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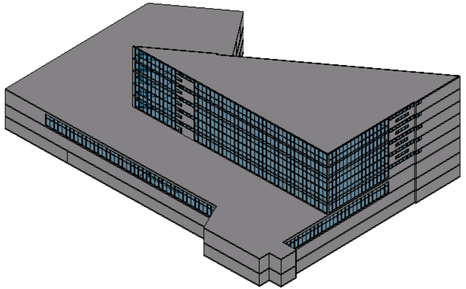
Army National Guard
Readiness Center Addition
Arlington, VA

Mitchell E. Peters
Mechanical Option

Thesis Final Presentation



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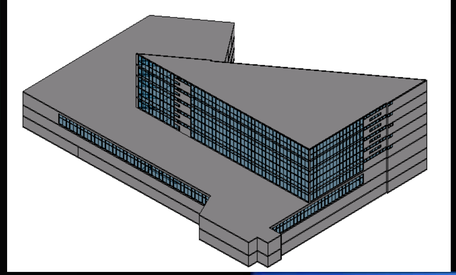

Building Overview

Location:	Arlington, VA
Size: 8 Levels	251,000 SF
Total Cost:	$100,000,000
Occupancy:	Administrative/Office
Delivery Method:	Design-Bid-Build with Lump Sum
Architect:	CH2MHILL
Engineers:	AECOM |DMJM H&N
Owner:	Army National Guard
Construction Period:	Dec. 2008 to March 2011

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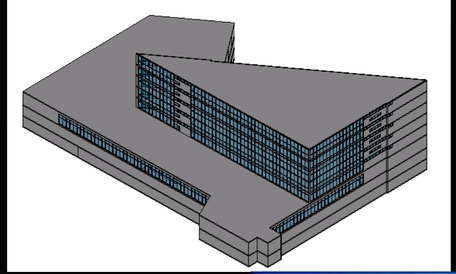
Mechanical Overview

Air Delivery System:	Hydronic 4 Pipe VAV 17 AHU with FCU
Chilled Water System:	(2) 400 Ton Water Cooled Chillers
Hot Water System:	(5) 1000 MBH Natural Gas Boilers
Control System:	Direct Digital Control using BAS



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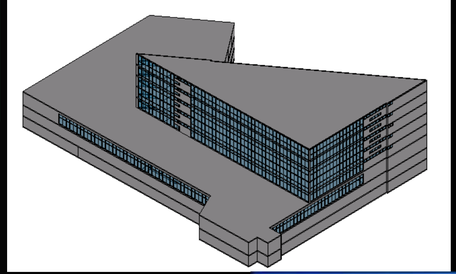

Cooling	
Supply (cfm/SF)	5.03
Ventilation (cfm/SF)	1.43
Load(SF/ton)	789

Heating	
Design Load (SF/ton)	543

Annual Energy Use(kBTU/SF*yr)	
Cooling	19.11
Heating	25.18
Pump	5.65
Fan	17.6
TOTAL	67.54

Annual Operating Costs	
Electricity(45.3%)	221,231.40
Chilled Water(16.3%)	79,780.35
Hot Water(18.7%)	91,527.15
Domostic Water(19.8%)	96,911.10
TOTAL	489,450
Total/SF	1.95

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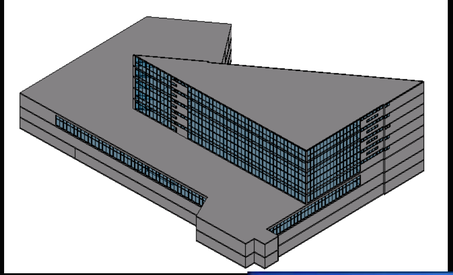

Redesign Goal:

Reduce Operating Costs as well as Energy Consumption at a reasonable first cost.

Accomplish with DOAS with incorporated ACB system.

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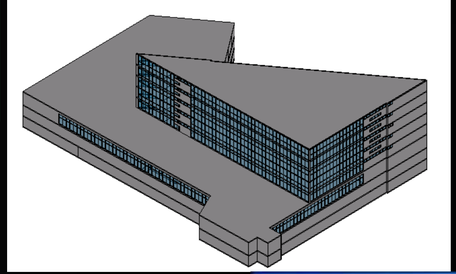

Dedicated Outdoor Air System

1. Less Ventilation Air
2. Indoor Air Quality
3. Decoupled Loads

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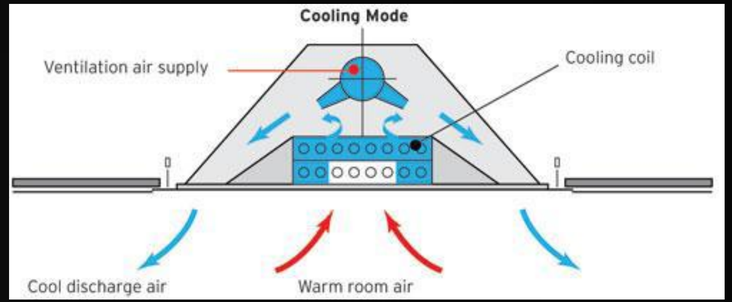
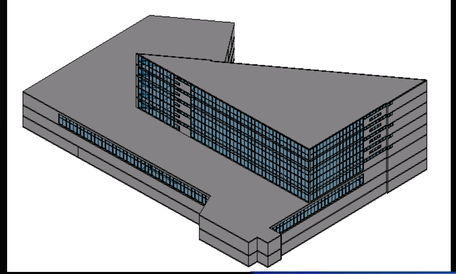


Active Chilled Beams



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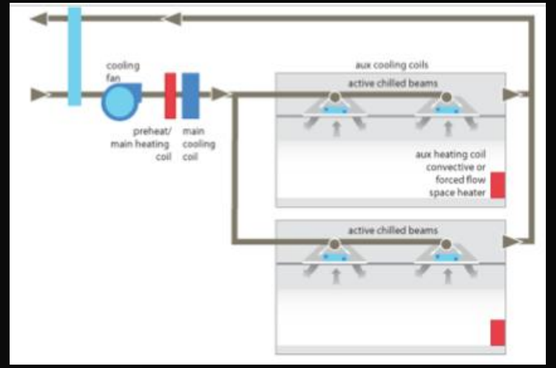

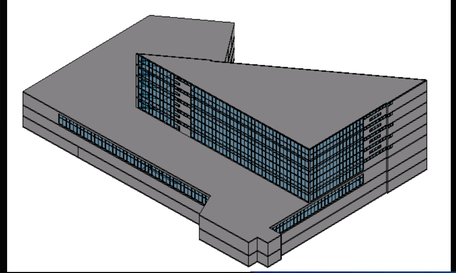

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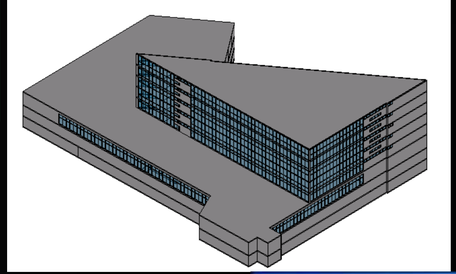

Indoor Design Conditions:

Cooling:

Dry Bulb:	77°F
Relative Humidity:	50%
Dew Point:	57.3°F
Humidity Ratio:	72.27°F
ACB Surface Temp:	62°F

Heating:

ACB Temp:	95°F
Inlet:	97°F
Outlet:	93°F

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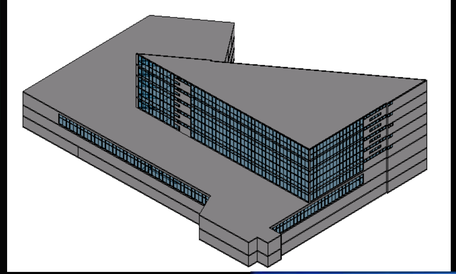

Supply Air:

Required: 52,100 CFM

$Q_L = 0.68 V_{SA} (\Delta W)$, or $W_{SA} = W_{SP} - Q_L / (0.68 V_{SA})$

W_{SA} = Supply Air Humidity Ratio (gr/lb of dry air)
W_{SP} = Space Humidity Ratio (gr/lb of dry air)
Q_L = Space Latent Load (BTU/hr)
V_{SA} = Supply Air Flow Rate (CFM)

Humidity Ratio: 42.1 gr/lb dry air

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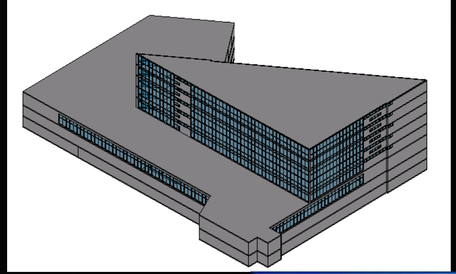

Sensible Load:

Temperature difference: 77-45= 32°F

$$Q_S = 1.08 V_{SA} (\Delta T)$$

Q_S= Space Sensible Load (BTU/hr)
V_{SA}= Supply Air Flow Rate (CFM)
ΔT= Difference between Room Air DB and Supply Air DB (°F)

ACB cooling capacity: 2,200 BTU/hr

ACB required: 1,277

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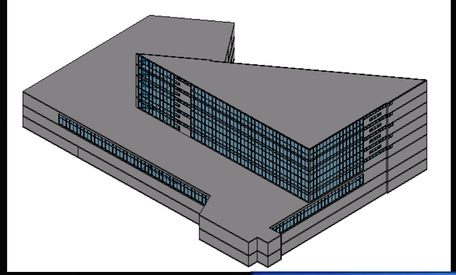

System	CFM	OA%	Reduction
ACB	52,100	100	148,700
Existing VAV	200,800		

System	Cooling (TONS)	Heating (MBH)
ACB	656	4957.3
Existing VAV	728	6320

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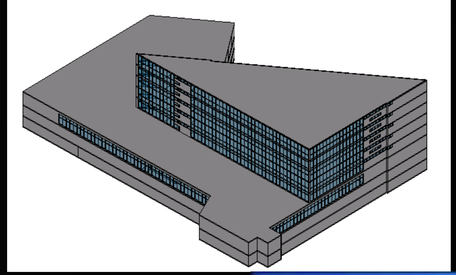

Annual Energy Use (kBTU/SF*yr)		
Cooling	19.11	14.52
Heating	25.18	19.14
Pump	5.65	12.34
Fan	17.60	14.11
Total:	67.54	60.11

Over 11% reduction in Energy Consumption

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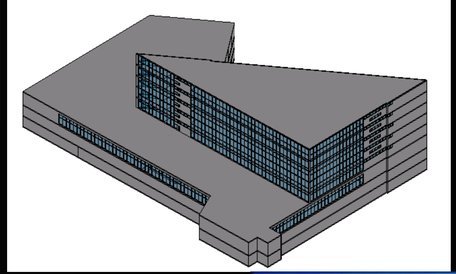

Initial Cost	
Equip. Type	Costs($)
AHU	-200,000
VAV	-18,434
FCU	0
PUMP	167,264
FAN	-15,645
ACB's	510,800
Total:	443,985

Resulting payback of 25 years

Daily operating cost/SF reduced from 1.95-1.83

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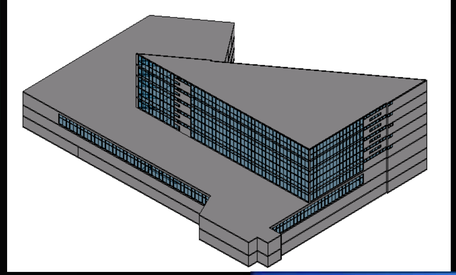

SCIF:

Sensitive Compartmented Information Facility
SCI storage
Door: requirements
single entry(fire escape) min. 1-3/4” thick
Walls: Ceilings, floors and walls must all be connected
Required STC of 50 or better-very load noise can faintly heard

ArNG doors- STC 55
ArNG walls- STC 56 with welded metal mesh

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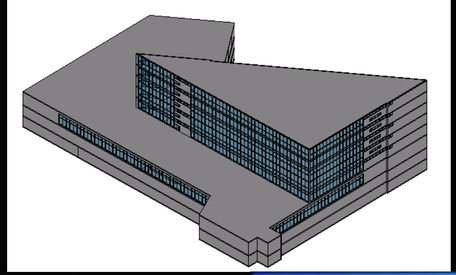

Soundproofing Considerations:

Current wall construction: 4 layers 5/8” GWB with welded mesh

STC 55

Cost: $12.02/SF

Redesign: 2 layers 5/8” GWB with resilient channel

STC 44 sound class 3-appropriate for SCIF

Cost: $7.18/SF- $30,000 in savings

Use in conjunction with sound masking device

Single unit covers 6,000 SF- costs less than savings

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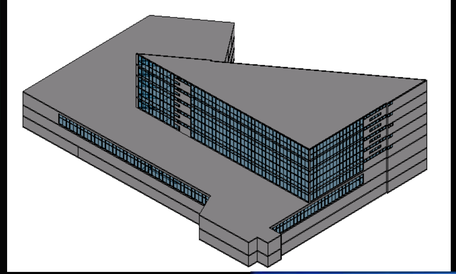

Conclusion:

More Energy Efficien
DOAS and its use of 100% OA inheriently has a higher IAQ
Maintence benefits
Maintained Thermal Comfort

Savings not as beneficial as hoped: First costs not overcome by operating costs.

VAV system as designed is cheap and economical

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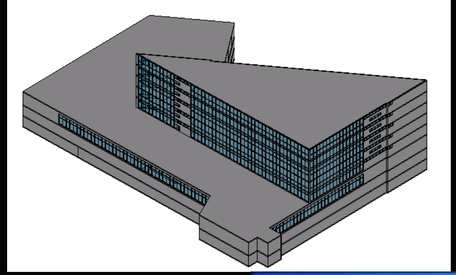

Acknowledgements:

Special Thanks To:
AE Faculty
&
Family and Friends

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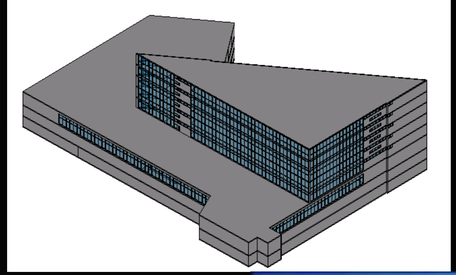

Questions