Proposal of AE Senior Thesis Study for Spring 2006
For the Johns Hopkins Hospital
Medical Office Building

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Executive Summary

In the Proposal of AE Senior Thesis Study for 2006, the topics of study as well as the method to their investigation will be discussed. The topics of breadth work will also be discussed.

The bulk of the work will be on changing the mechanical systems of the MOB from all electric packaged electric air handlers and terminal electric reheat to a more efficient system utilizing steam and chilled water from the nearby central plant. In addition to this, the MOB will also be evaluated for use of a DOAS system in the hopes of cutting down on first cost and operating costs.

The breadth work for the MOB consists of a constructability study and an electrical integration study. The constructability study will determine the added cost and schedule impact of connecting the MOB to the central plant. The electrical study will access any possible savings in equipment costs from removing the electrical equipment associated with the current all electric HVAC equipment.

Background Information

The building of study is the Medical Office Building, or MOB, at Johns Hopkins Hospital in Baltimore Maryland. The building is an 88,200 sq ft structure housing mainly medical examination rooms and offices of medical professionals along with waiting spaces for patients and several special use spaces such as radiology, dialysis etc. The MOB will have three above grade floors with one full lower level. It is currently under construction and is slated to be completed in late March of 2006.

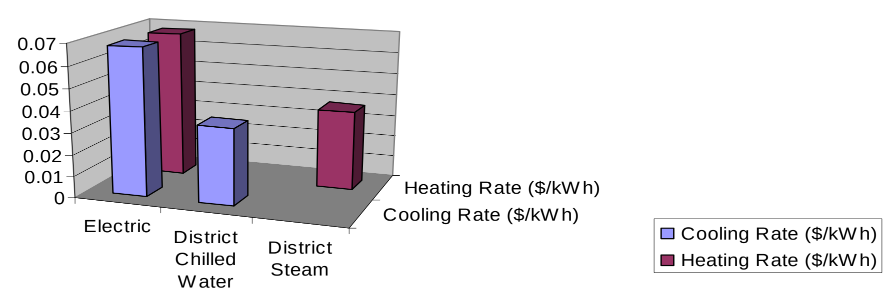
The building will utilize all electric systems for heating and cooling. A decision made to minimize first cost at the expense of system efficiency. The cooling and air distribution is accomplished through six rooftop packaged dx units. Each unit is rated at 61 Tons of cooling at 21000 scfm. Heating is accomplished by VAV electric reheat units.

The MOB is located on the same block as the Johns Hopkins central plant that supplies steam and chilled water to many of the buildings on campus.

Statement of the Problem

The system designed for the MOB will work and should pose no constructability issues. However they have been designed at the owner's behest to minimize only first cost. The current systems in the MOB are the most inefficient systems possible. As shown in the third technical report and illustrated in Figure 1, rates for electric cooling and heating are higher than those for both chilled water and steam from the central plant.

Figure 1



	Electric	District Chilled Water	District Steam
Cooling Rate ($/kWh)	0.068	0.0353	
Heating Rate ($/kWh)	0.068		0.0368

Proposed Solutions

The basic idea of my solutions is to provide a series of options for conditioning the space in the MOB ranging from the slightly more efficient but conventional to the more unusual and hopefully more efficient. In the initial design, first cost was the driving factor, and as it was minimized it lead to an inefficient operating system. To increase the operating efficiency of the system I have considered several alternatives and settled on the following.

Alternative #1 will be the redesign of the MOB as a VAV system, dropping the all electric systems and utilizing the excess steam and chilled water from the nearby central plant. This redesigned VAV using steam heat and chilled water cooling will be evaluated both with, and without use of enthalpy wheels.

Alternative #2 will be redesigning the MOBs mechanical systems as a DOAS system. The goal here is to provide the most efficient operating system possible with the capability to over ventilate certain spaces where patients, possibly with communicable illnesses, will be spending time. These spaces are the waiting rooms and examination rooms. Hopefully the DOAS system will decrease first cost versus the redesigned VAV thereby putting the DOAS first cost closer to that of the original all electric system and making it an attractive alternative to the owners.

The heating in the various spaces will be analyzed using individual steam radiators, steam coils in the VAV boxes and the existing electric reheat coils.

Solution Methods with Tasks and Tools

Alternative #1

The currently designed building systems will be redesigned for operation using chilled water for cooling and either steam or electric terminal reheat units. This scheme will be analyzed both with and without use of enthalpy wheels.

Task 1. Redesign of cooling equipment .

-Load calculations will be from reworked carrier HAP program used in technical assignment two.

-Ventilation requirements will be from the first technical assignment based on ASHRAE std 62.1-2004.

-Supply air parameters needed to satisfy sensible and latent load of the space will be calculated.

-Amount of chilled water needed will be calculated.

Task 2. Investigate alternate available AHUs.

-Size cooling equipment and AHUs for the current arrangement and for more unitary supply conditions with a lower number of AHUs.

-Investigate possible savings of having fewer, but larger capacity AHUs and cooling equipment.

Task 3. Investigate alternative heating methods.

-Size steam heating coils in the individual VAV boxes.

-Size individual room steam radiators.

-Size electric resistance heating coils in the individual VAV boxes.

Task 4. Perform economic analysis of different systems

-For AHUs and cooling equipment find first cost and operating cost

-For heating equipment find first cost and operating cost of systems to determine which scheme should be selected.

Alternative #2

A dedicated outdoor air system will be designed for the MOB. The system will have the design goals of having a reduced first cost versus Alternative #1 and having a lower operating cost that either Alternative #1 or the design all electric VAV system. Certain spaces may be purposely over ventilated due to their occupancy by people will illnesses.

Task 5. Determining the spaces target humidities and space sensible load.

-For purposes of both Task 1 and Task 2, rooms will be grouped together with similar rooms to expedite the calculations.

-Maximum of air needed to properly ventilate and air needed to remove space latent load will determine the supply air volume.

-Supply air will remove latent load so as to allow panels to operate at efficiently low temperature, perhaps temperature of central chilled water.

-Determine total space sensible load to be removed and that which is removed by supply air alone.

Task 6. Size chilled radiant ceiling panels to remove remaining space sensible load.

-Determine minimum entering water temperature for chilled radiant ceiling panels so as to avoid condensation problems.

-If chilled water supply temperature is too low, investigate methods of warming the supply water.

-Find cooling capacity per square foot of panel based on water temperature.

-Calculate area of chilled radiant ceiling panels needed for each room.

Task 7. Size cooling equipment.

-Find necessary cooling using district chilled water as well as enthalpy wheels.

-Investigate and necessary mixing of cooling coil leaving water with panel supply water to raise the panel supply water temperature above the space dew point temperature.

Task 8. Investigate available AHUs.

-Size AHUs, most likely for more unitary supply arrangement having fewer AHUs due to lower supply air volume.

Task 9. Investigate alternative heating methods.

-Size steam heating coils for terminal reheat boxes.

-Size individual room steam radiators.

-Size electric resistance heating coils for terminal reheat boxes.

Task 10. Investigate effects of enthalpy wheels.

-Choose appropriate enthalpy wheels based on performance, cost, availability, and impact on contamination of incoming outdoor air.

Task 11. Perform economic analysis of different systems

-For AHUs, cooling equipment and enthalpy wheels find first cost and operating costs.

-For different size ductwork find first cost.

-For chilled radiant ceiling panels, find first cost and associated supply chilled water cost and pumping cost.
-For heating equipment find first cost and operating cost of systems to determine which scheme should be selected.

Breadth Work

Analysis of Impact on Electrical Service and Equipment to the MOB

Changing the building HVAC from an all electric system to a system using electricity only for fan and pumping power will greatly reduce the size of the required electrical support equipment. In the breadth work, this reduction will be analyzed, both in terms of cost of equipment and possible saved space of reducing the size of the electrical equipment in the MOB.

Task 12. Find total current electrical dedication to mechanical system.
-From technical report two find the total mechanical system electrical draw.
-Find corresponding electrical equipment used for mechanical systems.

Task 13. Find new electrical usage and required equipment.
-For final proposed systems of alternatives one and two find required electrical usage.
-Find corresponding electrical equipment used for new mechanical systems and compare its cost to that of the design system.

Constructability of Alternative One and Alternative Two Systems

Both of the alternative systems will utilize chilled water and steam service from the central plant at Johns Hopkins Hospital. This will require interfacing with the existing central plant as well as running the supply lines through the block containing a parking garage and shipping facility.

Task 14. Asses the logistics of providing steam and chilled water service to the MOB.
-Analyze possible piping routes for the supply and any return lines for the steam and chilled water.
-Analyze building entrance point for steam and chilled water as well as any necessary metering equipment.

Task 15. Assess possible schedule impacts of system change.
-Analyze time to run supply and return lines to the MOB
-Analyze time to install chilled radiant ceiling panels in alternative two.

Timetable

The following is a tentative set of completion dates for the various tasks listed above. This schedule is entirely optimistic and will most likely be pushed back to a final completion date closer to the 24th of March. This is due to as yet unknown academic obligations and unforeseen obstacles to thesis progress.

The numbers in central cells denote completion dates for the tasks.

JANUARY

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
8	9 first classes	10	11	12	13	14
15	16 NO classes	17	18	19	20 **1**	21
22	23	24	25 **2,3**	26	27 **4**	28
29	30	31				

FEBRUARY

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1 **5,6**	2	3	4
5	6 **7,8,10**	7	8	9	10 **9**	11
12	13 **11**	14 valentines	15	16	17	18
19	20 **12**	21	22 **13**	23	24	25
26	27	28				

MARCH

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1 **14**	2	3 **15**	4
5	6 spring	7 break	8	9 spring	10 break	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

APRIL

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1
2	3	4	**5** THESIS DUE	6	7	8
9	**10** THE	**11** SIS PRE	**12** SENTATIONS	13	14	15
16	17	18	19	20	21	22 FE EXAM
23	24	25	26	27	**28** THESIS FINALS	29
30 FINALS-->	**1**	**2**	**3**	**4**	**5**	6 <--FINALS