TECHNICAL REPORT 3
Mechanical Systems and Existing Conditions
Northfield Mental Healthcare Center
Northfield, Ohio

Ji Won Park
Mechanical Option
Faculty Consultant: Dr. Stephen Treado
Date revised and submitted: November, 12nd, 2012

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Northfield Mental Healthcare center is located on the Northfield, Ohio. The building is a five story mental clinic building, and the project is renovation of three existing buildings and expansion of the existing facilities. Approximately 200,000 square feet would be added to the existing buildings, and the new portions of the buildings would be served as patient wings, administration, gymnasium, and clinic center. The new buildings were designed to provide better quality of building, safety of patients and staff, and aesthetically pleasing environment. The face brick walls were mainly used for the exterior walls, and smooth CMU, texted CMU, and curtain walls were also used to highlight freshness of new design. The building is not yet constructed but still in constructional document phase. The total estimated project cost is approximately $62.5 million, including 10.3 million of HVAC and fire protection equipment cost.

This report contains the analysis of existing mechanical systems on the Northfield Mental Healthcare Center. The purpose of this report is to evaluate the existing mechanical systems by defining design objectives, the outdoor and indoor design conditions, annual energy usage, and overall evaluation of mechanical system. Mechanical equipment summary contains constructions of air handling units, boiler schedule, and chiller schedule. System operation section describes how chilled water and hot water are generated and served to the entire building. Each description contains a schematic drawing of each system.

This report also contains LEED analysis, but since this facility does not aim to be LEED certified, LEED analyses on certain sections are performed. Even if the building is not LEED

certified building, this building utilizes some of the sustainable features such as highly insulated exterior envelope, efficient equipment, programmable temperature controls, occupancy sensors, and so on.

SECTION ONE. PROJECT BACKGROUND

1.1 PROJECT BACKGROUND

The Northfield Mental Healthcare center is located in Northfield, Ohio. The building is a five-story mental clinic building, and the project is a renovation and expansion of three existing buildings. Approximately 200,000 square feet would be added to the existing buildings, and the new portions of the buildings would be for patient wings, an administrative facility, a gym, and a clinic. The new buildings were designed to provide better quality for the structures, deliver to the safety of patients and staff, and to become an aesthetically pleasing environment.

The main goal of the Northfield Mental Healthcare center project is to provide a comfortable and safe environment for both patients and staff members. The main purpose of this project is to establish more spaces for additional patients transferred from the Cleveland healthcare campus, which is going to be closed after the completion of this project. The building is not yet constructed, as it is still in the bidding process. The total estimated project cost is approximately $62.5 million, including $10.3 million for HVAC and fire protection equipment costs.

1.2 EXISTING MECHANICAL SYSTEM SUMMARY

From this section, the existing mechanical system is referred to a newly designed mechanical system for The Northfield Mental Healthcare center expansion and renovation project.

10 different air-handling units are equipped in the Northfield Mental Healthcare Center, including two already existing air handlers. Two 65,000 CFM rooftop air handlers serve the two patient wings. Clinic and administration areas are served by a 7,950 CFM rooftop air handler. A 3,700 CFM indoor air handler and an 8,400 CFM indoor air handler serve the gym area and dietary areas, respectively. The boiler plant, chiller plant, and electrical room are served by the other three indoor air handlers, which have a maximum capacity of 5,000 CFM, 5,000 CFM, and 6,000 CFM, respectively. The existing air handlers serve partially renovated areas and existing administration areas.

Customized air handler 1 and 2 for the two patient wings are equipped with DDC-VAV terminals, which will reset the ventilation rate based on occupancy. The DDC-VAV terminals continuously measure the amount of supply air and ventilation fraction for each space. A building automation system controls the DDC-VAV terminals and outdoor airflow by changing the position of the outdoor air dampers. The control system of a DDC-VAV terminal is described in the Figure 1.

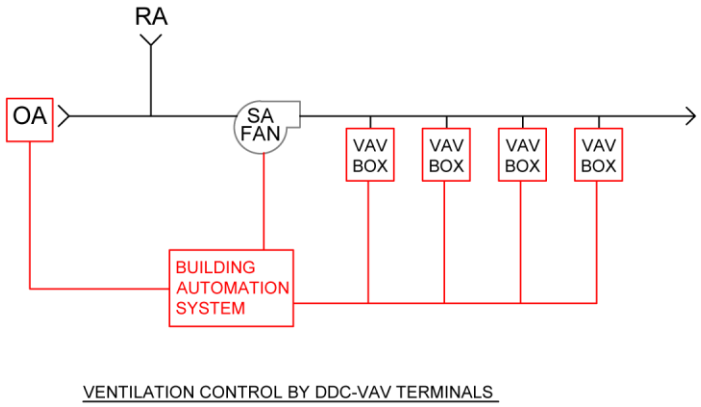

Figure 1: Ventilation Control by DDC-VAV Terminals

Air handler 3, which serves the gym area, is a dedicated outdoor air unit equipped with a sensible wheel. A total energy enthalpy wheel preconditions the outdoor air transferred to the unit. The total enthalpy wheel cools the outdoor air to 80.53 ˚F DB during the cooling season and heats the outdoor air to 51.55 ˚F DB during heating season, before delivering the conditioned outdoor air to the cooling coil and heating coil.

The building use programmable temperature control sensors and occupancy sensors, which reduce equipment load by a significant amount. Since most of the openings in the building are not operative, the amount of the outside air for each air handler is oversized in order to achieve the better indoor air quality. In order to maintain the comfortable temperature, even with the great amount of outside air entering the building, cabinet unit heaters and horizontal unit heaters are additionally placed to efficiently meet the space heating load.

Two 450-ton centrifugal chillers are located in the chiller plant and connected to a 2-cell-cooling tower, which is located outside of the energy center. Each chiller consists of two chilled water pumps: a primary chilled water pump and a secondary chilled water pump. The primary and secondary pumping arrangements help to increase system controllability, while decreasing total power input. It is recommended to use primary and secondary pumping systems for large complexes, all for energy efficiency. The primary chilled water pumps serve chilled water to chillers, while secondary chilled water pumps send chilled water to a cooling coil for each air handling equipment to serve the cooling load of the building.

Six 113.5-horsepower condensing boilers are located in the boiler plant and serve hot water. A primary pump equipped with each boiler sends heated water to the main hot water loop. Two secondary pumps, along with the main hot water loop, send hot water to a heating coil for each air handling equipment to serve the heating load of the building. Makeup water is heated by two domestic water heaters and served to the building. Variable frequency drive devices are used for most of the HVAC equipment, including heating water pumps, chilled water pumps, chillers, and cooling towers. Figure 2 shows the existing heating and cooling system.

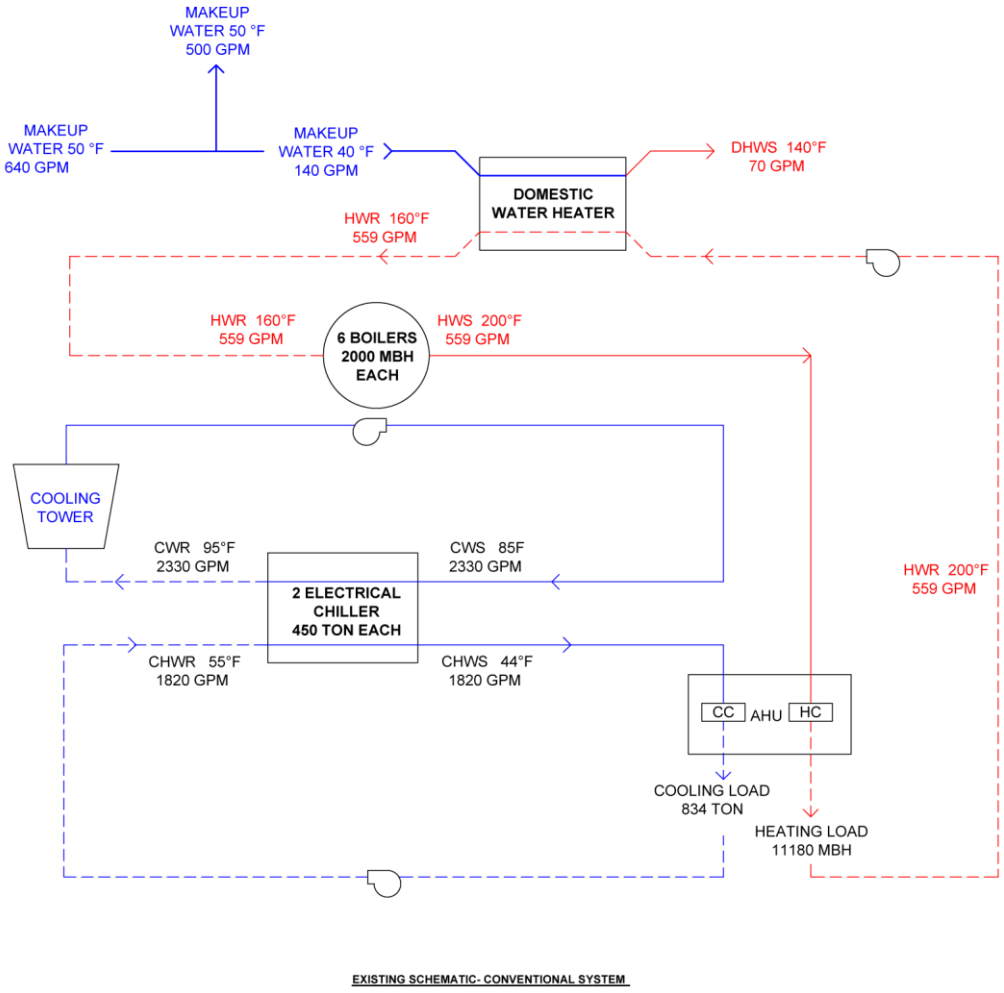

Figure 2: Existing Heating and Cooling System

1.3 DESIGN CRITERIA

The main goal of the Northfield Mental Healthcare center is to provide comfortable and safe environment for both patients and staff members. The main purpose of this project is establishing more spaces for additional patients transferred from Cleveland healthcare campus which is going to be closed after completion of this project. Since some of the mechanical

systems remain the same, the newly designed mechanical systems need to be balanced with the existing one. Ten air handlers will serve the entire building, but two of them are existing one serving partially renovated areas and existing administration areas. Since the total pressure drop over the ductwork finally connected to the existing air handler remain the same, the total pressure drop accumulated through the newly designed ductwork needs to be balanced with that of ductwork which will be demolished.

The total designed energy load consists of cooling, heating loads and dominatingly hospital equipment load. This equipment load can significantly be reduced by using programmable temperature control sensor and occupancy sensors. Since the most of openings in the building are not operative, infiltrations as well as ventilation are one of the major design concerns. The amount of the outside air takes an account of infiltrations, and the amount of the outside air would be defined in accordance of ASHRAE 62.1 and ASHRAE 170. The amount of the outside air was oversized in order to achieve the better indoor air quality. In order to maintain the comfortable temperature even with the great amount of the outside air entering into the building, cabinet unit heaters and horizontal unit heaters were designed to be placed for the winter.

The heating water systems and cooling water systems have primary and secondary distribution systems that are recommended by ASHRAE Standard 90.1. It is recommended to use primary and secondary pumping system for large complexes for energy efficiency. The primary and secondary pumping arrangements help to increase system controllability and decrease total horsepower required. The primary pump serves chillers and boilers, while the secondary pump serves the cooling load and heating load.

1.3.1 DESIGN CONDITION

The Northfield Mental Healthcare Center is located in Northfield, OH. Since the Northfield area is not listed in the ASHRAE Fundamental 2009, Cleveland, the closest big city, was used for the analysis. Table 1 shows the weather data inputs that were used for the analysis.

Cleveland, OH	
Latitude	41.4N
Longitude	81.85W
Elevation	804 FT
Heating DB (99.6%)	2.5 ˚F
Cooling DB (0.4%)	89.4˚F

Table 1: Design Condition

The design temperatures are shown in Table 2. The sequences of temperature control would be achieved by programmable temperature controller. The supply air temperature would be maintained at set point by modulating the economizer control damper and valves' positions. The supply air temperature set point is linearly reset in a range of 5 F, and supply air can be set at a minimum temperature of 55 F. The supply air can be reset higher than 55F in order to maintain the room temperature as 75 F. When room temperature indicates below 70F, the controller would be deactivated. When the mixed air temperature is below 40 F, the outside air damper would be closed and return air damper would be opened.

When the outside air temperature is between 65 F and the supply air temperature set point, the return air damper would be fully closed, the outside air damper would be positioned at the maximum outdoor air economizer position, and the digital panel would

modulate the chilled water valve in order to call for cooling. When the outside air temperature is below than 65 F, the return damper would be fully opened and modulate the chilled water control valve to call for cooling. When the outside air temperature is below than the supply air temperature set point, the chilled water sensor becomes deactivated in order to maintain the supply air temperature set point. When the outside air temperature is below than the supply air temperature, the outside air damper would be positioned at the minimum position and the return damper would be opened. The ASHRAE weather data and design conditions of the project are described in Table 1 and Table 2.

Temperature Set Points	DB Temp (F)
OA	90 F DB, 71 F WB
RA	72 F DB, 50 % RH
SA	55 F DB
MA	Depends on OA %

Table 2: Design Temperature

1.3.2 VENTILATION REQUIREMENTS

The ventilation requirements and calculation on the Northfield Mental Healthcare center were performed and described in the technical report 1. Both the existing conditions and newly designed conditions were considered, since the project is both renovation and expansion. The spaces that are not required for the minimum ventilation were omitted for the ventilation calculation analysis.

The entire building is served by ten different air handlers, but five of them contribute on the occupied spaces, another two contribute on the energy center, and the

other two existing air handlers contribute on the renovated areas. Air handler 1 and 2 are designed to supply 65,000 CFM to each newly designed patient wing with designed outdoor airflow of 20,000 CFM. The minimum outdoor airflow requirement in accordance of the ASHRAE Standard 62.1 was calculated to be 17,500 CFM and 16,500 CFM respectively for the left patient wing and the right patient wing. The designed outdoor airflow values for air handler 1 and 2 are more than the minimum outdoor air requirements, thus they comply with ASHRAE Standard 62.1.

The total outdoor air flow required for the gym, clinic/admin, and dietary areas were calculated to be approximately 72,000 CFM total which is under the designed outdoor airflow of 12,500 CFM total. Since there was a lack of information on the outdoor airflow of the existing air handlers, compliance for the existing air handlers were unknown. Table 3 shows a summary of comparisons between the designed supply and outdoor airflows and the calculated minimum requirements.

Unit	Areas Served	Supply Air (CFM)	Outdoor Airflow (CFM)	Minimum OA (CFM)	Comply (Y/N)
AHU-1	Patient Wing Area 4	65,000	20,000	17,500	Y
AHU-2	Patient Wing Area 5	65,000	20,000	16,500	Y
AHU-3	Gym	3,025	3,700	7,200	Y
AHU-4	Clinic/Admin	7,950	2,450		Y
AHU-5	Dietary	8,400	6,200		Y
EX. AHU	Mckee A/B	70,000	-	5,300	N/A
EX. AHU	Mckee C	14,000	-		N/A
Total		233,375	52,350	46,500	

Table 3: Summary of Ventilation Calculations

Most of the ventilation loads and their equipment were oversized for the safety and better efficiencies. Oversized outdoor airflow provides better indoor air quality for the

building. The detailed calculations on the required outdoor airflows are attached to the Appendix A.

1.3.3 MECHANICAL EQUIPMENT SUMMARY

Except for the air handler 3, all the air handlers used for the newly designed spaces are outdoor roof top units consisting of VFD return fan, 30 % economizer, pre-filters, after-filter, heating water preheat coil, chilled water coil, supply fan, and sound attenuator. The air handler 1 and 2 serve the left patient wing and the right patient wing respectively. The air handler 3 has the same unit construction but is an indoor air handling unit located in Gymnasium area with 100% of heat recovery system. The air handler 4 and 5 serve admin/clinic area and dietary area respectively. The air handler 6, 7, and 8 are indoor units and are located in the energy center.

Most of the air handlers used for the building are variable air volume models except for the air handler 1 and 2 which are custom model and the air handler 3 which is constant volume model. The entering air temperatures and leaving air temperatures of cooling and heating of each air handler are listed in Table 4. Internal supply fans used for each air handler are described in Table 5.

AHU Schedule	Service	Supply CFM	Cooling		Heating	
			EAT (F)	LAT (F)	EAT (F)	LAT (F)
AHU-1	Left Patient Wing	32,500	80.4	55.0	0	60.0
AHU-2	Right Patient Wing	32,500	80.4	55.0	0	60.0
AHU-3	Gymnasium	3,700	80.53	50.0	0	90.0
AHU-4	Admin/Clinic	7,950	80.1	50.0	0	60.0
AHU-5	Dietary	8,400	80.4	50.0	0	60.0
AHU-6	Boiler Plant	5,000	-	-	0	90.0
AHU-7	Chiller Plant	6,000	83.0	52.0	0	90.0
AHU-8	Chiller Plant	6,000	80.3	52.0	0	90.0
EX. AHU 1	Mckee A/B	-	-	-	-	-
EX. AHU 2	Mckee C	-	-	-	-	-

Table 4: Air Handling Unit Cooling and Heating Schedule

AHU Supply Fan Schedule	Service	Supply CFM	Min. OA CFM	HP	No. Fans	RPM
AHU-1	Left Patient Wing	32,500	20,000	75	2	1,800
AHU-2	Right Patient Wing	32,500	20,000	75	2	1,800
AHU-3	Gymnasium	3,700	3,700	10	1	3,342
AHU-4	Admin/Clinic	7,950	2,450	25	1	1,800
AHU-5	Dietary	8,400	6,200	20	1	2,098
AHU-6	Boiler Plant	5,000	5,000	10	1	1,800
AHU-7	Chiller Plant	6,000	5,000	15	1	2,339
AHU-8	Chiller Plant	6,000	6,000	15	1	2,065
AHU-EXT 1	Mckee A/B	-	-	-	-	-
AHU-EXT 2	Mckee C	-	-	-	-	-

Table 5: Air Handling Unit Supply Fan Schedule

There are five major types of exhaust fans used for this project: patient room exhaust, general exhaust, emergency exhaust, boiler room exhaust, and kitchen exhaust hood. The general exhaust fans run continuously, and exhaust dampers are controlled by the digital control panels. Expansion modules are required for those digital control panels. Two EF-1 and one EF-2 are located on the roof of each patient wing. EF-3 is used for gym area and admin/ clinic area, and EX-4 is located on the roof above the trash holding area. EF-5, 6, and 7 are located above kitchen hood on the roof; Kitchen exhaust hood is directly ducted through roof structure and will not be recirculated.

Return and Exhaust Fan Schedule	Service	CFM	ESP (in wg)	MHP
EF-1A	Patient Room Exhuast	2,200	1.5	3
EF-1B	Patient Room Exhuast	2,200	1.5	3
EF-1C	General Exhuast	1,300	1.5	1-1/2
EF-2A	Patient Room Exhuast	2,200	1.5	3
EF-2B	Patient Room Exhuast	2,200	1.5	3
EF-2C	General Exhuast	1,300	1.5	1-1/2
EF-3	General Exhuast	600	0.75	1/2
EF-4A	General Exhuast	400	0.75	1/3
EF-4B	General Exhuast	300	0.75	1/4
EF-5	General Exhuast	2,000	1.5	2
EF-6A	Emergency Exhuast	3,000	1	3
EF-6B	Emergency Exhuast	3,000	1	3
EF-7	Boiler Room Exhaust	5,000	1	5
KEF-1	Kitchen Hood	3,000	0.75	1-1/2
KEF-2	Kitchen Hood	2,700	0.75	1-1/2
KEF-3	Kitchen Hood	500	0.75	1/4

Table 6: Return and Exhaust Fan Schedule

Chilled water is generated from the cooling tower and transferred to two chillers located in the energy center. The flow rate of the chilled water is controlled by DDC controller which measures the supply and return temperature as well as differential pressure transmissions across the chilled water pumps. The chilled water is then circulated to air handling units and distributed to the entire building. Hot water is generated from the six boilers located in the energy center. The boilers provide heating, preheating, and reheating water. Heating water return temperature is controlled by DDC controller, and the hot water is served by six primary heating water pumps and two secondary heating water pumps; the primary heating water pumps serve boilers and the secondary heating water pump serve the heating load. The boiler schedule, chiller schedule, and pump schedule are described in Table 7, Table 8, and Table 9 respectively.

Boiler Schedule	Type / Fuel	HP	MBH IN	MBH OUT	Max Pressure (psig)
B-1	Condensing / Natural gas	113.5	4,000	3,800	125
B-2	Condensing / Natural gas	113.5	4,000	3,800	125
B-3	Condensing / Natural gas	113.5	4,000	3,800	125
B-4	Condensing / Natural gas	113.5	4,000	3,800	125
B-5	Condensing / Natural gas	113.5	4,000	3,800	125
B-6	Condensing / Natural gas	113.5	4,000	3,800	125

Table 7: Boiler Schedule

ChillerSchedule	Type	Tons output	Evaporator GPM	Condenser GPM
CH-1	Centrifugal	450	1,075	1,350
CH-2	Centrifugal	450	1,075	1,350

Table 8: Chiller Schedule

Pump Schedule	Service	GPM	Head (ft wg)	MHP
P-HWP-1	Heating Water	190	10	2
P-HWP-2	Heating Water	190	10	2
P-HWP-3	Heating Water	190	10	2
P-HWP-4	Heating Water	190	10	2
P-HWP-5	Heating Water	190	10	2
P-HWP-6	Heating Water	190	10	2
S-HWP-1	Heating Water	1,900	75	60
S-HWP-2	Heating Water	1,900	75	60
TWP-1	Tower Water	2,700	23	40
TWP-2	Tower Water	2,700	23	40
P-CWP-1	Chilled Water	1,750	24	25
P-CWP-2	Chilled Water	1,750	24	25
S-HWP-1	Chilled Water	1,600	90	50
S-HWP-2	Chilled Water	1,600	90	50

Table 9: Pump Schedule

1.3.4 MECHANICAL FIRST COSTS

Table 10 shows breakdown of first costs for HVAC systems, fire protection equipment, and plumbing equipment according to a report produced by the contractor. The costs include the costs of equipment, installation, material used for the equipment, and miscellaneous. The total estimated cost is approximately $16,180,000 with a cost per square foot of $81.00 / SF. The detailed cost breakdown is described in Appendix B.

Equipment First Cost	Amount
HVAC	
Equipment	3,677,150
Pipe, Valves, Fittings, & Insulation	2,170,750
Sheet Metal	4,391,200
Miscellaneous	15,000
Fire Protection	
Equipment	985,649
Plumbing	
Equipment	115,100
Patient Room Fixtures with chase piping	1,598,133
Fixtures with chase piping	212,500
Rain water storm / collection system	252,984
Sanitary system	1,276,458
Domestic Water	1,330,000
Gas Distribution	89,250
Commercial Kitchen	65,000
Total	**16,179,174**

Table 10: First Cost Summary

1.3.5 LOST USABLE SPACE

Table 11 shows breakdown of unusable spaces. Common areas for unusable spaces are mechanical rooms and electrical rooms. Existing building portions were also taken an

account for this analysis. The big mechanical room located on the basement of existing building takes a majority of unusable space for the entire building.

	Unusable Area (SF)
Patient Wing Area 4	986
Patient Wing Area 5	986
Gym	365
Clinic/Admin	854
Dietary	871
Mckee A/B	652
Mckee C	9,351
Total	14,065

Table 11: Lost Usable Space

1.4 SYSTEM OPERATION

1.4.1 AIR SIDE OPERATION

As mentioned above, five air handlers and two existing air handlers supply the building with heating, ventilation and air conditioning, and the other three air handlers supply the energy center. Air handler 1 and 2 produce almost 10 times greater supply air than the other air handlers and supply air to both patient wings. Each air handling unit is equipped with a VFD return fan, a 30 % economizer, a pre-filter, after-filter, a preheat coil, a chilled water coil, a supply fan, and a sound attenuator in a sequence. Variable frequency drives are equipped for both supply fan and return fan installed inside of air handling units. Figure 3 is the air handling unit control diagram.

The supply airflow and air temperatures are controlled by modulating various damper positions and the variable frequency drives depending on the measured supply air

temperature at the highlighted sensors. Cooling operation is called when the outside air temperature sensed by the BAS is between 65 F and the supply air temperature set point by modulating the return dampers as fully closed and the relief damper as fully opened. Heating operation is called when the outside air temperature is below the supply air temperature set point by modulating outdoor air damper and relief air damper to be at the minimum position. The return fans are operating when supply fans are operating. When the supply fans stop operating, the return fans automatically stop operating as well. If a supply fan or a return fan fails to be operated, the system will generate alarm.

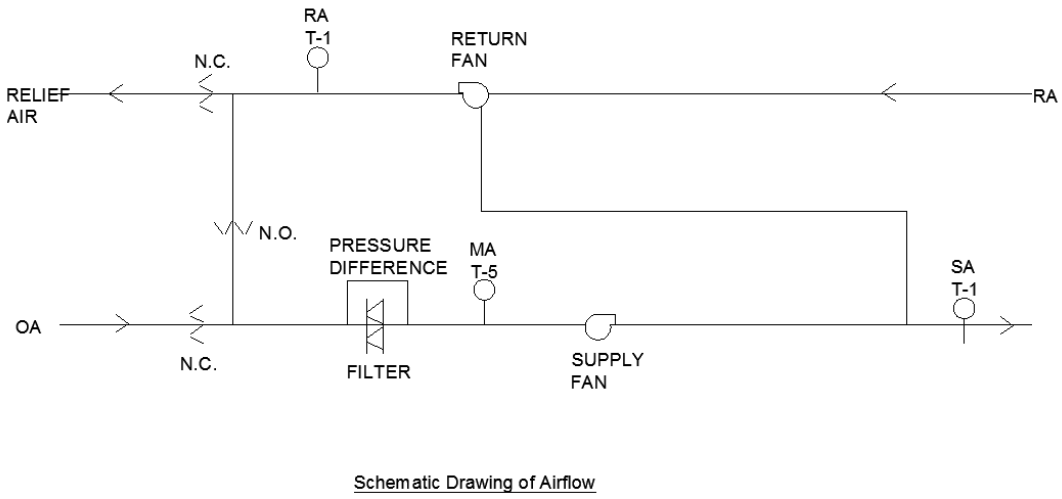

Figure 3: Schematic Drawing of Airflow

1.4.2 WATER SIDE OPERATIONS

Chilled water is generated and served from the cooling towers to chillers through tower pumps. A three way modulating valve equipped inside of the tower controls the water flow rate through the chillers. DDC controller is used for controlling operations of the

chillers. DDC controller determines the cooling load by measuring the supply and return temperatures and differential pressure transmissions across the chilled water pumps. The chilled water is also distributed to the air handling units through cooling coils. When the outdoor air temperature is below than a certain point, for example 45 F, the chiller water system will be inactivated until the outdoor air temperature rises above 50 F. Figure 4 shows the chilled water flow diagram.

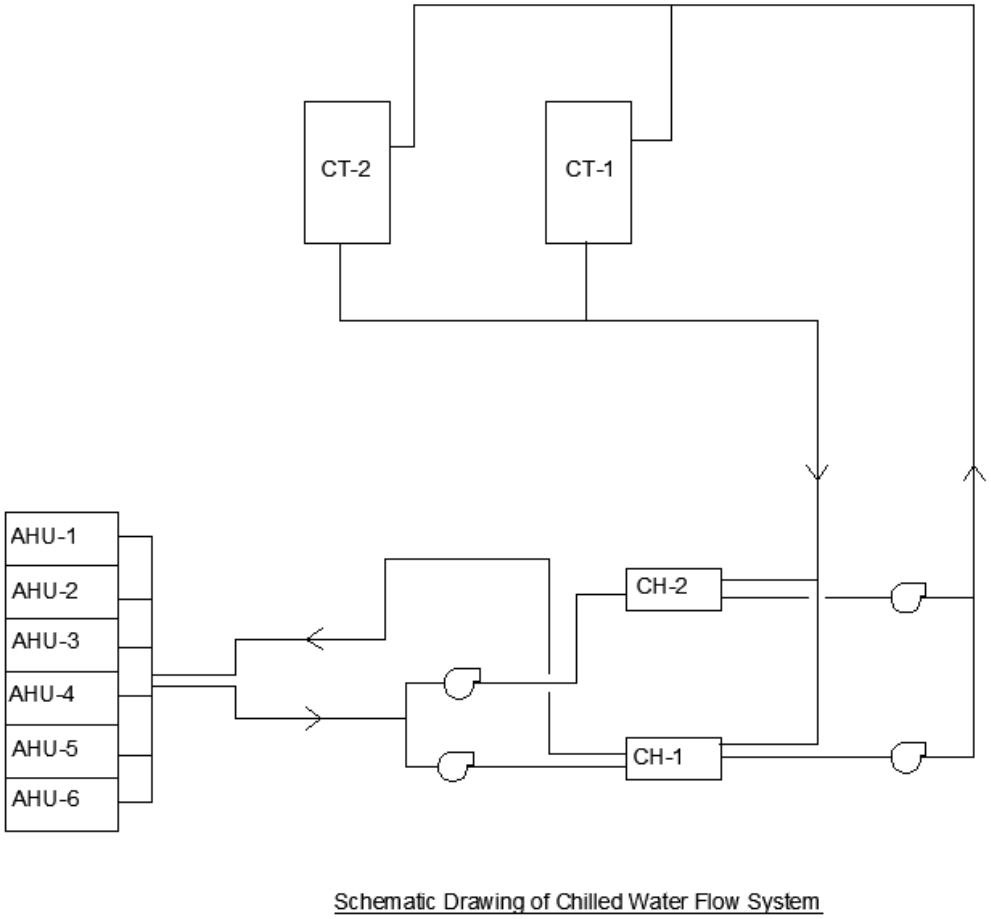

Figure 4: Chilled Water Flow Diagram

The hot water is generated from six boilers which are located in the energy center. The hot water flow rate is controlled by the DDC controller. The boilers provide heating, preheating and reheating water. DDC controller connected to each boiler monitors the heating water return temperature and alarms if the temperature difference between the supply and the return water exceed a certain point. With a capacity of 113.5 HP, each boiler uses natural gas as a fuel and has gas fired burner. Water is delivered through vertical inline pumps with capacity of 190 GPM to each boiler. There are total six primary heating water pumps and two secondary heating water pumps; the primary heating water pumps serve boilers and the secondary heating water pump serve the heating load. Figure 5 shows the heating water flow diagram.

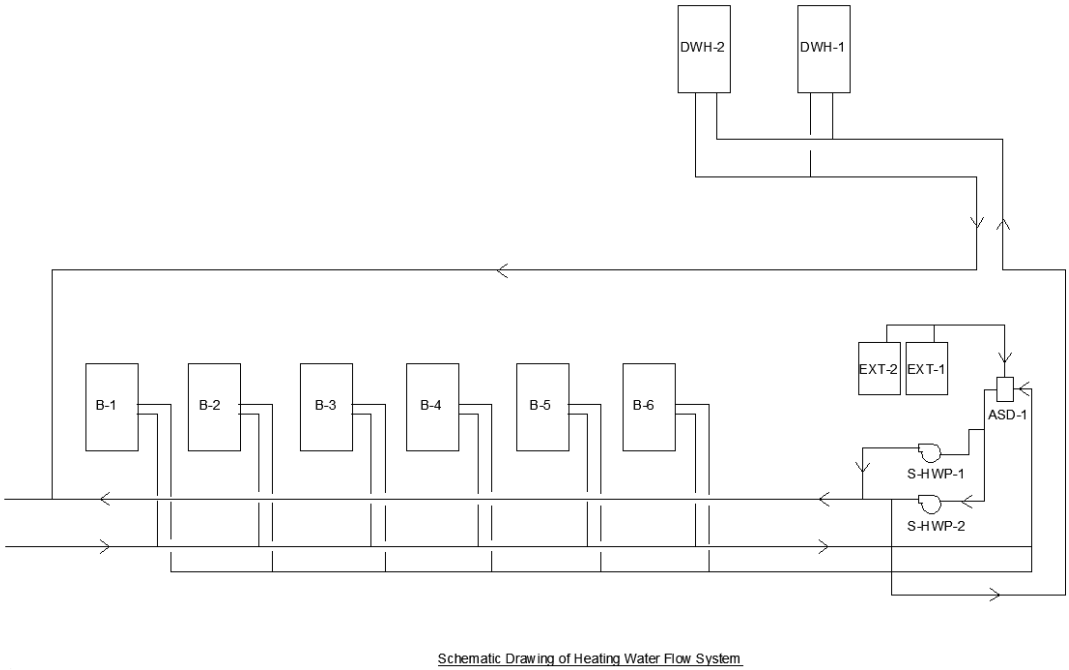

Figure 5: Heating Water Flow Diagram

1.4.2 MODEL DESIGN

Each of the 1130 rooms was input into the TRACE model. Each room was designated with different internal loads and airflow assumptions, depending upon the primary space use and occupancy. Restrooms and small storages were neglected. All the exterior walls, windows, as well as doors with their orientations, were input in order to calculate envelope loads for each space. Lighting and electrical load, occupancy and airflow assumptions, as well as construction for the building envelope, are described in the following sections. All of the input rooms were then assigned to 20 different zones, all of which have their own temperature controls. Multiple zones, served by an air-handling unit, were bounded together and assigned to a system. Figure 6 shows how the zones are assigned to a system.

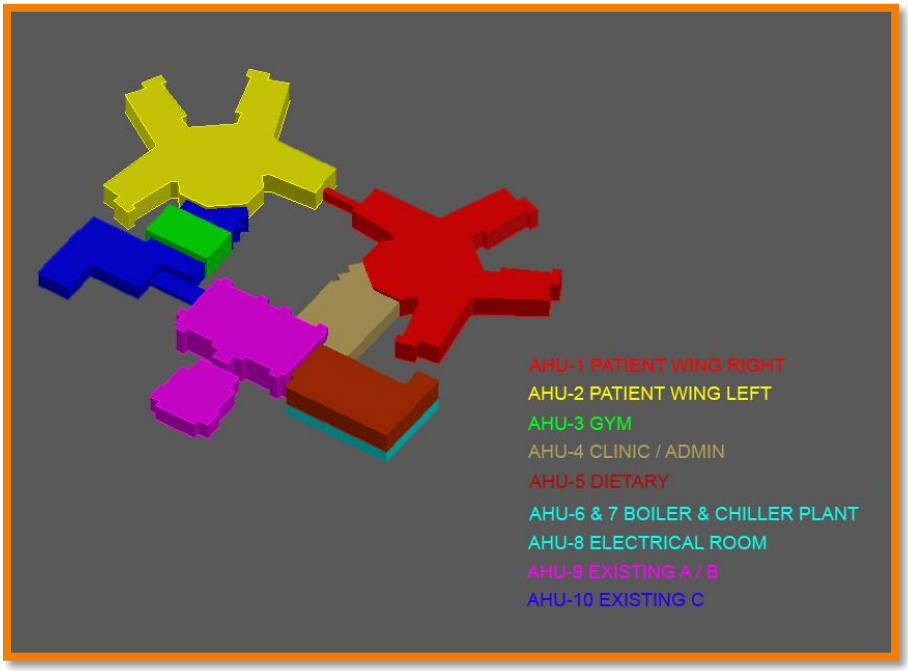

Figure 6: TRACE Energy Model Zoning

1.4.3 LIGHTING AND EQUIPMENT ELECTRICAL LOAD ASSUMPTIONS

24 different templates were created for each of the various space types, which all have assumed lighting and miscellaneous equipment power density values. The assumptions on lighting power density were taken from ASHRAE Standard 90.1-2007. The assumptions on miscellaneous equipment power density are based on nameplate ratings from electrical equipment. Table 12 shows a summary of lighting and electrical load assumptions.

Space Type	LPD (W/SF)	Miscellaneous Loads (W)
Conference Room	1.23	300
Corridor	0.89	0
Exam Room	1.66	150
Gym	0.72	0
Kitchen	0.99	5 W/SF
Lobby	0.9	0
Locker Room	0.75	0
Lounge	1.07	350
Nurse Station	0.87	350
Office	1.11	350
Patient Room	0.62	150
Storage	0.63	0

Table 12: Lighting and Electrical Load Assumptions

1.4.4 OCCUPANCY ASSUMPTIONS

The number of occupants, per square feet, is assumed based on Table 6-1 of ASHRAE 62.1- 2007. The occupancy densities that were not listed in Table 6-1 were estimated based on the number of furniture shown in architectural plans. Table 13 shows the occupancy assumptions used for the TRACE model.

Space Type	Occupancy Density (#/1000SF)	(SF/#)
Conference Room	50	20
Corridor	0	0
Exam Room	25	2 people
Gym	30	33
Kitchen	20	50
Lobby	30	33
Locker Room		6 people
Lounge	25	40
Nurse Station	30	3 people
Office	5	200
Patient Room	10	100
Storage	0	0

Table 13: Occupancy Assumptions

1.4.5 AIRFLOW ASSUMPTIONS

The minimum ventilation rates, for each space type, were obtained from ASHRAE Standard 62.1. The amount of infiltration for hospital spaces were obtained from ASHHRAE Standard 170. The minimum ventilation rate based on the number of people, the minimum ventilation rate based on square feet, and infiltration values are listed on Table 14.

Space Type	Minimum Ventilation Rates (CFM/#)	Minimum Ventilation Rates (CFM/SF)	Infiltration (ACH)
Conference Room	5	0.06	0.6
Corridor	2 CFM	2 CFM	0.6
Exam Room	2 CFM	2 CFM	0.3
Gym	0	0.3	0.6
Kitchen	7.5	0.12	0.6
Lobby	5	0.06	0.6
Locker Room	4 CFM	4 CFM	0.6
Lounge	5	0.06	0.6
Nurse Station	2 CFM	2 CFM	0.6
Office	5	0.06	0.6
Patient Room	25	0.25	0.3
Storage	0	0.12	0.6

Table 14: Airflow Assumptions

1.4.6 CONSTRUCTION OF BUILDING ENVELOPE

The Northfield Mental Healthcare Center is designed with four different wall types and one roof type. However, only one type of wall, roof, and window was used for the analysis, for simplification. U-values for the wall, roof, and window were taken from construction documents and are listed on Table 15, Table 16, and Table 17.

Walls	R-value	Thicknes (ft)	Conductivity
Surface Air Film (Vertical)	0.680	-	-
Common 4" Brick	0.799	0.333	0.4167
Air Layer 3/4" to 4" (Vertical)	0.980	-	-
2" Insulation	6.680	0.167	0.025
1/2" Gypsum or Plaster Board	0.454	0.042	0.0926
Mineral Wool/Fiber, Batt, R-21	22.611	0.511	0.0226
5/8" Gypsum or Plaster Board	0.562	0.052	0.0926
Overall R-Value	32.765		
Overall U-Value	**0.031**		

Table 15: Exterior Wall Construction

Roof	R-value
Outside Film	0.250
3 1/2" Polyiso Rigid	21.700
1" Spray Fire Proof	1.500
Inside Film	0.680
Overall R-Value	24.130
Overall U-Value	**0.041**

Table 16: Roof Construction

Windows	
Overall U-Value	**0.280**
SHGC	0.440
Shading Coefficient	0.505

Table 17: Window Construction

1.4.7 DESIGNED TEMPERATURE CONTROL

A programmable temperature controller attains the temperature for supply air, to a space. Table 2 shows designed temperature set points for each air handler. The supply air temperature would be maintained, at a set point, by modulating the economizer control damper and valve positions. The supply air temperature set point is linearly reset in a range of 5 ˚F, as supply air can be set at a minimum temperature of 55 ˚F. When room temperature indicates below 70 ˚F, the controller would be deactivated. When the mixed air temperature hits below 40 ˚F, the outside air damper would be closed and the return air damper would be opened.

When the outside air temperature is between 65 ˚F and the supply air temperature set point, the return air damper would be fully closed. Additionally, the outside air damper would be positioned at the maximum outdoor air economizer position, and the digital

panel would modulate the chilled water valve in order to call for cooling. When the outside air temperature is below 65 ˚F, the return damper would fully open and modulate the chilled water control valve to call for cooling.

When the outside air temperature is below the supply air temperature set point, the chilled water sensor would deactivate in order to maintain the supply air temperature set point. When the outside air temperature is lower than the supply air temperature, the outside air damper would be positioned at the minimum position and the return damper would be opened.

1.5 ENERGY MODELING - OUTPUT

1.4.1 COOLING, HEATING, AND VENTILATION LOAD

Load calculations of the Northfield Mental Healthcare Center, calculated by the engineer of the project, were performed by utilizing the CHVAC program. The CHVAC energy model created by the engineer might use different assumptions for lighting and electrical load, occupancy, and airflow, as well as different methods to separate rooms into zones. Also, the outputs of the CHVAC energy model was re-evaluated by using their own excel program to balance with the minimum outdoor airflow required for the hospital, as well as to take account of the reheating process. The summary of load calculations, provided by the engineer of the project and the output of the TRACE model, is described in

Table 18.

ZONES		Design			TRACE		
		Cooling (Btu/hr)	Heating (Btu/hr)	Ventilation (CFM)	Cooling (Btu/hr)	Heating (Btu/hr)	Ventilation (CFM)
AHU-1	Patient Wing (Right)	2,871,500	2,128,464	65,000	2,565,694	3,565,409	57,377
AHU-2	Patient Wing (Left)	2,871,500	2,128,464	65,000	2,601,886	3,631,777	59,361
AHU-3	Gym	172,620	131,690	3,025	122,473	103,633	2,832
AHU-4	clinic/admin	338,530	250,150	7,950	367,611	461,731	9,314
AHU-5	Dietary	320,450	236,510	7,350	386,454	476,020	9,430
AHU 6	boiler plant	-	488,020	-	-	93,002	-
AHU 7	Chiller plant	-	488,020	-			
AHU 8	Electrical Room	262,710	224,920	-	274,841	105,323	-
AHU-9	Existing A/B	2,900,000	1,250,000	70,000	3,027,007	2,119,661	64,056
AHU-10	Existing C	600,000	750,000	14,000	656,227	623,479	13,044
Reheat		-	4,230,000	-	-	-	
Total		10,337,310	12,306,238	232,325	10,002,193	11,180,035	215,414
Tons		**861**			**834**		
MBH			**12,306**			**11,180**	

Table 18: Design Load Values VS. Calculated Load Values

The cooling load, heating load, and ventilation load, calculated by the engineer, seem to be larger than the output of the TRACE model. The comparison of loads, by zones, is unnecessary because zones are divided in a different manner. The difference between the engineer's design values and the TRACE output values is within 10 percent. The major difference can be found in the heating load. A possible reason, for the cause of the difference, is that the reheating process was considered in the CHVAC model. The cooling load and heating load outputs of the TRACE model are 834 tons and 11,180 MBH, respectively. These outputs will be used for mechanical alternatives' analyses. Table 19 contains a summary of load comparisons and differences in loads between the CHVAC model and TRACE model.

	Cooling (Btu/hr)	Heating (Btu/hr)	Ventilation (CFM)
Design	10,337,310	12,306,238	232,325
TRACE	10,002,193	11,180,035	215,414
Difference	335,117	1,126,203	16,911
Difference (%)	3.2	9.2	7.3
	(Underestimated)	(Underestimated)	(Underestimated)

Table 19: Cooling Load, Heating Load, and Ventilation Load Summary

1.4.2 DOMESTIC HOT AND COLD WATER LOAD

The need of domestic cold water and hot water for plumbing fixtures was also estimated by counting plumbing fixtures, which are located in the building. Table 20 shows calculations on the amount of domestic hot and cold water needed. Since all the plumbing fixtures do not run for whole time, the domestic hot water demand was estimated to be 25% of the total hot water needed for plumbing fixtures. The temperature of makeup water entering the domestic water heater was assumed to be at 40˚F, and the temperature of hot water leaving the domestic water heater was assumed to be at 140 ˚F. Based on these assumptions, the total energy consumption for producing domestic hot water was calculated and summarized on Table 21.

FIXTURE TYPE	COUNT	HW FIXTURE UNIT	HW (GPH)	CW FIXTURE UNIT	CW (WSFU)
Water Closet	284	-	-	10	2,840
Urinal	4	-	-	5	20
Lavatory	304	8	2,432	2	456
SINK	87	10	870	2	131
Mop Basin	15	15	225	3	38
Shower	234	20	4,680	2	468
Washing Machine	14	8	112	3	42
TOTALS			8,319		3,994
		TOTAL HW NEED (GPM)	139	TOTAL CW NEED (GPM)	3,994

Table 20: Domestic Water Needs Calculation

Domestic Hot Water: Energy Consumption	
EWT (F)	40
LWT (F)	140
DELTA T (F)	100
HW DEMAND (GPH) -25%	2,080
INPUT RATE (BTUH)	2,165,540
OUTPUT RATE (BTUH)	1,732,432
GAS DEMAND (CFH)	2,165.54
HW STORAGE TANK (GAL)	1,248

Table 21: Domestic Hot water Energy Consumption

1.6 ENERGY CONSUMPTION

The total energy consumption was calculated based on the outputs of the TRACE model. Since the energy consumption rates of mechanical equipment were estimated, based on the general consumption rate specified either on product catalogs or specifications, the actual energy consumption of the mechanical equipment can differ from the estimated total energy consumption given by the TRACE model. Table 22 contains a summary of total annual electricity and gas consumption.

Summary of Load Calculation and Energy Consumption Calculation	
Total SF (SF)	260,000
Cooling (TONS)	834
Space Heating (MBH)	11,180
Chilled Water (GPM) @11F Difference	1,820
Hot Water (GPM) @ 40F Difference	559
Domestic Hot Water (GPM)	139
Total Energy Consumption (KWh)	32,779,802
Total Electricity Consumption (KWh)	14,127,906
Total Natural Gas Consumption (Therms / yr)	636,589

Table 22: Summary of Load Calculation and Energy Consumption Calculation

Energy Usage Breakdown of the TRACE model is described on Table 23. Space cooling requires almost 33% of the total electricity consumption, and space heating requires almost 85% of the total gas consumption. Figure 7 and Figure 8 show electricity consumption breakdowns and natural gas consumption breakdowns, respectively. Multiple ways to reduce energy consumption breakdowns used for the space cooling and heating will be studied in the section two of this report.

Energy Usage Breakdown									
Electricity (%)							Gas (%)		
Heating	Cooling	Lighting	Equipment	Fans	Pumps	Other	Heating	Equipment	Water System
0	33	10	14	27	5	10	85	13	3
100							100		

Table 23: Energy Usage Breakdown

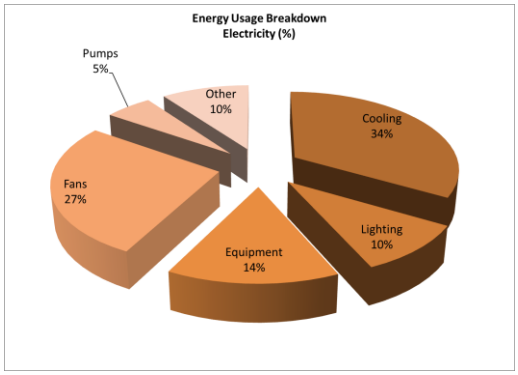

Figure 7: Electricity Usage Breakdown

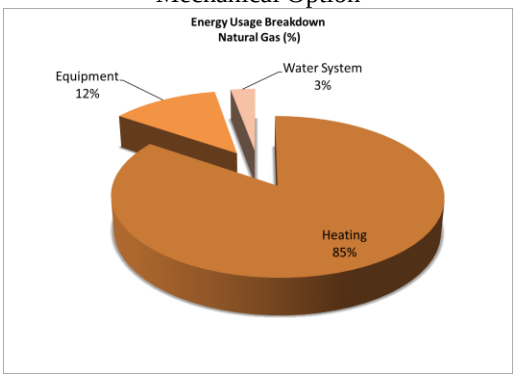

Figure 8: Natural Gas Usage Breakdown

Based on the estimated energy consumption, energy use index was calculated and summarized on Table 24. The EUI values are calculated based on energy consumption with a full load performance. Table 25 describes the typical EUI values of the hospital model, with base load performance, in climate Zone 5A. If a demand factor is applied for the TRACE model, the EUI value will be calculated much closer to the typical EUI value of the hospital model with baseline performance.

EUI Value Calculated		
Electricity EUI	185	kBtu/SF
Natural Gas EUI	250	kBtu/SF
EUI	435	kBtu/SF

Table 24: Calculated EUI Values

EUI Value of Typical Hospital (Baseline Model)		
EUI	388	kBtu/SF

Table 25: EUI Value of Typical Hospital

1.7 EMISSION

Emissions from the energy usage were calculated using emission factors from the Regional Grid Emissions Factors 2007 file. Table 26 shows the mass of each pollutant produced by electricity usage for this building.

	Emission for Delivered Electricity		Precombustion Emission for Delivered Natural Gas		On-Site Combustion Emission for Boiler		Total
	Factor	Mass of Pollutant	Factor	Mass of Pollutant	Factor	Mass of Pollutant	
Pollutant	lb/ kWh	lb	lb/ ft^3	lb	lb/ ft^3	lb	lb
CO2e	1.74E+00	9.46E+07	2.78E+01	2.64E+07	1.23E+02	1.17E+08	2.38E+08
CO2	1.64E+00	8.92E+07	1.16E+01	1.10E+07	1.22E+02	1.16E+08	2.16E+08
CH4	3.59E-03	1.95E+05	7.04E-01	6.69E+05	2.50E-03	2.38E+03	8.67E+05
N2O	3.87E-05	2.10E+03	2.35E-04	2.23E+02	2.50E-03	2.38E+03	4.70E+03
NOx	3.00E-03	1.63E+05	1.64E-02	1.56E+04	1.11E-01	1.05E+05	2.84E+05
SOx	8.57E-03	4.66E+05	1.22E+00	1.16E+06	6.32E-04	6.01E+02	1.63E+06
CO	8.54E-04	4.64E+04	1.36E-02	1.29E+04	9.33E-02	8.87E+04	1.48E+05
TNMOC	7.26E-05	3.95E+03	4.56E-05	4.33E+01	6.13E-03	5.82E+03	9.82E+03
Lead	1.39E-07	7.56E+00	2.41E-07	2.29E-01	5.00E-07	4.75E-01	8.26E+00
Mercury	3.36E-08	1.83E+00	5.51E-08	5.24E-02	2.60E-07	2.47E-01	2.13E+00
PM10	9.26E-05	5.04E+03	8.17E-04	7.76E+02	8.40E-03	7.98E+03	1.38E+04
Solid Waste	2.05E-01	1.11E+07	1.60E+00	1.52E+06	0.00E+00	0.00E+00	1.27E+07

Table 26: Emission Calculation

1.8 LEED ANALYSIS

The Northfield Mental Healthcare Center did not aim for a LEED certification. The building, however, utilizes some of the sustainable features, such as a highly insulated exterior envelope, efficient equipment, programmable temperature controllers, and occupancy sensors. Even if this facility was not designed to be LEED certified, a simple LEED analysis was conducted for this report for future reference. This analysis would be

helpful to see how many more LEED points are required in order for the building to be LEED certified, if this building will attempt to become a LEED certified building in the future.

The LEED 2009 rating system for New Construction and Major Renovations was used for this analysis. In order to obtain the LEED basic, at least 40 points are required. Since there was insufficient information about the building systems, several points were analyzed ambiguously.

1.8.1 ENERGY AND ATMOSPHERE

EA Prerequisite 1: Fundamental Commissioning of Building Energy Systems (Required)

Intent: To verify that the project's energy-related systems are installed and calibrated to perform according to the owner's project requirements, the basis of design, and construction documents.

Commissioning process activities must be completed by the project team in order to achieve this point. The Northfield Mental Healthcare Center is not constructed yet, so this point would be a pending point.

EA Prerequisite 2: Minimum Energy Performance (Required)

Intent: To establish the minimum level of energy efficiency for the proposed building and systems, in order to reduce environmental and economic impacts associated with excessive energy use.

The Northfield Mental Healthcare Center complies with the mandatory provisions in ASHRAE 90.1.

EA Prerequisite 3: Fundamental Refrigerant Management (Required)

Intent: To reduce stratospheric ozone depletion.

Chlorofluorocarbon (CFC) is not used for any of the HVAC systems at the Northfield Mental Healthcare Center.

EA Credit 1: Optimize Energy Performance (2 Points)

Intent: To achieve increasing levels of energy performance beyond the prerequisite standard, in order to reduce environmental and economic impacts associated with excessive energy use.

Based on the energy consumption performed by the engineer, it can be assumed that 14% of energy reduction is achievable and eligible to obtain 2 points.

1.8.2 INDOOR ENVIRONMENTAL QUALITY

IE Q Prerequisite 1: Minimum Indoor Air Quality Performance (Required)

Intent: To establish minimum indoor air quality (IAQ) performance to enhance indoor air quality in buildings, thus contributing to the comfort and well-being of the occupants.

Mechanical ventilation systems for the Northfield Mental Healthcare Center were designed using the ventilation rate procedure.

IE Q Prerequisite 2: Environmental Tobacco Smoke (ET S) Control (Required)

Intent: To prevent or minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems from environmental tobacco smoke (ETS).

The Northfield Mental Healthcare Center prohibits smoking in the building and prohibits on-property smoking within 25 feet of entries.

IE Q Credit 2: Increased Ventilation (1 Point)

Intent: To provide additional outdoor air ventilation in order to improve indoor air quality (IAQ) and promote occupant comfort, well-being, and productivity.

The Northfield Mental Healthcare Center mostly deals with mechanically ventilated spaces, and outdoor air ventilation rates for breathing zones were increased by at least 30% above the minimum rates required by ASHRAE Standard 62.1-2007.

IE Q Credit 5: Indoor Chemical and Pollutant Source Control (1 Point)

Intent: To minimize exposure to potentially hazardous particulates and chemical pollutants.

The air-handling units used in the Northfield Mental Healthcare Center consist of pre-filters and final-filters, with a minimum of MERV 13. The hazardous areas that use hazardous gases or chemicals are sufficiently exhausted.

IE Q Credit 6.2: Controllability of Systems—Thermal Comfort (1 Point)

Intent: To provide a profusion of thermal comfort systems that can be controlled by individual occupants or groups in multi-occupant spaces (e.g., classrooms or conference areas) and to promote their productivity, comfort, and well-being.

The Northfield Mental Healthcare Center provides comfort system controls for all shared multi-occupant spaces in order to achieve individual occupants or groups' thermal comforts.

IE Q Credit 7.1: Thermal Comfort—Design (1 Point)

Intent: To provide a comfortable thermal environment that promotes occupant productivity and well-being.

The Northfield Mental Healthcare Center is equipped with a BAS, which monitors thermal conditions, inclusive of temperature and air speeds.

1.9 OVERALL EVALUATION SUMMARY

The mechanical systems of the Northfield Mental Healthcare Center comply with the mandatory provisions in ASHRAE Standards, but the maximum efficiencies of the systems were not achieved due to project budget issues. Some of the energy efficiencies were achieved by equipping programmable temperature controllers, occupancy sensors, BAS controllers, and variable frequency-derive controllers.

Increasing outdoor air intake for mechanical ventilation and equipping pre-filters and final-filters inside of each air-handling unit accomplishes indoor air quality for the Northfield Mental Healthcare Center. Even if routine maintenance is required for those filters and results in higher maintenance costs, those installed filters result in longer equipment life. VAV systems will also enhance the higher indoor air quality of the building; varying the supply air volume will reduce the building energy usage by reducing work done by fans, but it will still increase indoor air quality by producing a very little margin of error from desired temperatures. In addition, VAV systems enable the individually controlled zones to have their own thermostats, which can control their thermal comfort by adjusting the controller.

The cooling and heating loads are also efficiently served by using condensing boilers and electric centrifugal chillers. Also, VFD, installed in pumps and fans, saves energy by controlling their outputs based on the needs of occupants. However, adapting more efficient heating and cooling systems or on-site energy generation systems can reduce high annual total energy consumption.

The approximate construction cost is $62.5 million for the entire project and $312.5 /SF. According to the commercial real estate specialists' online resources, this cost lies in

the mid-high region of the range. Figure 9 shows the construction cost per square foot, for a 4 to 8 story hospital. The first cost, including the costs of equipment, installation, material used for the equipment, and miscellaneous, was calculated to be $81.00 / SF. The first cost of the HVAC equipment, fire protection equipment, and plumbing equipment seems to be average when compared to hospital projects of a similar size.

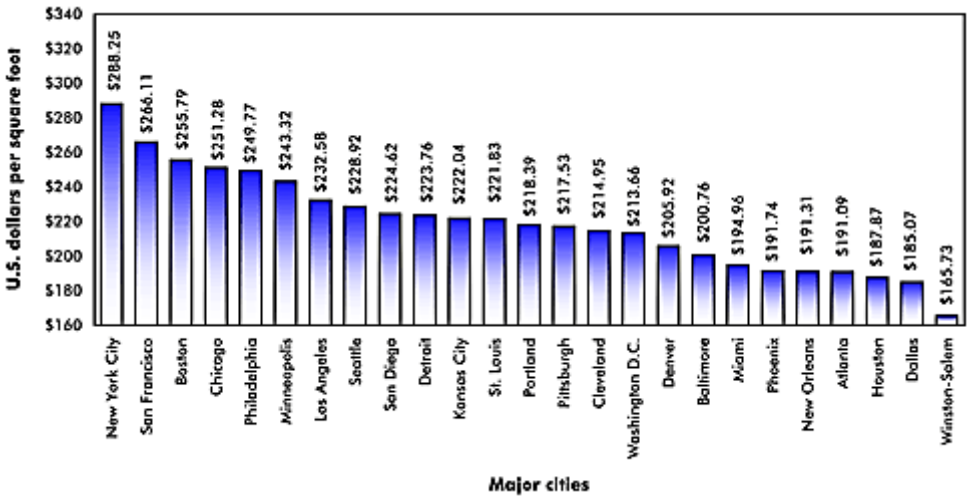

Figure 9: Construction Cost per Square Foot for 4 to 8 Story Hospital

Based on the construction cost, the first installation cost, and performance of the systems, this project is reasonably well designed. The annual operating and fuel costs for all of the mechanical equipment, however, seem to be higher than that of typical, large hospitals. A reduction of annual operating and fuel costs will be the primary consideration of this thesis project.

1.10 REFERENCE

Figure 9:

"Cost per Square Foot For New Commercial Construction." *The Commercial Real Estate Specialists ONLINE RESOURCES*. The Commercial Real Estate, n.d. Web. 12 Nov. 2012. <http://www.thecommercialrealestatespecialists.com/cpsf.html>.

APPENDIX A: The Minimum Outdoor Airflow Requirement in Accordance of the ASHRAE Standard 62.1 and the ASHRAE Standard 170.

Patient Wing Area 4		ASHRAE 62.1							ASHRAE 170							
Zone #	Zone Description	Area	Height (ft)	#/1000SF	CFM/#	#	CFM/SF	Req. Vent. Air (CFM)	OA min ACH	Req. Vent. Req. (CFM)	Min. Vent. Req. (CFM)	Effectiv-eness	OA	Total Supply	Fraction Zp	Compli-ance
1	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
2	Patient Room	280	8	10	5	3	0.06	31	2	75	75	0.80	93	175	0.53	Yes
3	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
4	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
5	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
6	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
7	Corridor	4210	8	0	0	0	0.06	253	2	1123	1123	1.00	1123	1375	0.82	Yes
8	Group Patient Room	245	8	20	5	5	0.06	39	2	65	65	1.00	65	600	0.11	Yes
9	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
10	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
11	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
12	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
13	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
14	Patient Room	280	8	10	5	3	0.06	31	2	75	75	0.80	93	200	0.47	Yes
15	Patient Room	290	8	10	5	3	0.06	32	2	77	77	0.80	97	300	0.32	Yes
16	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	150	0.42	Yes
17	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	150	0.42	Yes
18	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	150	0.42	Yes
19	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	150	0.42	Yes
20	Office	80	8	5	5	0	0.06	7	0	0	7	1.00	7	75	0.09	Yes
21	Office	180	8	5	5	1	0.06	15	0	0	15	1.00	15	125	0.12	Yes
22	Dinning	555	8	70	7.5	39	0.18	392	2	148	392	1.00	392	2200	0.18	Yes
23	Corridor	4155	8	0	0	0	0.06	249	2	1108	1108	1.00	1108	1625	0.68	Yes
24	Dinning	540	8	70	7.5	38	0.18	381	2	144	381	1.00	381	2200	0.17	Yes
25	Group Patient Room	745	8	20	5	15	0.06	119	2	199	199	1.00	199	1600	0.12	Yes
26	Group Patient Room	185	8	20	5	4	0.06	30	2	49	49	1.00	49	400	0.12	Yes
27	Office	165	8	5	5	1	0.06	14	0	0	14	1.00	14	125	0.12	Yes
28	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	150	0.43	Yes
29	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	150	0.43	Yes
30	Patient Room	290	8	10	5	3	0.06	32	2	77	77	0.80	97	200	0.48	Yes
31	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	150	0.43	Yes
32	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	150	0.43	Yes
33	Laundry	75	8	10	5	1	0.12	13	0	0	13	1.00	13	75	0.17	Yes
34	Visitation	400	8	10	5	4	0.06	44	2	107	107	1.00	107	800	0.13	Yes
35	Office	100	8	5	5	1	0.06	9	0	0	9	1.00	9	100	0.09	Yes
36	Office	95	8	5	5	1	0.06	8	0	0	8	1.00	8	75	0.11	Yes
37	Patient Room	125	8	10	5	1	0.06	14	2	33	33	0.80	42	125	0.33	Yes
38	Office	110	8	5	5	1	0.06	10	0	0	10	1.00	10	150	0.06	Yes
39	Patient Room	95	8	10	5	1	0.06	11	2	25	25	0.80	32	100	0.32	Yes
40	Corridor	220	8	0	0	0	0.06	13	2	59	59	1.00	59	350	0.17	Yes
41	Corridor	1080	8	0	0	0	0.06	65	2	288	288	1.00	288	975	0.30	Yes
42	Corridor	640	8	0	0	0	0.06	38	2	171	171	1.00	171	600	0.28	Yes
43	Storage	155	8	0	0	0	0.12	19	2	41	41	1.00	41	150	0.28	Yes
44	Soil	140	8	0	0	0	0.12	17	2	37	37	1.00	37	75	0.50	Yes

45	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	50	0.16	Yes
46	Lounge	185	8	25	5	5	0.06	35	0	0	35	1.00	35	175	0.20	Yes
47	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
48	Office	95	8	5	5	1	0.06	8	0	0	8	1.00	8	75	0.11	Yes
49	Office	90	8	5	5	2	0.06	15	0	0	15	1.00	15	125	0.12	Yes
50	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
51	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	75	0.11	Yes
52	Locker	80	8	10	5	1	0.06	9	0	0	9	1.00	9	125	0.07	Yes
53	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
54	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
55	Visitation	435	8	10	5	4	0.06	48	2	116	116	1.00	116	850	0.14	Yes
56	Office	105	8	5	5	1	0.06	9	0	0	9	1.00	9	100	0.09	Yes
57	Office	95	8	5	5	1	0.06	8	0	0	8	1.00	8	75	0.11	Yes
58	Patient Room	125	8	10	5	1	0.06	14	2	33	33	0.80	42	125	0.33	Yes
59	Office	110	8	5	5	1	0.06	10	0	0	10	1.00	10	150	0.06	Yes
60	Patient Room	95	8	10	5	1	0.06	11	2	25	25	0.80	32	75	0.42	Yes
61	Office	145	8	5	5	1	0.06	13	0	0	13	1.00	13	125	0.10	Yes
62	Office	175	8	5	5	1	0.06	15	0	0	15	1.00	15	300	0.05	Yes
63	Office	130	8	5	5	1	0.06	11	0	0	11	1.00	11	200	0.06	Yes
64	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
65	Nourishment	320	8	10	5	3	0.18	74	2	85	85	1.00	85	350	0.24	Yes
66	IT	90	8	0	0	0	0.06	5	0	0	5	1.00	5	125	0.04	Yes
67	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	75	0.11	Yes
68	Office	130	8	5	5	1	0.06	11	0	0	11	1.00	11	125	0.09	Yes
69	Office	175	8	5	5	1	0.06	15	0	0	15	1.00	15	275	0.05	Yes
70	Office	145	8	5	5	1	0.06	13	0	0	13	1.00	13	125	0.10	Yes
71	Group Patient Room	195	8	20	5	4	0.06	31	2	52	52	1.00	52	400	0.13	Yes
72	Office	150	8	5	5	1	0.06	13	0	0	13	1.00	13	300	0.04	Yes
73	Laundry	90	8	10	5	1	0.12	15	0	0	15	1.00	15	100	0.15	Yes
74	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	150	0.42	Yes
75	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	150	0.42	Yes
76	Patient Room	165	8	10	5	2	0.06	18	2	44	44	0.80	55	150	0.37	Yes
77	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	150	0.42	Yes
78	Patient Room	290	8	10	5	3	0.06	32	2	77	77	0.80	97	200	0.48	Yes
79	Patient Room	280	8	10	5	3	0.06	31	2	75	75	0.80	93	200	0.47	Yes
80	Patient Room	160	8	10	5	2	0.06	18	2	43	43	0.80	53	125	0.43	Yes
81	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	125	0.51	Yes
82	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	125	0.51	Yes
83	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	125	0.51	Yes
84	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	125	0.52	Yes
85	Group Patient Room	280	8	20	5	6	0.06	45	2	75	75	1.00	75	600	0.12	Yes
86	Group Patient Room	475	8	20	5	10	0.06	76	2	127	127	1.00	127	1000	0.13	Yes
87	Group Patient Room	245	8	20	5	5	0.06	39	2	65	65	1.00	65	500	0.13	Yes
88	Group Patient Room	185	8	20	5	4	0.06	30	2	49	49	1.00	49	400	0.12	Yes
89	Office	85	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
90	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	125	0.51	Yes
91	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	150	0.42	Yes
92	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	125	0.52	Yes

93	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	125	0.52	Yes
94	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	150	0.43	Yes
95	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	150	0.43	Yes
96	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	125	0.52	Yes
97	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	125	0.52	Yes
98	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	150	0.43	Yes
99	Patient Room	280	8	10	5	3	0.06	31	2	75	75	0.80	93	250	0.37	Yes
100	Patient Room	290	8	10	5	3	0.06	32	2	77	77	0.80	97	250	0.39	Yes
101	Patient Room	280	8	10	5	3	0.06	31	2	75	75	0.80	93	175	0.53	Yes
102	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	250	0.27	Yes
103	Patient Room	160	8	10	5	2	0.06	18	2	43	43	0.80	53	225	0.24	Yes
104	Corridor	4860	8	0	0	0	0.06	292	2	1296	1296	1.00	1296	1575	0.82	Yes
105	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
106	Patient Room	280	8	10	5	3	0.06	31	2	75	75	0.80	93	350	0.27	Yes
107	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
108	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
109	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
110	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
111	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
112	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
113	Office	150	8	5	5	1	0.06	13	0	0	13	1.00	13	200	0.07	Yes
114	Laundry	90	8	10	5	1	0.12	15	0	0	15	1.00	15	125	0.12	Yes
115	Group Patient Room	195	8	20	5	4	0.06	31	2	52	52	1.00	52	400	0.13	Yes
116	Group Patient Room	280	8	20	5	6	0.06	45	2	75	75	1.00	75	600	0.12	Yes
117	Group Patient Room	475	8	20	5	10	0.06	76	2	127	127	1.00	127	900	0.14	Yes
118	Group Patient Room	245	8	20	5	5	0.06	39	2	65	65	1.00	65	600	0.11	Yes
119	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
120	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
121	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
122	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
123	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
124	Patient Room	280	8	10	5	3	0.06	31	2	75	75	0.80	93	425	0.22	Yes
125	Patient Room	290	8	10	5	3	0.06	32	2	77	77	0.80	97	375	0.26	Yes
126	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
127	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
128	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
129	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	275	0.23	Yes
130	Office	85	8	5	5	1	0.06	8	0	0	8	1.00	8	175	0.04	Yes
131	Group Patient Room	180	8	20	5	4	0.06	29	2	48	48	1.00	48	400	0.12	Yes
132	Office	145	8	5	5	1	0.06	13	0	0	13	1.00	13	200	0.06	Yes
133	Office	175	8	5	5	1	0.06	15	0	0	15	1.00	15	275	0.05	Yes
134	Office	130	8	5	5	1	0.06	11	0	0	11	1.00	11	150	0.08	Yes
135	Corridor	640	8	0	0	0	0.06	38	2	171	171	1.00	171	550	0.31	Yes
136	Patient Room	80	8	10	5	1	0.06	9	2	21	21	0.80	27	100	0.27	Yes
137	Patient Room	125	8	10	5	1	0.06	14	2	33	33	0.80	42	150	0.28	Yes
138	Office	110	8	5	5	1	0.06	10	0	0	10	1.00	10	125	0.08	Yes
139	Office	105	8	5	5	1	0.06	9	0	0	9	1.00	9	175	0.05	Yes
140	Office	95	8	5	5	1	0.06	8	0	0	8	1.00	8	100	0.08	Yes

141	Visitation	400	8	10	5	4	0.06	44	2	107	107	1.00	107	800	0.13	Yes
142	Corridor	280	8	0	0	0	0.06	17	2	75	75	1.00	75	425	0.18	Yes
143	Corridor	1165	8	0	0	0	0.06	70	2	311	311	1.00	311	1700	0.18	Yes
144	Corridor	1080	8	0	0	0	0.06	65	2	288	288	1.00	288	975	0.30	Yes
145	Visitation	440	8	10	5	4	0.06	48	2	117	117	1.00	117	850	0.14	Yes
146	Office	140	8	5	5	1	0.06	12	0	0	12	1.00	12	125	0.10	Yes
147	Office	140	8	5	5	1	0.06	12	0	0	12	1.00	12	125	0.10	Yes
148	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
149	Office	95	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.07	Yes
150	Office	105	8	5	5	1	0.06	9	0	0	9	1.00	9	175	0.05	Yes
151	Office	110	8	5	5	1	0.06	10	0	0	10	1.00	10	150	0.06	Yes
152	Patient Room	125	8	10	5	1	0.06	14	2	33	33	0.80	42	150	0.28	Yes
153	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
154	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
155	Locker	80	8	10	5	1	0.06	9	0	0	9	1.00	9	125	0.07	Yes
156	Lounge	175	8	25	5	4	0.06	33	0	0	33	1.00	33	275	0.12	Yes
157	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
158	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
159	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
160	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	150	0.05	Yes
161	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
162	Nourishment	320	8	10	5	3	0.18	74	2	85	85	1.00	85	800	0.11	Yes
163	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
164	Office	130	8	5	5	1	0.06	11	0	0	11	1.00	11	150	0.08	Yes
165	Office	175	8	5	5	1	0.06	15	0	0	15	1.00	15	275	0.05	Yes
166	Office	145	8	5	5	1	0.06	13	0	0	13	1.00	13	200	0.06	Yes
167	Corridor	4375	8	0	0	0	0.06	263	2	1167	1167	1.00	1167	1400	0.83	Yes
168	Dinning	605	8	70	7.5	42	0.18	427	2	161	427	1.00	427	2200	0.19	Yes
169	Group Patient Room	195	8	20	5	4	0.06	31	2	52	52	1.00	52	400	0.13	Yes
170	Patient Room	80	8	10	5	1	0.06	9	2	21	21	0.80	27	100	0.27	Yes
171	Office	150	8	5	5	1	0.06	13	0	0	13	1.00	13	400	0.03	Yes
172	Laundry	90	8	10	5	1	0.12	15	0	0	15	1.00	15	125	0.12	Yes
173	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
174	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
175	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
176	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
177	Patient Room	290	8	10	5	3	0.06	32	2	77	77	0.80	97	425	0.23	Yes
178	Patient Room	280	8	10	5	3	0.06	31	2	75	75	0.80	93	425	0.22	Yes
179	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
180	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
181	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
182	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
183	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
184	Group Patient Room	280	8	20	5	6	0.06	45	2	75	75	1.00	75	700	0.11	Yes
185	Group Patient Room	475	8	20	5	10	0.06	76	2	127	127	1.00	127	1000	0.13	Yes
186	Group Patient Room	245	8	20	5	5	0.06	39	2	65	65	1.00	65	450	0.15	Yes
187	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
188	Office	85	8	5	5	1	0.06	8	0	0	8	1.00	8	150	0.05	Yes
189	Patient Room	170	8	10	5	2	0.06	19	2	45	45	0.80	57	250	0.23	Yes
190	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
191	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
192	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
193	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
194	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
195	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
196	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
197	Patient Room	290	8	10	5	3	0.06	32	2	77	77	0.80	97	375	0.26	Yes
198	Patient Room	280	8	10	5	3	0.06	31	2	75	75	0.80	93	475	0.20	Yes
199	Lounge	285	8	25	5	7	0.06	53	0	0	53	1.00	53	50	1.06	NO
200	Gym Entrance	210	8	30	0	6	0.30	63	0	0	63	1.00	63	225	0.28	Yes
201	Office	85	8	5	5	1	0.06	8	0	0	8	1.00	8	100	0.08	Yes
202	Waiting	260	8	5	5	1	0.06	22	2	69	69	1.00	69	125	0.55	Yes
203	Corridor	360	8	0	0	0	0.06	22	2	96	96	1.00	96	175	0.55	Yes
204	Corridor	1900	8	0	0	0	0.06	114	2	507	507	1.00	507	975	0.52	Yes
205	Corridor	780	8	0	0	0	0.06	47	2	208	208	1.00	208	225	0.92	Yes
	TOTALS:	62280						6880					17395	64775	0.27	Yes

Patient Wing Area 5		ASHRAE 62.1							ASHRAE 170							
Zone #	Zone Description	Area	Height (ft)	#/1000SF	CFM/#	#	CFM/SF	Req. Vent. Air (CFM)	OA min ACH	Req. Vent. Req. (CFM)	Min. Vent. Req. (CFM)	Effectiv-eness	OA	Total Supply	Fraction Zp	Compli-ance
1	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
2	Patient Room	280	8	10	5	3	0.06	31	2	75	75	0.80	93	175	0.53	Yes
3	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
4	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
5	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
6	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
7	Corridor	4210	8	0	0	0	0.06	253	2	1123	1123	1.00	1123	1375	0.82	Yes
8	Group Patient Room	245	8	20	5	5	0.06	39	2	65	65	1.00	65	600	0.11	Yes
9	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
10	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
11	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
12	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
13	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	150	0.44	Yes
14	Patient Room	280	8	10	5	3	0.06	31	2	75	75	0.80	93	200	0.47	Yes
15	Patient Room	290	8	10	5	3	0.06	32	2	77	77	0.80	97	300	0.32	Yes
16	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	150	0.42	Yes
17	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	150	0.42	Yes
18	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	150	0.42	Yes
19	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	150	0.42	Yes
20	Office	80	8	5	5	0	0.06	7	0	0	7	1.00	7	150	0.05	Yes
21	Office	180	8	5	5	1	0.06	15	0	0	15	1.00	15	150	0.10	Yes
22	Dinning	555	8	70	7.5	39	0.18	392	2	148	392	1.00	392	2200	0.18	Yes
23	Corridor	4155	8	0	0	0	0.06	249	2	1108	1108	1.00	1108	1625	0.68	Yes
24	Dinning	540	8	70	7.5	38	0.18	381	2	144	381	1.00	381	2200	0.17	Yes
25	Group Patient Room	745	8	20	5	15	0.06	119	2	199	199	1.00	199	1600	0.12	Yes
26	Group Patient Room	185	8	20	5	4	0.06	30	2	49	49	1.00	49	400	0.12	Yes
27	Office	165	8	5	5	1	0.06	14	0	0	14	1.00	14	125	0.12	Yes
28	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	150	0.43	Yes
29	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	150	0.43	Yes
30	Patient Room	290	8	10	5	3	0.06	32	2	77	77	0.80	97	200	0.48	Yes
31	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	150	0.43	Yes
32	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	150	0.43	Yes
33	Laundry	75	8	10	5	1	0.12	13	0	0	13	1.00	13	50	0.26	Yes
34	Visitation	400	8	10	5	4	0.06	44	2	107	107	1.00	107	850	0.13	Yes
35	Office	100	8	5	5	1	0.06	9	0	0	9	1.00	9	100	0.09	Yes
36	Office	95	8	5	5	1	0.06	8	0	0	8	1.00	8	75	0.11	Yes
37	Patient Room	125	8	10	5	1	0.06	14	2	33	33	0.80	42	125	0.33	Yes
38	Office	110	8	5	5	1	0.06	10	0	0	10	1.00	10	75	0.13	Yes
39	Patient Room	95	8	10	5	1	0.06	11	2	25	25	0.80	32	100	0.32	Yes
40	Corridor	220	8	0	0	0	0.06	13	2	59	59	1.00	59	250	0.23	Yes
41	Corridor	1080	8	0	0	0	0.06	65	2	288	288	1.00	288	975	0.30	Yes
42	Corridor	640	8	0	0	0	0.06	38	2	171	171	1.00	171	175	0.98	Yes
43	Storage	155	8	0	0	0	0.12	19	2	41	41	1.00	41	50	0.83	Yes
44	Soil	140	8	0	0	0	0.12	17	2	37	37	1.00	37	75	0.50	Yes

45	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	50	0.16	Yes
46	Lounge	185	8	25	5	5	0.06	35	0	0	35	1.00	35	150	0.23	Yes
47	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	75	0.11	Yes
48	Office	95	8	5	5	1	0.06	8	0	0	8	1.00	8	75	0.11	Yes
49	Office	90	8	5	5	2	0.06	15	0	0	15	1.00	15	125	0.12	Yes
50	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
51	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	75	0.11	Yes
52	Locker	80	8	10	5	1	0.06	9	0	0	9	1.00	9	125	0.07	Yes
53	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
54	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
55	Visitation	435	8	10	5	4	0.06	48	2	116	116	1.00	116	850	0.14	Yes
56	Office	105	8	5	5	1	0.06	9	0	0	9	1.00	9	100	0.09	Yes
57	Office	95	8	5	5	1	0.06	8	0	0	8	1.00	8	75	0.11	Yes
58	Patient Room	125	8	10	5	1	0.06	14	2	33	33	0.80	42	125	0.33	Yes
59	Office	110	8	5	5	1	0.06	10	0	0	10	1.00	10	75	0.13	Yes
60	Patient Room	95	8	10	5	1	0.06	11	2	25	25	0.80	32	75	0.42	Yes
61	Office	145	8	5	5	1	0.06	13	0	0	13	1.00	13	125	0.10	Yes
62	Office	175	8	5	5	1	0.06	15	0	0	15	1.00	15	175	0.09	Yes
63	Office	130	8	5	5	1	0.06	11	0	0	11	1.00	11	200	0.06	Yes
64	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
65	Nourishment	320	8	10	5	3	0.18	74	2	85	85	1.00	85	350	0.24	Yes
66	IT	90	8	0	0	0	0.06	5	0	0	5	1.00	5	125	0.04	Yes
67	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	75	0.11	Yes
68	Office	130	8	5	5	1	0.06	11	0	0	11	1.00	11	125	0.09	Yes
69	Office	175	8	5	5	1	0.06	15	0	0	15	1.00	15	275	0.05	Yes
70	Office	145	8	5	5	1	0.06	13	0	0	13	1.00	13	125	0.10	Yes
71	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	400	0.16	Yes
72	Office	150	8	5	5	1	0.06	13	0	0	13	1.00	13	300	0.04	Yes
73	Laundry	90	8	10	5	1	0.12	15	0	0	15	1.00	15	75	0.20	Yes
74	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	150	0.42	Yes
75	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	150	0.42	Yes
76	Patient Room	165	8	10	5	2	0.06	18	2	44	44	0.80	55	150	0.37	Yes
77	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	150	0.42	Yes
78	Patient Room	290	8	10	5	3	0.06	32	2	77	77	0.80	97	200	0.48	Yes
79	Patient Room	280	8	10	5	3	0.06	31	2	75	75	0.80	93	200	0.47	Yes
80	Patient Room	160	8	10	5	2	0.06	18	2	43	43	0.80	53	125	0.43	Yes
81	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	125	0.51	Yes
82	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	125	0.51	Yes
83	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	125	0.51	Yes
84	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	125	0.52	Yes
85	Group Patient Room	280	8	20	5	6	0.06	45	2	75	75	1.00	75	600	0.12	Yes
86	Group Patient Room	475	8	20	5	10	0.06	76	2	127	127	1.00	127	1000	0.13	Yes
87	Group Patient Room	245	8	20	5	5	0.06	39	2	65	65	1.00	65	500	0.13	Yes
88	Group Patient Room	185	8	20	5	4	0.06	30	2	49	49	1.00	49	400	0.12	Yes
89	Office	85	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
90	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	125	0.51	Yes
91	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	125	0.51	Yes
92	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	125	0.52	Yes

93	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	125	0.52	Yes
94	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	125	0.52	Yes
95	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	125	0.52	Yes
96	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	125	0.52	Yes
97	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	125	0.52	Yes
98	Patient Room	195	8	10	5	2	0.06	22	2	52	52	0.80	65	125	0.52	Yes
99	Patient Room	280	8	10	5	3	0.06	31	2	75	75	0.80	93	225	0.41	Yes
100	Patient Room	290	8	10	5	3	0.06	32	2	77	77	0.80	97	250	0.39	Yes
101	Patient Room	280	8	10	5	3	0.06	31	2	75	75	0.80	93	200	0.47	Yes
102	Patient Room	200	8	10	5	2	0.06	22	2	53	53	0.80	67	250	0.27	Yes
103	Patient Room	160	8	10	5	2	0.06	18	2	43	43	0.80	53	250	0.21	Yes
104	Corridor	4860	8	0	0	0	0.06	292	2	1296	1296	1.00	1296	1575	0.82	Yes
105	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
106	Patient Room	280	8	10	5	3	0.06	31	2	75	75	0.80	93	350	0.27	Yes
107	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
108	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
109	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
110	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
111	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
112	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
113	Office	150	8	5	5	1	0.06	13	0	0	13	1.00	13	200	0.07	Yes
114	Laundry	90	8	10	5	1	0.12	15	0	0	15	1.00	15	125	0.12	Yes
115	Group Patient Room	195	8	20	5	4	0.06	31	2	52	52	1.00	52	400	0.13	Yes
116	Group Patient Room	280	8	20	5	6	0.06	45	2	75	75	1.00	75	600	0.12	Yes
117	Group Patient Room	475	8	20	5	10	0.06	76	2	127	127	1.00	127	900	0.14	Yes
118	Group Patient Room	245	8	20	5	5	0.06	39	2	65	65	1.00	65	600	0.11	Yes
119	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
120	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
121	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
122	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
123	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
124	Patient Room	280	8	10	5	3	0.06	31	2	75	75	0.80	93	425	0.22	Yes
125	Patient Room	290	8	10	5	3	0.06	32	2	77	77	0.80	97	375	0.26	Yes
126	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
127	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
128	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
129	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	275	0.23	Yes
130	Office	85	8	5	5	1	0.06	8	0	0	8	1.00	8	150	0.05	Yes
131	Group Patient Room	180	8	20	5	4	0.06	29	2	48	48	1.00	48	400	0.12	Yes
132	Office	145	8	5	5	1	0.06	13	0	0	13	1.00	13	200	0.06	Yes
133	Office	175	8	5	5	1	0.06	15	0	0	15	1.00	15	275	0.05	Yes
134	Office	130	8	5	5	1	0.06	11	0	0	11	1.00	11	150	0.08	Yes
135	Corridor	640	8	0	0	0	0.06	38	2	171	171	1.00	171	550	0.31	Yes
136	Patient Room	80	8	10	5	1	0.06	9	2	21	21	0.80	27	100	0.27	Yes
137	Patient Room	125	8	10	5	1	0.06	14	2	33	33	0.80	42	150	0.28	Yes
138	Office	110	8	5	5	1	0.06	10	0	0	10	1.00	10	125	0.08	Yes
139	Office	105	8	5	5	1	0.06	9	0	0	9	1.00	9	175	0.05	Yes
140	Office	95	8	5	5	1	0.06	8	0	0	8	1.00	8	100	0.08	Yes

141	Visitation	400	8	10	5	4	0.06	44	2	107	107	1.00	107	800	0.13	Yes
142	Corridor	280	8	0	0	0	0.06	17	2	75	75	1.00	75	425	0.18	Yes
143	Corridor	1165	8	0	0	0	0.06	70	2	311	311	1.00	311	1700	0.18	Yes
144	Corridor	1080	8	0	0	0	0.06	65	2	288	288	1.00	288	975	0.30	Yes
145	Visitation	440	8	10	5	4	0.06	48	2	117	117	1.00	117	850	0.14	Yes
146	Office	140	8	5	5	1	0.06	12	0	0	12	1.00	12	125	0.10	Yes
147	Office	140	8	5	5	1	0.06	12	0	0	12	1.00	12	125	0.10	Yes
148	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
149	Office	95	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.07	Yes
150	Office	105	8	5	5	1	0.06	9	0	0	9	1.00	9	175	0.05	Yes
151	Office	110	8	5	5	1	0.06	10	0	0	10	1.00	10	150	0.06	Yes
152	Patient Room	125	8	10	5	1	0.06	14	2	33	33	0.80	42	150	0.28	Yes
153	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
154	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
155	Locker	80	8	10	5	1	0.06	9	0	0	9	1.00	9	125	0.07	Yes
156	Lounge	175	8	25	5	4	0.06	33	0	0	33	1.00	33	275	0.12	Yes
157	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
158	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
159	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	50	0.16	Yes
160	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	150	0.05	Yes
161	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
162	Nourishment	320	8	10	5	3	0.18	74	2	85	85	1.00	85	800	0.11	Yes
163	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	125	0.06	Yes
164	Office	130	8	5	5	1	0.06	11	0	0	11	1.00	11	150	0.08	Yes
165	Office	175	8	5	5	1	0.06	15	0	0	15	1.00	15	275	0.05	Yes
166	Office	145	8	5	5	1	0.06	13	0	0	13	1.00	13	200	0.06	Yes
167	Corridor	4375	8	0	0	0	0.06	263	2	1167	1167	1.00	1167	1400	0.83	Yes
168	Dinning	605	8	70	7.5	42	0.18	427	2	161	427	1.00	427	2200	0.19	Yes
169	Group Patient Room	195	8	20	5	4	0.06	31	2	52	52	1.00	52	400	0.13	Yes
170	Patient Room	80	8	10	5	1	0.06	9	2	21	21	0.80	27	525	0.05	Yes
171	Office	150	8	5	5	1	0.06	13	0	0	13	1.00	13	575	0.02	Yes
172	Laundry	90	8	10	5	1	0.12	15	0	0	15	1.00	15	325	0.05	Yes
173	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
174	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	150	0.42	Yes
175	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
176	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
177	Patient Room	290	8	10	5	3	0.06	32	2	77	77	0.80	97	250	0.39	Yes
178	Patient Room	280	8	10	5	3	0.06	31	2	75	75	0.80	93	250	0.37	Yes
179	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
180	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
181	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
182	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
183	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
184	Office	280	8	5	5	1	0.06	24	0	0	24	1.00	24	700	0.03	Yes
185	Office	475	8	5	5	2	0.06	41	0	0	41	1.00	41	1000	0.04	Yes
186	Office	245	8	5	5	1	0.06	21	0	0	21	1.00	21	500	0.04	Yes
187	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
188	Office	85	8	5	5	1	0.06	8	0	0	8	1.00	8	150	0.05	Yes
189	Patient Room	170	8	10	5	2	0.06	19	2	45	45	0.80	57	250	0.23	Yes
190	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
191	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
192	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
193	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
194	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
195	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
196	Patient Room	190	8	10	5	2	0.06	21	2	51	51	0.80	63	250	0.25	Yes
197	Patient Room	290	8	10	5	3	0.06	32	2	77	77	0.80	97	375	0.26	Yes
198	Patient Room	280	8	10	5	3	0.06	31	2	75	75	0.80	93	475	0.20	Yes
199	Corridor	600	8	0	0	0	0.06	36	2	160	160	1.00	160	1350	0.12	Yes
	TOTALS:	59000						6504					16383	63600	0.26	Yes

Eixisting		ASHRAE 62.1							ASHRAE 170							
Zone #	Zone Description	Area	Height (ft)	#/1000SF	CFM/#	#	CFM/SF	Req. Vent. Air (CFM)	OA min ACH	Req. Vent. Req. (CFM)	Min. Vent. Req. (CFM)	Effectiv-eness	OA	Total Supply	Fraction Zp	Compli-ance
1	Conference Room	710	8	50	5	36	0.06	220	0	0	220	1.00	220	1400	0.16	Yes
2	Office	195	8	5	5	1	0.06	17	0	0	17	1.00	17	125	0.13	Yes
3	Conference Room	460	8	50	5	23	0.06	143	0	0	143	1.00	143	600	0.24	Yes
4	Conference Room	100	8	50	5	5	0.06	31	0	0	31	1.00	31	100	0.31	Yes
5	Locker	105	8	10	5	1	0.06	12	0	0	12	1.00	12	75	0.16	Yes
6	Conference Room	715	8	50	5	36	0.06	222	0	0	222	1.00	222	1800	0.12	Yes
7	Locker	55	8	10	5	1	0.06	6	0	0	6	1.00	6	50	0.13	Yes
8	Locker	180	8	10	5	2	0.06	20	0	0	20	1.00	20	175	0.11	Yes
9	Locker	115	8	10	5	1	0.06	13	0	0	13	1.00	13	250	0.05	Yes
10	Locker	350	8	10	5	4	0.06	39	0	0	39	1.00	39	250	0.15	Yes
11	Locker	350	8	10	5	4	0.06	39	0	0	39	1.00	39	250	0.15	Yes
12	Lounge	425	8	25	5	11	0.06	79	0	0	79	1.00	79	575	0.14	Yes
13	Conference Room	330	8	50	5	17	0.06	102	0	0	102	1.00	102	800	0.13	Yes
14	Office	120	8	5	5	1	0.06	10	0	0	10	1.00	10	125	0.08	Yes
15	Office	85	8	5	5	1	0.06	8	0	0	8	1.00	8	100	0.08	Yes
16	Office	140	8	5	5	1	0.06	12	0	0	12	1.00	12	250	0.05	Yes
17	Corridor	510	8	0	0	0	0.06	31	2	136	136	1.00	136	200	0.68	Yes
18	Corridor	285	8	0	0	0	0.06	17	2	76	76	1.00	76	125	0.61	Yes
19	Lobby	210	8	10	5	2	0.06	23	0	0	23	1.00	23	500	0.05	Yes
20	Corridor	100	8	0	0	0	0.06	6	2	27	27	1.00	27	50	0.53	Yes
21	Office	110	8	5	5	1	0.06	10	0	0	10	1.00	10	225	0.04	Yes
22	Office	185	8	5	5	1	0.06	16	0	0	16	1.00	16	100	0.16	Yes
23	Conference Room	585	8	50	5	29	0.06	182	0	0	182	1.00	182	825	0.22	Yes
24	Corridor	425	8	0	0	0	0.06	26	2	113	113	1.00	113	125	0.91	Yes
25	Corridor	1985	8	0	0	0	0.06	119	2	529	529	1.00	529	550	0.96	Yes
26	Lounge	1505	8	25	5	38	0.06	279	0	0	279	1.00	279	1600	0.17	Yes
27	Corridor	75	8	0	0	0	0.06	5	2	20	20	1.00	20	50	0.40	Yes
28	Storage	240	8	0	0	0	0.12	29	2	64	64	1.00	64	75	0.85	Yes
29	Corridor	175	8	0	0	0	0.06	11	2	47	47	1.00	47	50	0.93	Yes
30	Conference Room	330	8	50	5	17	0.06	102	0	0	102	1.00	102	225	0.45	Yes
31	Storage	550	8	0	0	0	0.12	66	2	147	147	1.00	147	200	0.73	Yes
32	Corridor	145	8	0	0	0	0.06	9	2	39	39	1.00	39	50	0.77	Yes
33	Kithen	405	8	70	7.5	28	0.18	286	2	108	286	1.00	286	150	1.91	NO
34	Locker	125	8	10	5	1	0.06	14	0	0	14	1.00	14	75	0.19	Yes
35	Locker	125	8	10	5	1	0.06	14	0	0	14	1.00	14	75	0.19	Yes
36	Corridor	260	8	0	0	0	0.06	16	2	69	69	1.00	69	75	0.92	Yes
37	Office	260	8	5	5	1	0.06	22	0	0	22	1.00	22	125	0.18	Yes
38	Office	135	8	5	5	1	0.06	12	0	0	12	1.00	12	100	0.12	Yes
39	Office	160	8	5	5	1	0.06	14	0	0	14	1.00	14	125	0.11	Yes
40	Waiting	205	8	5	5	1	0.06	18	2	55	55	1.00	55	350	0.16	Yes
41	Conference Room	340	8	50	5	17	0.06	105	0	0	105	1.00	105	450	0.23	Yes
42	Office	140	8	5	5	1	0.06	12	0	0	12	1.00	12	100	0.12	Yes
43	Storage	75	8	0	0	0	0.12	9	2	20	20	1.00	20	100	0.20	Yes
44	Lobby	245	8	10	5	3	0.06	27	0	0	27	1.00	27	250	0.11	Yes

45	Office	435	8	5	5	2	0.06	37	0	0	37	1.00	37	450	0.08	Yes
46	Office	55	8	5	5	0	0.06	5	0	0	5	1.00	5	75	0.06	Yes
47	Exam Room	55	8	5	5	0	0.06	5	2	15	15	1.00	15	50	0.29	Yes
48	Lounge	530	8	25	5	13	0.06	98	0	0	98	1.00	98	725	0.14	Yes
49	Kitchen	335	8	70	7.5	2	0.18	75	2	89	89	1.00	89	200	0.45	Yes
50	Corridor	140	8	0	0	0	0.06	8	2	37	37	1.00	37	50	0.75	Yes
51	Corridor	75	8	0	0	0	0.06	5	2	20	20	1.00	20	50	0.40	Yes
52	Corridor	755	8	0	0	0	0.06	45	2	201	201	1.00	201	125	1.61	NO
53	Office	405	8	5	5	2	0.06	35	0	0	35	1.00	35	1200	0.03	Yes
54	Office	285	8	5	5	2	0.06	25	0	0	25	1.00	25	225	0.11	Yes
55	Corridor	45	8	0	0	0	0.06	3	2	12	12	1.00	12	50	0.24	Yes
56	Office	105	8	5	5	1	0.06	9	0	0	9	1.00	9	375	0.02	Yes
57	Office	105	8	5	5	1	0.06	9	0	0	9	1.00	9	175	0.05	Yes
58	Corridor	40	8	0	0	0	0.06	2	2	11	11	1.00	11	50	0.21	Yes
59	Office	105	8	5	5	1	0.06	9	0	0	9	1.00	9	325	0.03	Yes
60	Office	105	8	5	5	1	0.06	9	0	0	9	1.00	9	325	0.03	Yes
61	Office	135	8	5	5	1	0.06	12	0	0	12	1.00	12	425	0.03	Yes
62	Office	190	8	5	5	1	0.06	16	0	0	16	1.00	16	150	0.11	Yes
63	Corridor	125	8	0	0	0	0.06	8	2	33	33	1.00	33	50	0.67	Yes
64	Office	140	8	5	5	1	0.06	12	0	0	12	1.00	12	100	0.12	Yes
65	Kitchen	65	8	70	7.5	5	0.18	46	2	17	46	1.00	46	50	0.92	Yes
66	Corridor	160	8	0	0	0	0.06	10	2	43	43	1.00	43	50	0.85	Yes
67	Conference Room	300	8	50	5	15	0.06	93	0	0	93	1.00	93	400	0.23	Yes
68	Conference Room	330	8	50	5	17	0.06	102	0	0	102	1.00	102	400	0.26	Yes
69	Office	365	8	5	5	2	0.06	31	0	0	31	1.00	31	350	0.09	Yes
70	Nurse Station	170	8	30	5	5	0.06	36	2	45	45	1.00	45	200	0.23	Yes
71	Storage	145	8	0	0	0	0.12	17	2	39	39	1.00	39	100	0.39	Yes
72	Visitation	150	8	10	5	2	0.06	17	2	40	40	1.00	40	175	0.23	Yes
73	Norishment	105	8	10	5	1	0.18	24	2	28	28	1.00	28	50	0.56	Yes
74	Corridor	210	8	0	0	0	0.06	13	2	56	56	1.00	56	50	1.12	NO
75	Corridor	285	8	0	0	0	0.06	17	2	76	76	1.00	76	50	1.52	NO
76	Soil	130	8	0	0	0	0.12	16	2	35	35	1.00	35	50	0.69	Yes
77	Storage	150	8	0	0	0	0.12	18	2	40	40	1.00	40	100	0.40	Yes
78	Office	85	8	5	5	1	0.06	8	0	0	8	1.00	8	100	0.08	Yes
79	Office	95	8	5	5	1	0.06	8	0	0	8	1.00	8	100	0.08	Yes
80	Office	90	8	5	5	1	0.06	8	0	0	8	1.00	8	100	0.08	Yes
81	Office	140	8	5	5	1	0.06	12	0	0	12	1.00	12	125	0.10	Yes
82	Corridor	175	8	0	0	0	0.06	11	2	47	47	1.00	47	50	0.93	Yes
83	Lounge	165	8	25	5	4	0.06	31	0	0	31	1.00	31	225	0.14	Yes
84	Corridor	180	8	0	0	0	0.06	11	2	48	48	1.00	48	50	0.96	Yes
85	Conference Room	875	8	50	5	44	0.06	272	0	0	272	1.00	272	1100	0.25	Yes
	TOTALS:	22860						3674					5232	22900	0.23	Yes

Gym & Admin & Diaterary		ASHRAE 62.1							ASHRAE 170							
Zone #	Zone Description	Area	Height (ft)	#/1000SF	CFM/#	#	CFM/SF	Req. Vent. Air (CFM)	OA min ACH	Req. Vent. Req. (CFM)	Min. Vent. Req. (CFM)	Effectiv-eness	OA	Total Supply	Fraction Zp	Compli-ance
1	Conference Room	285	8	50	5	14	0.06	89	0	0	89	1.00	89	100	0.89	Yes
2	Corridor	210	8	0	0	0	0.06	13	2	56	56	1.00	56	225	0.25	Yes
3	Office	85	8	5	5	1	0.06	8	0	0	8	1.00	8	100	0.08	Yes
4	Waiting	260	8	5	5	1	0.06	22	2	69	69	1.00	69	300	0.23	Yes
5	Lobby	360	8	10	5	4	0.06	40	0	0	40	1.00	40	450	0.09	Yes
6	Corridor	1900	8	0	0	0	0.06	114	2	507	507	1.00	507	975	0.52	Yes
7	Corridor	780	8	0	0	0	0.06	47	2	208	208	1.00	208	225	0.92	Yes
8	Lounge	415	8	25	5	10	0.06	77	0	0	77	1.00	77	275	0.28	Yes
9	Kitchen	160	8	70	7.5	11	0.18	113	2	43	113	1.00	113	125	0.90	Yes
10	Gym	3530	8	30	0	106	0.30	1059	0	0	1059	1.00	1059	2650	0.40	Yes
11	Corridor	840	8	0	0	0	0.06	50	2	224	224	1.00	224	1300	0.17	Yes
12	Waiting	190	8	5	5	1	0.06	16	2	51	51	1.00	51	250	0.20	Yes
13	Corridor	485	8	0	0	0	0.06	29	2	129	129	1.00	129	450	0.29	Yes
14	Office	100	8	5	5	1	0.06	9	0	0	9	1.00	9	150	0.06	Yes
15	Office	100	8	5	5	1	0.06	9	0	0	9	1.00	9	150	0.06	Yes
16	Office	100	8	5	5	1	0.06	9	0	0	9	1.00	9	150	0.06	Yes
17	Office	100	8	5	5	1	0.06	9	0	0	9	1.00	9	75	0.11	Yes
18	Office	125	8	5	5	1	0.06	11	0	0	11	1.00	11	175	0.06	Yes
19	Office	115	8	5	5	1	0.06	10	0	0	10	1.00	10	150	0.07	Yes
20	Office	115	8	5	5	1	0.06	10	0	0	10	1.00	10	150	0.07	Yes
21	Office	120	8	5	5	1	0.06	10	0	0	10	1.00	10	75	0.14	Yes
22	Corridor	455	8	0	0	0	0.06	27	2	121	121	1.00	121	125	0.97	Yes
23	Office	165	8	5	5	1	0.06	14	0	0	14	1.00	14	225	0.06	Yes
24	Office	100	8	5	5	1	0.06	9	0	0	9	1.00	9	150	0.06	Yes
25	Office	80	8	5	5	0	0.06	7	0	0	7	1.00	7	125	0.05	Yes
26	Office	380	8	5	5	2	0.06	32	0	0	32	1.00	32	550	0.06	Yes
27	Conference Room	440	8	50	5	22	0.06	136	0	0	136	1.00	136	1000	0.14	Yes
28	Office	230	8	5	5	1	0.06	20	0	0	20	1.00	20	250	0.08	Yes
29	Corridor	760	8	0	0	0	0.06	46	2	203	203	1.00	203	225	0.90	Yes
30	Corridor	350	8	0	0	0	0.06	21	2	93	93	1.00	93	125	0.75	Yes
31	Patient Room	120	8	10	5	1	0.06	13	2	32	32	0.80	40	125	0.32	Yes
32	Patient Room	120	8	10	5	1	0.06	13	2	32	32	0.80	40	125	0.32	Yes
33	Patient Room	210	8	10	5	2	0.06	23	2	56	56	0.80	70	150	0.47	Yes
34	Patient Room	140	8	10	5	1	0.06	15	2	37	37	0.80	47	100	0.47	Yes
35	Office	185	8	5	5	1	0.06	16	0	0	16	1.00	16	175	0.09	Yes
36	Soil	85	8	0	0	0	0.12	10	2	23	23	1.00	23	100	0.23	Yes
37	Office	80	8	5	5	0	0.06	7	0	0	7	1.00	7	125	0.05	Yes
38	Office	135	8	5	5	1	0.06	12	0	0	12	1.00	12	200	0.06	Yes
39	Storage	155	8	0	0	0	0.12	19	2	41	41	1.00	41	150	0.28	Yes
40	Patient Room	125	8	10	5	1	0.06	14	2	33	33	0.80	42	125	0.33	Yes
41	Storage	80	8	0	0	0	0.12	10	2	21	21	1.00	21	100	0.21	Yes
42	Patient Room	125	8	10	5	1	0.06	14	2	33	33	0.80	42	125	0.33	Yes
43	Office	125	8	5	5	1	0.06	11	0	0	11	1.00	11	125	0.09	Yes
44	Office	55	8	5	5	0	0.06	5	0	0	5	1.00	5	100	0.05	Yes
45	Corridor	340	8	0	0	0	0.06	20	2	91	91	1.00	91	300	0.30	Yes
46	Corridor	1330	8	0	0	0	0.06	80	2	355	355	1.00	355	375	0.95	Yes
47	Laundry	155	8	10	5	2	0.12	27	0	0	27	1.00	27	150	0.18	Yes
48	Office	275	8	5	5	1	0.06	24	0	0	24	1.00	24	200	0.12	Yes
49	Office	240	8	5	5	2	0.06	24	0	0	24	1.00	24	200	0.12	Yes
50	Lounge	155	8	25	5	4	0.06	29	0	0	29	1.00	29	150	0.19	Yes
51	Office	345	8	5	5	2	0.06	30	0	0	30	1.00	30	200	0.15	Yes
52	Storage	2705	8	0	0	0	0.12	325	2	721	721	1.00	721	1000	0.72	Yes
53	Office	100	8	5	5	1	0.06	9	0	0	9	1.00	9	150	0.06	Yes
54	Office	100	8	5	5	1	0.06	9	0	0	9	1.00	9	150	0.06	Yes
55	Conference Room	170	8	50	5	9	0.06	53	0	0	53	1.00	53	500	0.11	Yes
56	Kitchen	580	8	70	7.5	41	0.18	409	2	155	409	1.00	409	825	0.50	Yes
57	Kitchen	805	8	70	7.5	56	0.18	568	2	215	568	1.00	568	1225	0.46	Yes
58	Kitchen	610	8	70	7.5	43	0.18	430	2	163	430	1.00	430	850	0.51	Yes
59	Kitchen	655	8	70	7.5	46	0.18	462	2	175	462	1.00	462	600	0.77	Yes
60	Storage	475	8	0	0	0	0.12	57	2	127	127	1.00	127	400	0.32	Yes
61	Kitchen	50	8	70	7.5	4	0.18	35	2	13	35	1.00	35	175	0.20	Yes
	TOTALS:	24165						4833					7155	20550	0.35	Yes

APPENDIX B: Mechanical First Costs

Equipment First Cost			
HVAC	**Quantity**	**Unit**	**Amount**
Equipment			
Cooling Tower	2	EA	150,000
Chillers	2	EA	480,000
Low Temp Chillers	1	EA	205,000
AHU	3,500	CFM	14,000
AHU	4,500	CFM	18,000
AHU	6,600	CFM	26,400
AHU	16,000	CFM	64,000
AHU	70,000	CFM	280,000
AHU	15,000	CFM	60,000
AHU	4,500	CFM	18,000
AHU	4,500	CFM	18,000
AHU	33,500	CFM	134,000
AHU	33,500	CFM	134,000
AHU	33,500	CFM	134,000
AHU	33,500	CFM	134,000
Boilers	8	EA	380,000
Cooling Tower pumps	2	EA	40,000
Chilled Water Pumps	2	EA	40,000
Secondary Chilled Water Pumps	2	EA	40,000
Ice Storage Chilled Water Pumps	2	EA	36,000
Plate and Frame Heat Exchanger	1	EA	130,000
Chilled water air separator	1	EA	15,000
Chilled water expansion tank	1	EA	10,000
Make up water tank - chilled water	1	EA	2,500
Ice Storage Tanks	13	EA	97,500
Heating water pumps	2	EA	40,000
Secondary Heating water pumps	2	EA	40,000
Domestic Water Heat Exchanger	3	EA	90,000
Heating water Air separator	1	EA	15,000
Heating water expansion tank	2	EA	30,000
Make up water PRV/tank - heating water	1	EA	7,500
Water chemical treatment	2	EA	4,000
Pump inertia bases	12	EA	18,000
Variable Frequency Drives for pumps	12	LS	42,000
Variable Frequency Drives for AHU's/Cooling Towers	14	LS	70,000
Rooftop Exhaust Fans	1	EA	3,500
Rooftop Exhaust Fans	12	EA	114,000
Dx split system - Elev equipment room	5	LS	27,500
FPVAV air terminal units with reheat	320	EA	479,250
Hydronic Cabinet Heaters	20	EA	36,000
Pipe, Valves, Fittings, & Insulation			
X-Large CW and HW distribution piping	1,000	LF	275,000
Large CW and HW distribution piping	2,800	LF	560,000

Water closets	177	EA	277,890
W.C. Fixture	177	EA	123,015
Shower Fixture	177	EA	307,980
Toilet Seat	177	EA	20,355
Shower Fixture	177	EA	307,980
Fixtures with chase piping			
Water closets	46	EA	69,000
Urinals	3	EA	5,100
Lavatories	43	EA	55,900
Sink	6	EA	12,000
Janitor Closet Mop basin and faucet	10	EA	19,500
Electric water cooler	12	EA	26,400
Exterior hose bibbs	12	EA	9,600
Floor drains	30	EA	15,000
Rain water storm / collection system			
RWC's	132,280	SF	231,489
Roof Drains	33	EA	21,495
Sanitary system			
Above ground sanitary waste and vent	21,564	FT	615,060
Underground ground sanitary waste	132,280	SF	661,398
Domestic Water			
Medium CW and HW distribution piping	2,000	LF	190,000
Copper/Insulated piping	285,000	SF	1,140,000
Gas Distribution			
Propane Tank	1	EA	36,000
Meter Setting	1	EA	6,000
Meter Setting	1	EA	6,000
3" gas line from Tank to equipment room	150	LF	11,250
Propane equipment room distribution	1	LS	15,000
Natural Gas equipment room distribution	1	LS	15,000
Commercial Kitchen			
Plumbing to Kitchen Equipment	1	EA	50,000
Natural Gas distribution	1	LS	15,000
Total			4,939,425

Equipment First Cost	Amount
HVAC	
Equipment	3,677,150
Pipe, Valves, Fittings, & Insulation	2,170,750
Sheet Metal	4,391,200
Miscellaneous	15,000
Fire Protection	
Equipment	985,649
Plumbing	
Equipment	115,100
Patient Room Fixtures with chase piping	1,598,133
Fixtures with chase piping	212,500
Rain water storm / collection system	252,984
Sanitary system	1,276,458
Domestic Water	1,330,000
Gas Distribution	89,250
Commercial Kitchen	65,000
Total	**16,179,174**

Medium CW and HW distribution piping	3,200	LF	304,000
Heating Water system distribution piping	285,000	SF	783,750
HW coil connections at air handling unit	12	EA	66,000
CHW coil connections at air handling unit	12	EA	90,000
CHW Pump connections	8	EA	72,000
HW Pump connections	4	EA	20,000
Sheet Metal			
Supply Air & Return Air ductwork	258,600	CFM	1,810,200
Outside Air Ductwork	100,200	CFM	501,000
Exhaust Ductwork	125,000	CFM	500,000
Kitchen Exhaust Ductwork	15,000	CFM	120,000
Temperature Control	1	LS	1,005,000
Air and Water Balancing	1	LS	205,000
Rigging and Setting Equipment	1	LS	250,000
Miscellaneous			
Concrete housekeeping pads	1	LS	15,000
Temporary Heat	1	LS	
Labor for LEED commissioning	1	LS	
Total			10,254,100

Equipment First Cost			
Fire Protection	**Quantity**	**Unit**	**Amount**
Equipment			
6" detector check backflow and piping	1	LS	7,500
Dry System piping / compressor / controls		LS	
Dry pipe sprinklers - new concealed area		SF	-
Wet pipe sprinklers - new concealed area	260,774	SF	912,711
Wet pipe sprinklers - new exposed area	23,796	SF	65,438
Fire Pump / Transfer Switch		EA	-
Bond		LS	-
Total			985,649

Equipment First Cost			
Plumbing	**Quantity**	**Unit**	**Amount**
Equipment			
Backflow preventor assembly	1	EA	7,500
Shell Type Heat Exchanger	3	EA	40,500
Storage Tanks	2	EA	31,000
HW recirc pumps	2	EA	13,600
Master Mixing valve station	1	LS	15,000
Point of use Mixing valves		LS	-
Elevator sump pump & piping	5	EA	7,500
Patient Room Fixtures with chase piping			
Lavatory System	177	EA	560,913