

•Moderate noise levels

•Reduced temperature control if several rooms are served by the same VAV unit

•Reduced indoor air quality as a result of being a mixed-air system

•Maintenance of equipment is in occupied area

•Higher energy consumption due to increased fan energy

•Higher energy consumption as summertime use of hot water system is required for hot water reheats of VAV boxes

•Overall ductwork costs are greater due to the larger supply and return ductwork systems providing mixed-air rather than ventilation only

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Option 2 – Chilled Beam Induction Unit System w/ DOAS

Pros:
•High energy efficiency
•Low noise levels
•Flexibility of installation
•Moderate first cost
•Very low maintenance, no fans or filters at units
•Moderate overall installed costs
•Excellent humidity control
•Higher amounts of outside air required to meet capacity of units in smaller zone areas; resulting in improved indoor air quality
•No electrical requirements for terminal units
•No floor space required for equipment
•Each unit can provide individual control
•Reduced automatic temperature controls installed costs resulting from reduced control components

Cons:
•Requires increased coordination with "ceiling" system. (e.g. additional piping, HW, CHW & condensate piping)
•Requires additional ventilation air in some cases
•Condensate drain maintenance for terminal units

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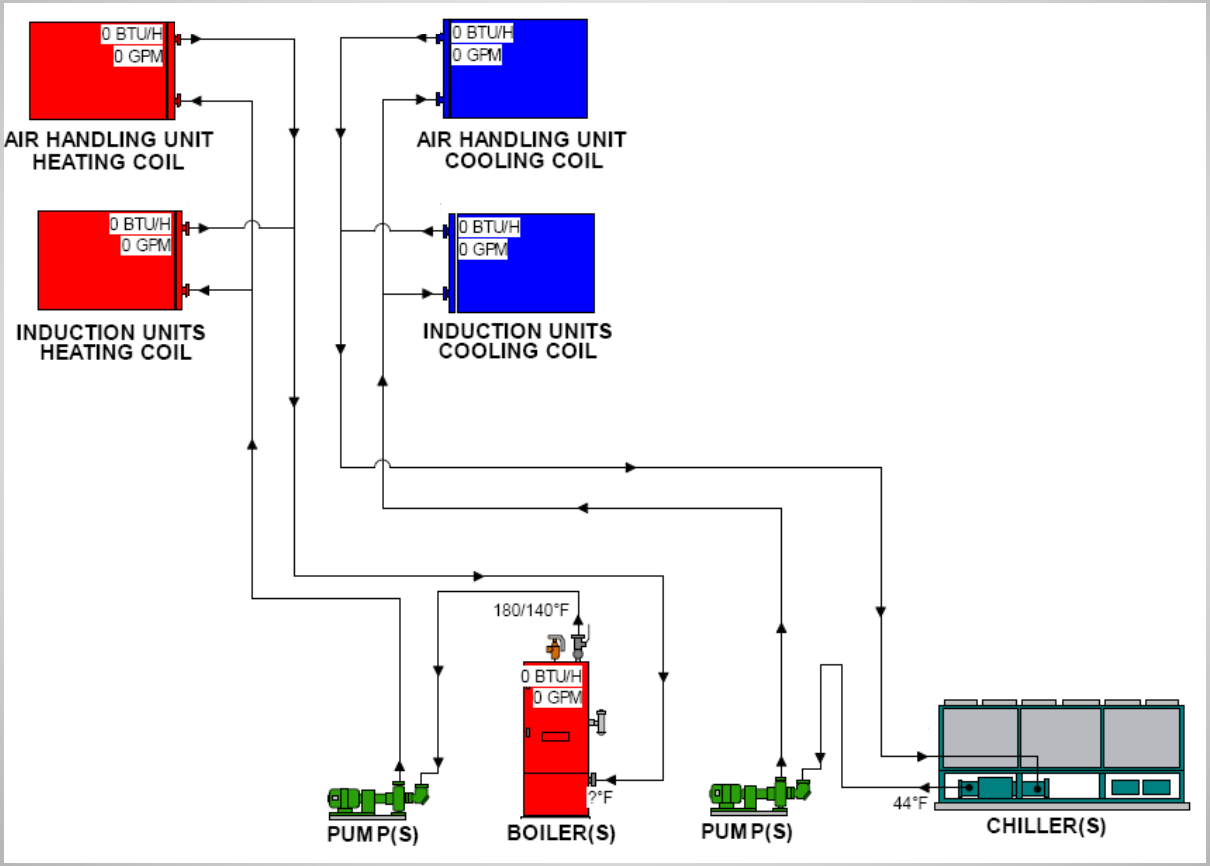
Option 2 – Chilled Beam Induction Unit System (Piping Diagram)



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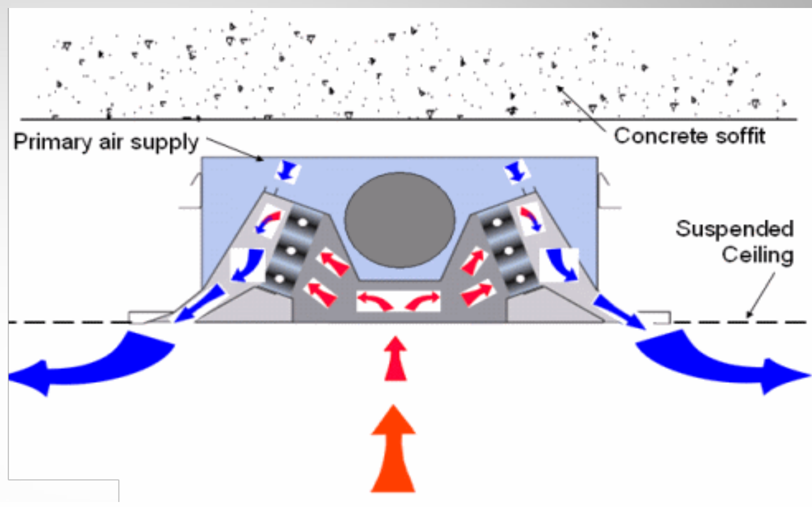
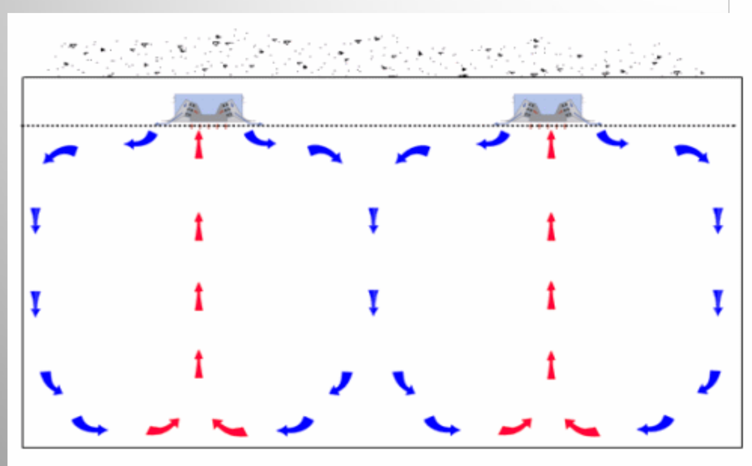
Option 2 –
How Chilled Beam/Induction Units Work

- Primary Air 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.





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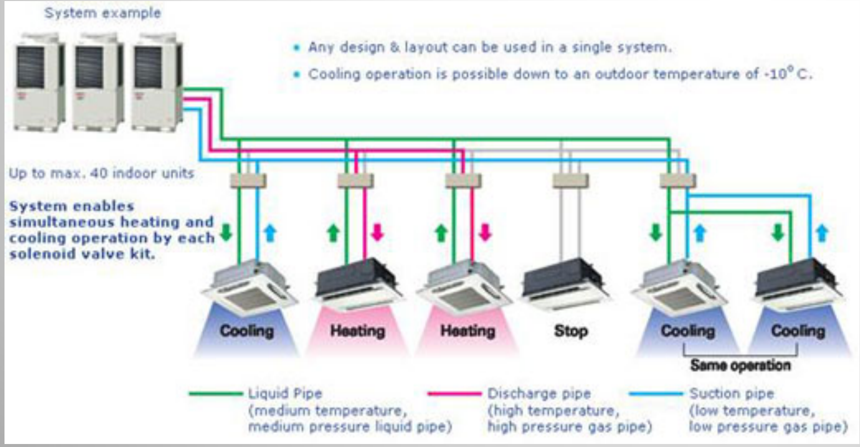
Option 3 – Variable Flow Refrigerant (VRF) System w/ DOAS

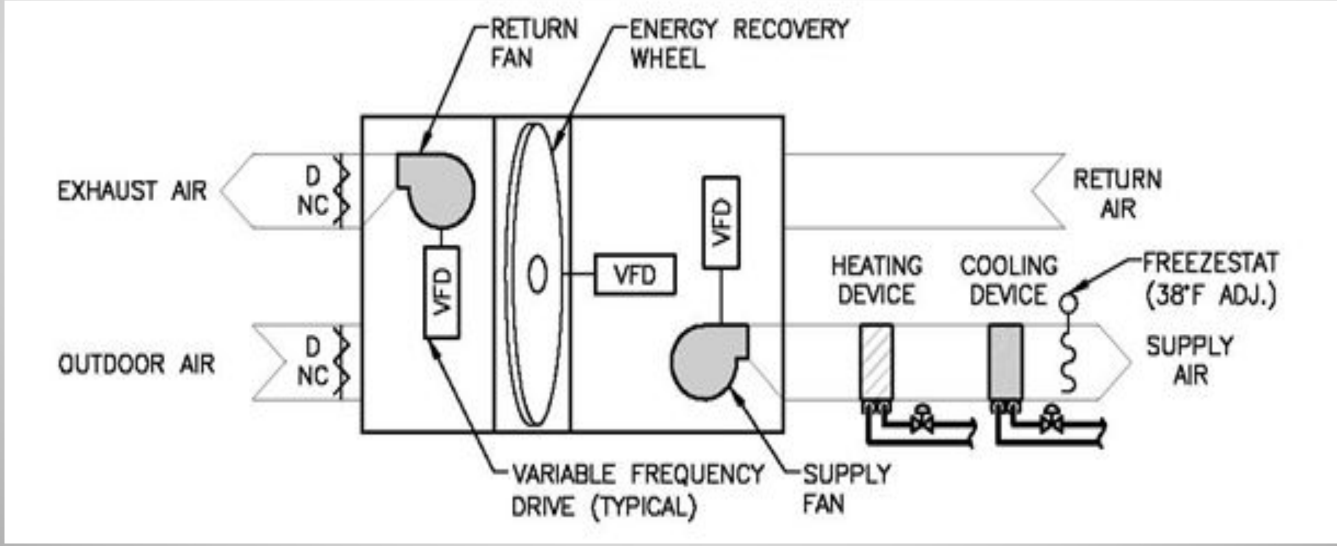
Pros:
- Lower piping installed costs due to refrigerant piping system only
- Moderate overall installed costs
- Chiller plant and distribution systems not required
- Reduced boiler plant size
- Single cabinet can be utilized for both heating and cooling applications
- Smaller central ventilation ductwork as only the code required ventilation air is provided to meet occupancy load



Cons:
- Individual fan motors in space
- Higher noise levels
- Quarterly filter changes per unit
- More complex automatic temperature controls
- Higher automatic temperature controls installed costs on a per unit basis due to amount of control devices required
- Condensate drain maintenance for terminal units
- Maintenance of equipment is in occupied area
- Higher energy consumption due to increased electric heating

Dedicated Outside Air Handling System

- **Typical to System Options 2 & 3**
- **Increases Energy Efficiency due to:**
  - **Energy Recovery**
  - **Sizing Equipment for Specific Duty (AHU for Latent Cooling and Terminal Units for Sensible Cooling)**



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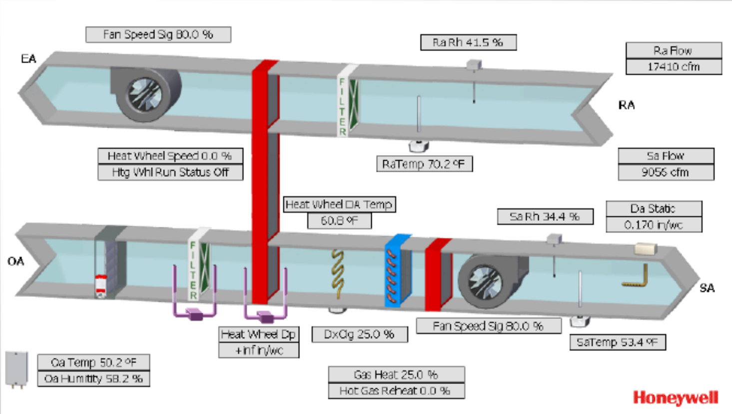
HVAC Plant and Supplemental Systems and Equipment

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

Chiller Plant (Option 1&2 Only)
- High efficiency air-cooled chiller
- Chilled water temperature reset controls
- Variable speed pumps with VFD's

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



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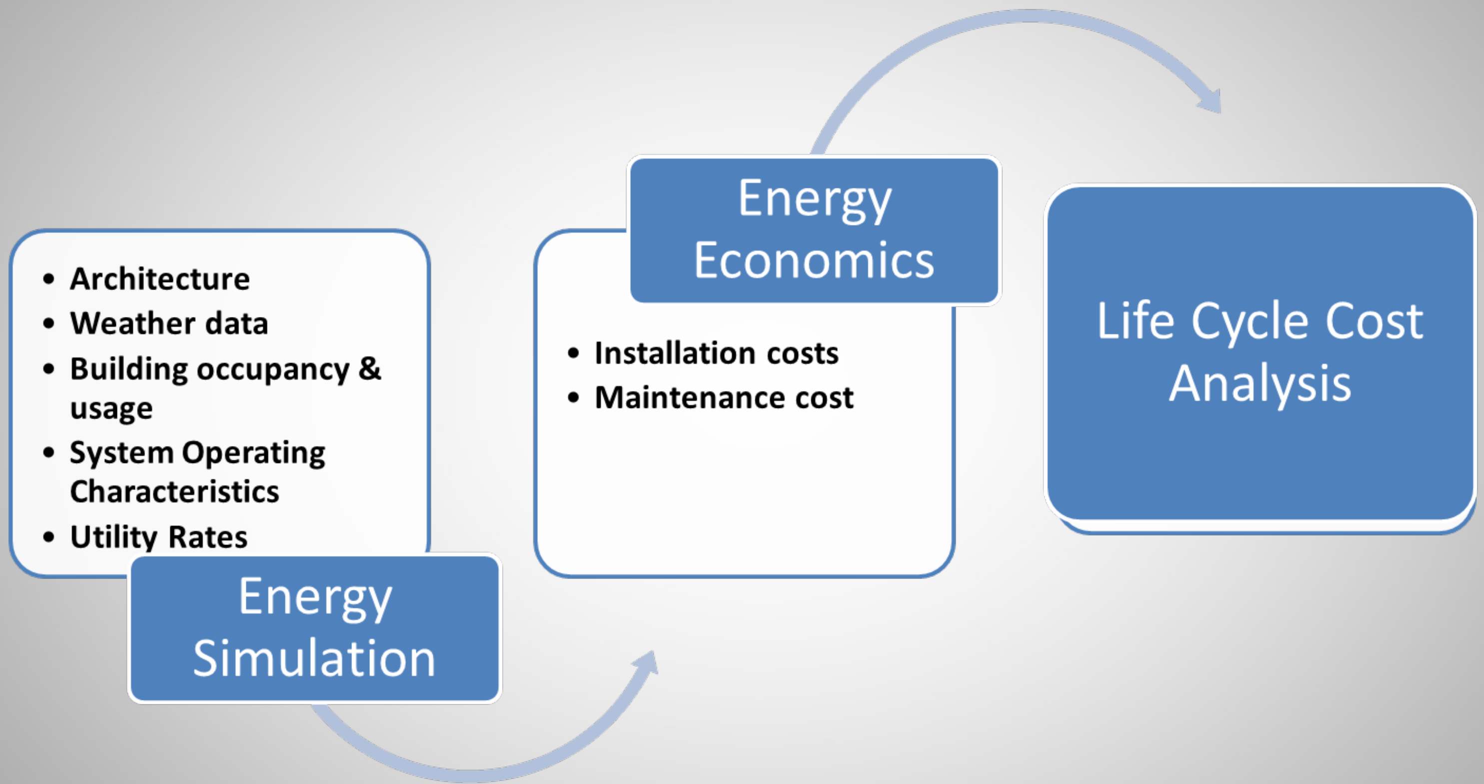
Energy Economics Methodology



Energy Model Analysis Methodology

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

Essex Public Safety - Mechanical System Payback Summary

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 kBTU/s.f. (EUI)	Annual Maint. Cost	Combined Annual Expense	Combined Expense Savings**	Total Life-Cycle Savings***	Discounted Payback (Years)****
-	1. Hot/chilled water coil VAV AHU systems with energy recovery wheel serving terminal VAV boxes with hot water reheat coils 2. Standard efficiency gas-fired boiler plant 3. Standard efficiency air-cooled chiller	$1,145,476	313,030	4,201.4	$50,084	$50,417	$100,501	$3.24	169.98	$11,550	$112,051	-	-	-

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 kBTU/s.f. (EUI)	Annual Maint. Cost	Combined Annual Expense	Combined Expense Savings**	Total Life-Cycle Savings***	Discounted Payback (Years)****
1	1. Hot/chilled water coil VAV AHU systems with energy recovery wheel serving terminal VAV boxes with hot water reheat coils 2. High efficiency gas-fired boiler plant 3. High efficiency air-cooled chiller	$1,195,476	307,620	3,440.3	$49,219	$41,283	$90,502	$2.92	144.84	$11,550	$102,052	$9,999	$183,600	5
2	1. Four-pipe chilled/hot water coil induction units 2. Hot/chilled water coil 100% O.A. ventilating units with energy recovery wheel 3. High efficiency gas-fired condensing boiler plant 4. High efficiency air-cooled chiller	$1,534,969	248,050	3,171.6	$39,688	$38,059	$77,747	$2.51	129.61	$10,500	$88,247	$23,804	$153,384	20
3	1. Variable refrigerant flow (VRF) terminal evaporator units with air-cooled condensing units 2. Hot/chilled water coil 100% O.A. ventilating units with energy recovery wheels 3. High efficiency gas-fired condensing boiler plant	$1,340,274	288,820	2,640.7	$46,211	$31,688	$77,899	$2.51	116.97	$14,400	$92,299	$19,752	$272,408	11

Conclusions and Recommendations

Our observations of the Mechanical System Payback Summary suggests that option three, a VRF unit system, represents the most cost effective solution by yielding an approximate $141,121 savings over the 30 year study period with an instant payback in comparison to the baseline system.

Thank You

Questions and Discussions

Essex Public Safety Building Project

Value Engineering Changes

- Reduced building area by ~2,200 square feet from SD
- Narrowed Apparatus Bay by 4’ overall
- Eliminated of (1) Bunk Room & (1) Personal Decon Room
- Combined Sergeant & Detective Offices into shared office
- Relocated Mechanical Room to Mezzanine (less basement excavation)
- Reduced size of public areas, including eliminated (1) Toilet Room
- Reduced brick at exterior (brick remains at driving areas for durability)
- Eliminated Basement Storage under Training Room

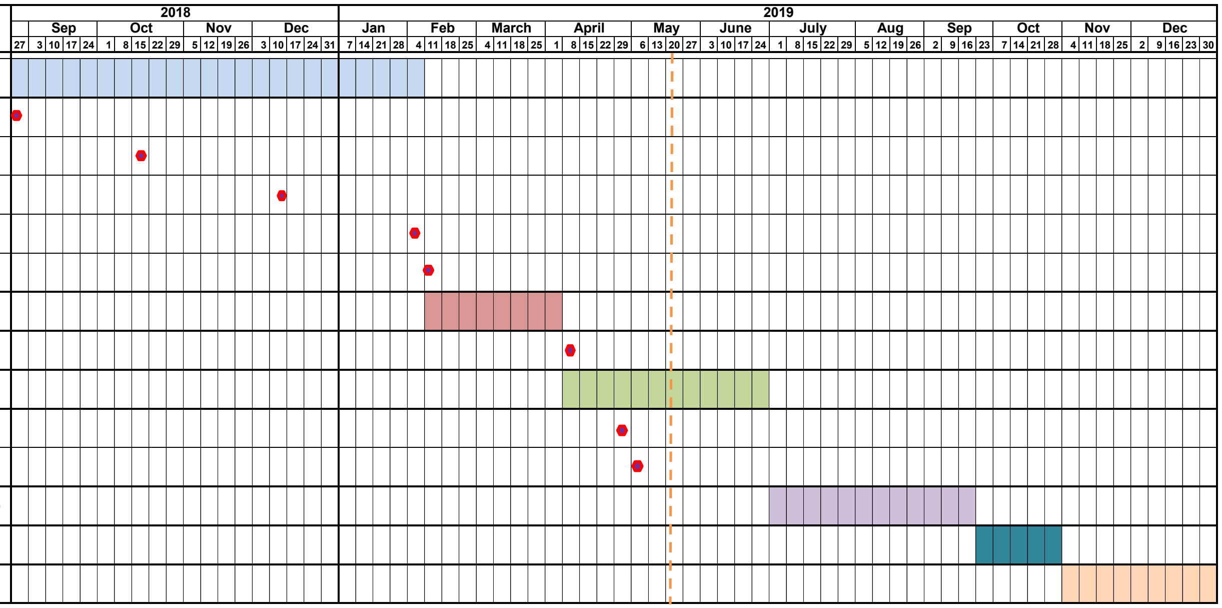
Essex Public Safety Building Project

Rowley Comparison

- **Escalation:** construction midpoint ~2 years later than Rowley
- **Site:** tight, sloped site w/ wetlands (flat site w/ limited cut/fill at Rowley)
- **Structure:** multi-story steel/concrete structure (single-story wood framing at Rowley)
- **Zoning:** physical and mechanical separation of red, green and neutral zones (no separation at Rowley)
- **Finishes:** robust CMU in booking, brick at drivable areas, etc. (GWB, composite siding, etc. at Rowley)
- **Program:** Spaces not included at Rowley (Police Garage, Patrol Room, separated support spaces at Apparatus Bay, etc.)

Essex Public Safety Facility
Schedule Overview

	Start	Finish
Architect Selection/Options Analysis	**27-Aug-18**	**11-Feb-19**
Special Town Meeting - OPM	27-Aug-18	
Fall Town Meeting - Architect	16-Oct-18	
Public Forum	13-Dec-18	
Public Forum	6-Feb-19	
Special Town Meeting - Land Acquisition	11-Feb-19	
Schematic Design	**12-Feb-19**	**8-Apr-19**
Public Forum	10-Apr-19	
Design Development	**9-Apr-19**	**1-Jul-19**
Public Forum	1-May-19	
Town Meeting - Project Funding Approval	6-May-19	
Construction Documents	**2-Jul-19**	**22-Sep-19**
Bidding	**23-Sep-19**	**4-Nov-19**
Construction	**5-Nov-19**	**31-Jan-21**



Essex Public Safety Facility
Schedule Overview

	Start	Finish	2020																																																			2021			
			Jan				Feb				March				April					May				June				July					Aug				Sep				Oct				Nov				Dec					Jan			
			7	14	21	28	4	11	18	25	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23	7	14	21	28	4	11	18	25	2	9	16	23	30	4	11	18	25
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Timing of Future Town Meeting Borrowing Vote

Potential Options Comparison

Full Funding Approval Based on 60% CDs	Full Funding Approval Based on Actual Bids
▪ Schedule: Mid-September, prior to issuing Invitation to Bid	▪ Schedule: Late October, after bids received and prior to issuing notice of award
▪ Pros: ○ Bidders assured funds are in place to award contract ○ Less risk of delaying award	▪ Pros: ○ No risk of bids coming in over budget ○ Voters may prefer approving budget based on actual bid numbers
▪ Cons: ○ Must carry contingency and/or Add Alts to mitigate risk of bids exceeding budget ○ Voters may prefer to know that budget is based on hard bid numbers	▪ Cons: ○ Depending on what other project are out for bid, participation from bidders may be diminished ○ More constrained window for Town Meeting

Overview of D-B-B and CM at-Risk

Design - Bid – Build (M.G.L. Ch. 149)

- "Traditional approach" for public construction projects in Massachusetts
- Design and construction stages proceed sequentially
- Owner completes design, issues bids on competed design
- Lowest "Eligible and Responsive" General Contractor is awarded the contract
- Owner executes lump sum contract with General Contractor
- Best suited for less complicated projects that are budget sensitive but not schedule sensitive and not subject to change

Construction Manager at Risk (M.G.L. Ch. 149A)

- CM at Risk selected in the design stage
- CM at Risk selected on qualifications and fee
- Owner first executes preconstruction contract with CM for constructability reviews, construction scheduling, and project cost estimates during the design process
- Owner negotiates Guaranteed Maximum Price for the project – contract becomes a cost plus fixed fee contract for construction phase
- Best suited for complex projects that are schedule sensitive, require complicated phasing and high level of oversight and difficult to define

Project Delivery Methods

CM at Risk Advantages:

- Ability to select contractor based on qualifications
- Ability to release early packages under same contractor to accelerate schedule and time to market
- Contractor involved early in the design process prior to bid release to provide preconstruction services such as constructability reviews, phasing analysis, cost estimates, and value engineering
- Trade contractors know the contractor prior to submitting bids

CM at Risk Disadvantages:

- Approval required by the Office of the Inspector General
- Less competition from non-trade subcontractors
- Cost of CM services including pre-construction (adds 2-3% to initial cost)
- GMP may not be executed until after construction begins thus reducing options if pricing comes in over budget

Considerations for the Essex Public Safety Project:

- Overall duration of design schedule would not allow for early CM input or opportunities for early bid packages, reducing benefits to cost premium
- New Construction minimizes the frequency of changes and claims
- The Project will be completed in a single phase on an unoccupied site
- Additional cost for Pre-Construction Phase would be incurred prior to total project funding approval
- Design-Bid-Build more typical in projects of this scale - ample pool of qualified bidders