DASCO Medical Office Building

Saint Joseph Medical Center

Towson, Maryland

Mechanical Technical Report 1

ASHRAE Standard 62.1 Ventilation Report

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Mechanical Option

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Executive Summary

Technical Assignment 1 is an evaluation of ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Standard 62.1-2007. Standard 62.1 focuses on ventilation for acceptable indoor air quality. In this assignment, Sections 5 and 6 were reviewed for compliance of the DASCO Medical Office Building mechanical system with this standard.

This building was designed as a shell and core, open-plan for medical office use by future tenants. As the four story building found tenants, different phases of fit-outs started, and the open space was built into offices, exam rooms, waiting rooms, and specialty imagining and cancer treatment spaces.

The building mechanical system is a fan powered variable air volume system with a return air plenum. Three (3) air handling units, two (2) are located on the roof and one (1) above a linear accelerator bunker on the rear side of the building. Each AHU was designed to deliver approximately 20% outdoor air to the spaces. AHU-1 serves the ground floor and part of the first. AHU-2 serves the second and third floors, and AHU-3 serves only the first floor.

As per the assignment requirements, the ventilation rate procedure was used to evaluate the buildings outdoor air needs based on occupancy and square feet of usable space. It should be noted that Standard 62.1 outlines an Indoor Air Quality Procedure that was not looked at as part of this assignment.

Assumptions

ASHRAE Standard 62.1-2007 has been established to provide minimum ventilation rates for breathing zone outdoor air flow. Using the Ventilation Rate Procedure, it is necessary to determine space type, occupancy, and floor area. In order to perform these calculations the room usage was based on the room name provided on the construction documents. The floor areas were measured using Auto CAD files and rounded to the nearest square foot. Based on the level of detail on the floor plans, most space occupancies were determined by the furniture plans. Any other occupancy was estimated using Table 6-1 (ASHARE 2007) which includes a list of default values for occupant density. Since this is a medical office building, and some of the spaces are not listed in Table 6-1, the occupancy was determined through an assumption of how the space may be used during normal conditions.

Any equipment and machine rooms that have individual wall mounted air conditioning units linked to outdoor air cooled condensing units provided adequate ventilation. All toilets, janitor closets, storage rooms, and sections of corridors which do not have a diffuser are supplied fresh air through transfer ducts. To determine the minimum exhaust rates for janitor closets, soiled laundry storage rooms, and private toilets, values were taken from Table 6-4 (ASHRAE 2007). Calculations of the zone outdoor air flow in section 6.2.2.3 require the zone air distribution effectiveness factor which is determined using Table 6-2 (ASHRAE 2007). Since this building's air distribution configuration is ceiling supply of cool air, the $E_z = 1.0$ and thus does not affect the zone outdoor air flow.

Building Design

The DASCO Medical Office Building was constructed by the DASCO Companies on the campus of Saint Joseph Medical Center in Towson, Maryland. Initially the building was designed as a 4 story, 64,000 square foot shell and core facility. Each open floor plan has approximately 12,700 square feet of leasable space. Mechanical shafts, two private toilets, two elevators, a main corridor and electrical rooms comprise the core which is the remaining 3,300 square feet of each floor. A two story addition to the shell of the building facing the driveway and patient drop-off added 2,200 square feet to the first floor. As tenants such as Midatlantic Cardiovascular Associates, Radamerica Inc., and Saint Joseph Medical Center began to lease the medical office space the open floor was converted into physician offices, exam rooms, conference rooms, and waiting rooms. In addition to these normal office type spaces specialized rooms were engineered into the building to accommodate the practices of the different physician groups. The building now has two linear accelerators, a nuclear laboratory, infusion suites, and a CT and PET/CT scanner. The linear accelerators are located in a separate attachment to the building on the back side. This space is constructed of five foot thick concrete walls which create a two story bunker to house each linear accelerator. The pieces of medical equipment are used to administer radiation treatment to cancer patients. An existing parking garage adjacent to the building has been linked to the building through a compartmentalized breezeway. Construction of the shell building started in October 2005 and the final tenant fit-outs should be completed by November 2007.

Mechanical Systems

The mechanical system for the DASCO Medical Office Building was initially engineered for the shell and core building phase with the knowledge that the building would be fit-out to accommodate tenant needs in the future. Designers understood the building to be a medical office building and not a hospital, so that any future spaces requiring hospital quality fit-outs such as diagnostic imaging and laboratories would be evaluated individually. This is evident since additional HVAC equipment has been added to the building since the shell and core construction. The nuclear lab has two computer room air conditioning units providing direct cooling over the two machines located in the space. Fan powered HEPA ceiling modules were added to the clean and ante rooms of the first floor infusion center fit-out. Also due to the cooling demands of the two linear accelerators and the PET/CT scanner, located on the ground floor, each has a separate closed loop chilled glycol system running though individual chillers located outside of the linear accelerator bunker.

Mechanical design for the shell and core building, engineered with the intent of future fit-outs, is an all air variable air volume (VAV) system. There are two 130 ton Trane Intellipak high efficiency direct expansion rooftop air handling units designed for approximately 20% outdoor air. AHU-1 has a 37,000 cubic feet per minute (cfm) capacity (7,400 cfm outdoor air) intended to serve the ground and first floor; while AHU-2 has a 36,000 cfm capacity (7,200 cfm outdoor air) intended to serve the second and third floors. Each is equipped with a 0-100% economizer section with proportional dampers allowing for 0-100% outside air. With the design of the first floor fit-out, which is a multi-disciplinary space; a third air handler was added to the project. This unit is a 30 ton Trane Intellipak high efficiency direct expansion rooftop air handling unit providing approximately 20% outdoor air. The location of the third unit is on the roof of the linear accelerator area, with a capacity of 10,680 cfm (2,000 cfm outdoor air).

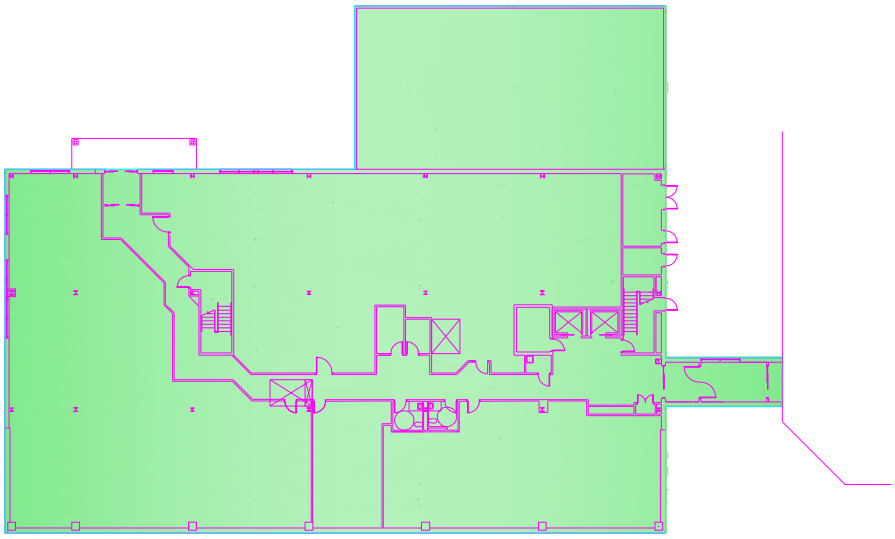
Each air handler serves fan powered VAV boxes which provide the outdoor air to the spaces. Return air travels through a ceiling plenum to three separate return air ducts leading back to the air handling units.

Table 1 gives the supply air and outside air for each air handling unit. The color matches to the area served by each unit on the floor plans below.

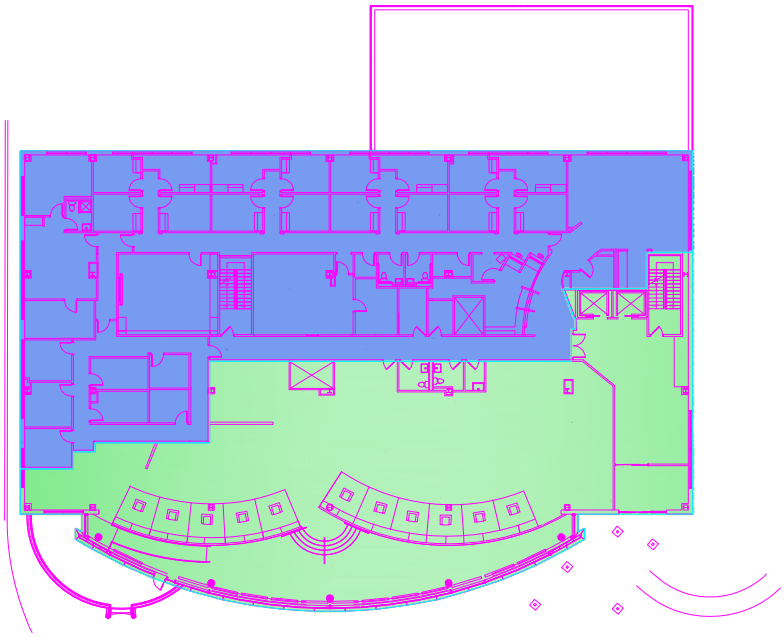
Table 1 - Air Handling Units

No.	Total Supply Air	Outside Air	Color
AHU-1	37,000	7,400	
AHU-2	36,000	7,200	
AHU-3	10,680	2,000	

Air Handling Unit Space Breakdown



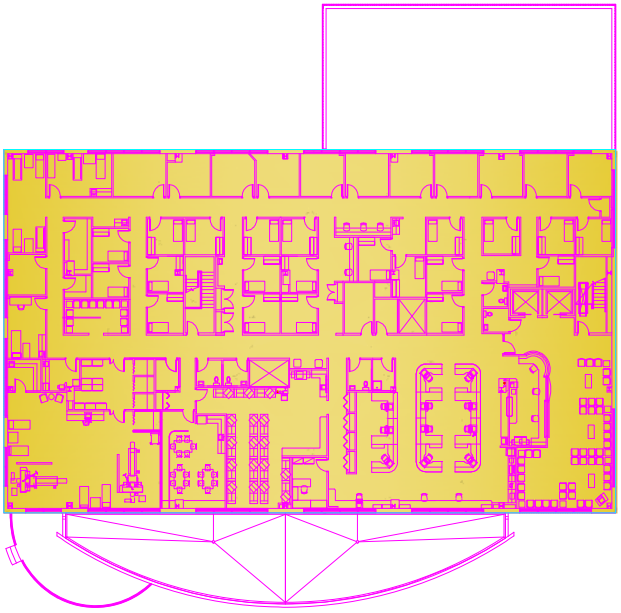
Ground Floor



First Floor

Air Handling Unit Space Breakdown

Second Floor



Third Floor

Section 5 Requirements

ASHRAE Standard 62.1-2007, Section 5 goes through the systems and equipment requirements. It is required by this standard that for plenum systems, when the ceiling is used both to recirculate return air and distribute ventilation air, the system must provide the required minimum ventilation airflow. The DASCO building only returns air through the ceiling plenum, and the ventilating terminal units are directly connected to the ventilation air ducts. All three AHUs are located on a roof top, two of these on the third floor roof and the other on the linear accelerator bunker roof which is at the first floor level. The roof top location ensures that the air intake minimum separation distance outlined in Table 5-1 (ASHRAE 2007) is met for object such as garage entry, street parking, garbage storage, etc. and based on roof drawings the isolation exhausts added after the shell and core design are further than 15 feet away from the AHUs. It should also be noted that wire mesh screens were called out on the drawings for the shell and core building phase to make certain that nothing got into the open ended ducts. Also bird screens were called out on the roof plan for outdoor air intakes and relief air discharge sides of the AHUs. Because the building is adjacent to an attached parking garage, the architect designed a vestibule to provide and airlock between the garage and the adjacent occupiable spaces as stated in section 5.16 (ASHRAE 2007).

Section 6 Requirements

The Ventilation Rate Procedure was established to determine the necessary outdoor air intake flow. This method is based on the physical size of each space, the amount of occupants assumed to populate each space, and the primary function of each space. Zone outdoor airflow is determined by factoring in a distribution effectiveness number which is based on the air distribution method into each space. Zone primary airflow is used to find the primary outdoor air fraction. This needs to be calculated because the DASCO Medical Office Building has a multiple-zone recirculating system. After adding each room required outdoor airflow to find the uncorrected outdoor air intake, the zone primary outdoor air fraction is used to determine the system ventilation efficiency. This uncorrected outdoor air intake becomes the necessary outdoor air intake when factored by the system efficiency, which in most cases results in a larger number.

Table 3 in Appendix A defines a list of variables used in Section 6. Table 4 in Appendix A lists the different equations given to calculate the required outdoor air intake flow. The calculation procedure is detailed in Appendix A.

According to Section 6 it is also required to ensure that exhaust airflow meets the requirements of Table 6-4 (ASHRAE 2007). Exhaust air can be a combination of outdoor air, recirculated air, or transfer air. The primary rooms of concern are toilets, janitor closets, and soiled utility rooms. Table 5 in Appendix A details each space that requires ventilation compared with the standard minimum exhaust rates.

Discussion of Results

Table 2 - Summary of Results			
	design total supply air	design outside air	outside air required per ASHRAE Std. 62.1-2007
AHU-1	37,000	7,400	3,822
AHU-2	36,000	7,200	6,935
AHU-3	10,680	2,000	1,810
Totals	83,680	16,600	12,567

As Table 2 above shows each air handling unit has the ability to supply sufficient outdoor air to each space. It should be noted that the building was designed as a shell and core so ventilation requirements may have been approximated based on knowledge of medical office building occupancy and space functions. Each AHU was designed for approximately 20% outdoor air, and assumption made by the engineers prior to the fit-out design. This seems to be an adequate estimate of the ventilation requirements. The calculations shown in this report are based on the building as it has been fit-out since shell construction and original design. Each floor now resembles the completed building and its final space breakdowns and occupancies. This may change in the future depending on tenant needs, but as for now the building mechanical system meets ASHRAE Standard 62.1-2007.

One of the reasons AHU-1 may seem over sized for outdoor air is due to the fact that there was a two-story addition to the front of the building and a fit-out on the first floor. AHU-3 was added because the engineering team felt that AHU-1, which was originally designed to handle the ground and first floor, would not be sufficient after the occupancy and space functions were decided for that first floor fit-out. The other AHUs seem to be very close to the required outdoor air.

Appendix A

Table 3 - ASHRAE Standard 62.1-2007 Section 6, Ventilation Rate Procedure	
Az	Zone floor area
Pz	Zone population
Rp	Outdoor airflow rate required per person
Rz	Outdoor airflow rate required per square foot
Ez	Zone air distribution effectiveness
Voz	Design zone outdoor airflow
Zp	Zone primary outdoor air fracton
Vbz	Breathing zone outdoor airflow
Vpz	Zone promary airflow
Vou	Uncorrected outdoor air intake
D	Occupant diversity
Ps	System population
Vot	Outdoor air intake flow

Table 4 - ASHRAE Standard 62.1-2007 Section 6, Equations	
1	Vbz=(Pz*Rp+Az*Ra)
2	Voz=Vbz/Ev
3	Zp=Voz/Vpz
4	D=Ps/ΣPz
5	Vou=D*Σ(Rp*Pz)+Σ(Ra*Az)
6	Vot=Vou/Ev

Table 5 - ASHRAE 62.1-2007 Standard 6, Exhaust Requirements							
		design		Exhaust req.		total exhaust	exhaust
Room	Function	cfm	area	cfm/unit	cfm/sq. ft.	needed	provided
129	hc toilet	50	53	25		25	125
105	hc toilet	50	39	25		25	125
139	hc toilet	50	48	25		25	125
117	dirty	0	18	0	1	18	50
100-10	patient toilet	50	52	25		25	75
100-05	staff toilet	50	52	25		25	75
i-124	toilet	0	53	25		25	80
i-125	toilet	0	53	25		25	80
i-134a	toilet	50	50	25		25	85
105	jan clos.	0	37	0	1	37	75
106	mens toilet	0	57	25		25	75
107	womens toilet	0	57	25		25	75
s-204	jan. clos.	0	37	0	1	37	75
s-205	mens toilet	0	57	25		25	75
s-206	womens toilet	0	57	25		25	75
210	toilet/shower	50	80	25		25	125
234	hc toilet	50	48	25		25	125
a-211	patient toilet	0	46	25		25	75
a-215	staff toilet	0	51	25		25	75
a-236	patient toilet	0	52	25		25	75
a-239	staff toilet	0	52	25		25	75
a-246	public toilet	0	52	25		25	75
310	staff toilet	50	51	25		25	125
311	janitor	0	47	0	1	47	75
314	patient toilet	50	47	25		25	125
315	patient toilet	50	47	25		25	125
345	patient toilet	50	42	25		25	125
346	patient toilet	50	43	25		25	125
128a	toilet	0	52	25		25	75
101	patient toilet	0	76	25		25	100
116	soiled utility	0	33	0	1	33	100
111	staff toilet	0	50	25		25	75
110	patient toilet	0	50	25		25	75

Ventilation Rate Procedure

Variables described below are listed in Table 3 in Appendix A.

Equations described below are referenced by number to Table 4 in Appendix A.

Step 1:

- Find each room area in square feet (Az)
- Determine the zone population (Pz)
- Using Table 6-1 (ASHRAE 2007) determine the outdoor airflow rate per person (Rp)
- Using Table 6-1 (ASHRAE 2007) determine the outdoor airflow rate per area (Ra)
- Insert these values into equation 1 to determine breathing zone outdoor airflow (Vbz)

Step 2:

- The zone air distribution effectiveness (Ez) is one (1) based on Table 6-2 (ASHRAE 2007)
- Therefore, zone outdoor airflow (Voz) as determined by equation 2 is equal to Vbz

Step 3:

- Each rooms primary outdoor airflow (Vpz) is determined from the drawings
- Then, equation 3 is used resulting in the primary outdoor air fraction (Zp)

Step 4:

- The occupant diversity is found using equation 4 (Ps=Pz for each air handler)

Step 5:

- Equation 5 is used to find the uncorrected outdoor air intake (Vou)
- This number is a summation of each Vbz determined earlier for each zone

Step 6:

- Use the Zp and Table 6-3 (ASHRAE 2007) to find the system ventilation efficiency (Ev)
- Then determine the outdoor air intake (Vot) using equation 6

Appendix B

Calculation Spreadsheets

AHU-1

Room	Function	design cfm supply	exhaust	area (Az)	Occupancy (Pz)	OA required (Rp)	OA required (Ra)	Vbz	Vpz	Zp
003	corridor	315		1480	0	0	0.06	89	315	0.282
003a	link	495		304	0	0	0.06	18	495	0.037
008	electrical room	50		84	0	0	0.06	5	50	0.101
009	telephone	380		55	0	0	0	0	380	0.000
014	elec. Room	1000		185	0	0	0.06	11	1000	0.011
126	director	395		140	1	5	0.06	12	395	0.030
125	chief tech	195		85	1	5	0.06	10	195	0.052
124	physicist	305		85	1	5	0.06	10	305	0.033
123	treatment planning	570		120	1	5	0.06	10	570	0.018
122	dressing	65		29	1	5	0.06	7	65	0.104
121	dressing	50		29	1	5	0.06	7	50	0.135
127	corridor	160		265	0	0	0.06	16	160	0.099
143	corridor	75		179	0	0	0.06	11	75	0.143
128	office	245		123	1	5	0.06	10	245	0.043
129	hc toilet	50	125	53	0	0	0	0	50	0.000
131	chart storage	85		213	0	0	0.12	26	85	0.301
132	file serv/phone/stor	145		70	0	0	0.12	8	145	0.058
136	exam	120		108	2	5	0.06	16	120	0.137
135	exam	105		90	2	5	0.06	15	105	0.147
134	exam	105		90	2	5	0.06	15	105	0.147
144	storage	50		89	0	0	0.12	11	50	0.214
146	mold block	145	245	100	0	5	0.06	6	145	0.041
145	corridor	100		100	0	0	0.06	6	100	0.060
147	staff lounge	185		122	3	5	0.06	23	185	0.122
148	chart storage	170		159	0	0	0.12	19	170	0.112
150	rad/oncogolgy stor	60		188	0	0	0.12	23	60	0.376
149	chart storage	50		127	0	0	0.12	15	50	0.305
#	shell space	2000		2075	10	5	0.06	176	2000	0.088
112	linacc	1365		789	2	15	0.06	77	1365	0.057
111	linacc	1485		789	2	15	0.06	77	1485	0.052
108	mech room	165		76	0	5	0.06	5	165	0.028
110	control	785		209	2	5	0.06	23	785	0.029
113	control	785		219	2	5	0.06	23	785	0.029

107	control room	460		126	2	5	0.06	18	460	0.038
106	ct simulator	1050		287	2	15	0.06	47	1050	0.045
105	hc toilet	50	125	39	0	0	0	0	50	0.000
104	ofc mgr	185		120	2	5	0.06	17	185	0.093
115	view boxes	100		168	0	5	0.06	10	100	0.101
139	hc toilet	50	125	48	0	0	0	0	50	0.000
117	dirty	0	50	18	0	0	0.06	1	0	-
118	clean	50		18	0	5	0.06	1	50	0.022
114	dark room	130		54	1	5	0.12	11	130	0.088
119	dressing	50		44	1	5	0.06	8	50	0.153
120	sub-waiting	135		154	5	5	0.06	32	135	0.240
137	nursing	175		79	1	5	0.06	10	175	0.056
138	stretcher	50		81	1	5	0.06	10	50	0.197
116	corridor	0		133	0	0	0.06	8	0	-
103	storage	50		67	0	0	0.12	8	50	0.161
102	reception	305		135	4	5	0.06	28	305	0.093
140	conference	800		182	9	5	0.06	56	800	0.071
141	exam	105		90	2	5	0.06	15	105	0.147
142	med storage	50		58	0	0	0.12	7	50	0.139
101	waiting	1350		415	12	5	0.06	87	1350	0.065
100-04	prep/injection	105		92	1	5	0.06	11	105	0.100
100-06	prep/injection	105		92	1	5	0.06	11	105	0.100
100-08	prep/injection	105		92	1	5	0.06	11	105	0.100
100-10	patient toilet	50	75	52	0	0	0	0	50	0.000
100-12	hot lab	105		90	1	10	0.18	26	105	0.250
100-01	corridor	105		322	0	0	0.06	19	105	0.184
100-00	waiting	170		184	6	5	0.06	41	170	0.241
100-03	reg/techs	250		163	2	5	0.06	20	250	0.079
100-05	staff toilet	50	75	52	0	0	0	0	50	0.000
100-07	control	500		124	1	5	0.06	12	500	0.025
100-09	pet/ct scan	1015		374	2	15	0.06	52	1015	0.052
100-11	equip	0		92	0	0	0.06	6	0	-
r-005	social work/diet	165		126	1	5	0.06	13	165	0.076
r-007	nurses	165		120	1	5	0.06	12	165	0.074
r-008	phd	115		108	1	5	0.06	11	115	0.100

r-004	registry/research	1105		800	16	5	0.06	128	1105	0.116
r-003	research nurses	325		118	1	5	0.06	12	325	0.037
r-002	office	150		91	1	5	0.06	10	150	0.070
r-006	genetics pastoral	165		137	1	5	0.06	13	165	0.080
r-001	recep/waiting	825		433	13	7.5	0.06	123	825	0.150
c-11	corridor	55		107	0	0	0.06	6	55	0.117
e101	elevator lobby	570		738	7	5	0.06	81	570	0.142
i-117	phlebotomy	140		140	1	10	0.18	35	140	0.251
i-118	pharmacy	160		92	2	5	0.18	27	160	0.166
i-118a	work room	265		112	1	5	0.06	12	265	0.044
i-118b	ante room	565		71	1	10	0.06	14	565	0.025
i-118c	clean room	750		112	0	5	0.06	7	750	0.009
i-119	reception	190		202	6	5	0.06	42	190	0.223
i-120	waiting	834		742	25	7.5	0.06	232	834	0.278
i-121a	front office	295		223	3	5	0.06	28	295	0.096
i-123	soiled utility	50		86	0	0	0	0	50	0.000
i-124	toilet	0	80	53	0	0	0	0	0	-
i-125	toilet	0	80	53	0	0	0	0	0	-
i-126	hall	200		334	0	0	0.06	20	200	0.100
i-128	consult	130		91	5	5	0.06	30	130	0.234
i-130	triage	130		72	1	25	0.06	29	130	0.226
i-131	clean utility	185		245	0	5	0.06	15	185	0.079
i-132a	infusion bay 2	10985		4205	16	5	0.06	332	10985	0.030
i-134	private office	375		152	0	5	0.06	9	375	0.024
i-134a	toilet	50	85	50	0	0	0	0	50	0.000
i-136	break room	225		139	4	5	0.06	28	225	0.126
i-138	it closet	0		8	0	0	0	0	0	-
c-10	corridor	300		550	0	0	0.06	33	300	0.110
103	telephone	380		55	0	0	0	0	380	0.000
104	electrical room	50		84	0	0	0.06	5	50	0.101
105	jan clos.	0	75	37	0	0	0	0	0	-
106	mens toilet	0	75	57	0	0	0	0	0	-
107	womens toilet	0	75	57	0	0	0	0	0	-

Max Zp	0.376
Pz(total)	198
Vou	2675
D	1
Ev	0.7
Vot	3822

AHU-2

Room	Function	design cfm supply	exhaust	area (Az)	Occupancy (Pz)	OA required (Rp)	OA required (Ra)	Vbz	Vpz	Zp
s-202	telephone	380		55	0	0	0	0	380	0
s-203	elec. Room	50		84	0	0	0.06	5	50	0.101
s-204	jan. clos.	0	75	37	0	0	0	0	0	-
s-205	mens toilet	0	75	57	0	0	0	0	0	-
s-206	womens toilet	0	75	57	0	0	0	0	0	-
200	waiting	1110		520	20	7.5	0.06	181	1110	0.163
201	reception	410		470	4	5	0.06	48	410	0.118
202	corridor	345		1141	0	0	0.06	68	345	0.198
204	exam	95		108	1	5	0.06	11	95	0.121
205	exam	95		108	1	5	0.06	11	95	0.121
206	phone room	180		44	0	0	0	0	180	0.000
207	break room	295		239	12	5	0.06	74	295	0.252
208	meds closet	50		64	0	0	0.12	8	50	0.154
209	supply closet	0		35	0	0	0.12	4	0	-
210	toilet/shower	50	125	80	0	0	0	0	50	0.000
211	surgeon's office	340		254	3	5	0.06	30	340	0.089
212	surgeon's office	340		159	3	5	0.06	25	340	0.072
213	surgeon's office	395		157	3	5	0.06	24	395	0.062
214	pa office	110		129	3	5	0.06	23	110	0.207
215	physicans office	210		120	3	5	0.06	22	210	0.106
216	physicans office	395		120	3	5	0.06	22	395	0.056
217	exam	95		100	1	5	0.06	11	95	0.116
218	physicans office	210		114	3	5	0.06	22	210	0.104
219	physicans office	210		112	3	5	0.06	22	210	0.103
220	managers office	290		91	3	5	0.06	20	290	0.071
221	private office 1	195		92	3	5	0.06	21	195	0.105
222	private office 2	195		88	3	5	0.06	20	195	0.104
223	private office 3	295		96	3	5	0.06	21	295	0.070
224	private office 4	195		97	3	5	0.06	21	195	0.107
225	private office 5	195		91	3	5	0.06	20	195	0.105
226	private office 6	295		96	3	5	0.06	21	295	0.070
227	private office 7	195		101	3	5	0.06	21	195	0.108
228	private office 8	195		92	3	5	0.06	21	195	0.105
229	private office 9	295		95	3	5	0.06	21	295	0.070
230	private office 10	300		158	5	5	0.06	34	300	0.115

231	research office	205		166	2	5	0.06	20	205	0.097
232	research supply	85		253	0	0	0.12	30	85	0.357
233	open area	625		728	8	7.5	0.06	104	625	0.166
234	hc toilet	50	125	48	0	0	0	0	50	0.000
235	research supply	85		273	0	0	0.12	33	85	0.385
a-202	front office	140		154	1	5	0.06	14	140	0.102
a-203	reading	175		275	1	5	0.06	22	175	0.123
a-205	us 1	300		153	1	5	0.06	14	300	0.047
a-206	hallway	120		321	0	0	0.06	19	120	0.161
a-207	mammo 1	395		146	1	5	0.06	14	395	0.035
a-208	mammo 2	480		143	1	5	0.06	14	480	0.028
a-209	us 2/mammo 3	420		147	1	5	0.06	14	420	0.033
a-210	storage	50		59	0	0	0.12	7	50	0.142
a-211	patient toilet	0	75	46	0	0	0	0	0	-
a-212	dressing	180		199	5	5	0.06	37	180	0.205
a-213	tech work area	270		90	1	5	0.06	10	270	0.039
a-215	staff toilet	0	75	51	0	0	0	0	0	-
a-216	dexa	205		94	2	5	0.06	16	205	0.076
a-217	manager	105		96	2	5	0.06	16	105	0.150
a-218	imaging registration	175		60	2	5	0.06	14	175	0.078
a-219	shared waiting	1330		1152	44	7.5	0.06	399	1330	0.300
a-220	check in	155		136	2	5	0.06	18	155	0.117
a-221	manager office	90		82	1	5	0.06	10	90	0.110
a-222	check out	130		76	2	5	0.06	15	130	0.112
a-224	conference room	260		184	6	5	0.06	41	260	0.158
a-225	exam 6	285		120	1	5	0.06	12	285	0.043
a-226	exam 1	285		133	1	5	0.06	13	285	0.046
a-227	sterilization	410	460	120	2	5	0.06	17	410	0.042
a-228	exam 5	285		121	1	5	0.06	12	285	0.043
a-230	exam 3	320		135	1	5	0.06	13	320	0.041
a-231	exam 4	285		120	1	5	0.06	12	285	0.043
a-232	office	370		193	7	5	0.06	47	370	0.126
a-233	office	290		125	3	5	0.06	23	290	0.078
a-234	hallway	335		638	0	0	0.06	38	335	0.114
a-235	bbc	675		274	3	5	0.06	31	675	0.047
a-236	patient toilet	0	75	52	0	0	0	0	0	-
a-238	exam 2	285		135	1	5	0.06	13	285	0.046
a-239	staff toilet	0	75	52	0	0	0	0	0	-
a-242	storage	50		68	0	0	0.12	8	50	0.163
a-244	kitchen	215		40	0	5	0.06	2	215	0.011

a-245	med rec	305		274	6	5	0.06	46	305	0.152
a-246	public toilet	0	75	52	0	0	0	0	0	-
s-302	telephone	380		54	0	0	0	0	380	0.000
300	waiting	2400		1075	44	7.5	0.06	395	2400	0.164
301	reception	285		247	2	5	0.06	25	285	0.087
302	charts	2050		1630	14	5	0.06	168	2050	0.082
304	office manager	285		127	1	5	0.06	13	285	0.044
305	corridor	2696		1605	0	0	0.06	96	2696	0.036
310	staff toilet	50	125	51	0	0	0	0	50	0.000
311	janitor	0	75	47	0	0	0	0	0	-
313	file room	830		835	2	5	0.06	60	830	0.072
314	patient toilet	50	125	47	0	0	0	0	50	0.000
315	patient toilet	50	125	47	0	0	0	0	50	0.000
316	break room	685		431	18	5	0.06	116	685	0.169
318	server	195		50	0	5	0.06	3	195	0.015
319	file area	300		270	2	5	0.06	26	300	0.087
319a	dress	0		0	0	0	0	0	0	-
319b	dress	0		0	0	0	0	0	0	-
319c	dress	0		0	0	0	0	0	0	-
320	nuclear lab	600		1145	8	15	0.18	326	600	0.544
320a	hc dress	0		0	0	0	0	0	0	-
321	hot lab	210		73	2	10	0.18	33	210	0.158
322	blood lab	115		80	2	10	0.18	34	115	0.299
323	echo	390		168	2	10	0.18	50	390	0.129
324	research office	350		110	2	5	0.06	17	350	0.047
325	stress test	650		270	4	15	0.06	76	650	0.117
326	echo	445		198	3	10	0.18	66	445	0.148
327	pa office	405		161	1	5	0.06	15	405	0.036
328	physicans office	240		123	1	5	0.06	12	240	0.052
329	physicans office	330		130	1	5	0.06	13	330	0.039
330	physicans office	240		133	1	5	0.06	13	240	0.054
331	physicans office	330		132	1	5	0.06	13	330	0.039
332	physicans office	330		132	1	5	0.06	13	330	0.039
333	physicans office	240		132	1	5	0.06	13	240	0.054
334	physicans office	425		132	1	5	0.06	13	425	0.030
335	physicans office	150		132	1	5	0.06	13	150	0.086
336	physicans office	425		132	1	5	0.06	13	425	0.030
337	physicans office	440		132	1	5	0.06	13	440	0.029
339	exam 1	150		93	2	5	0.06	16	150	0.104
340	exam 3	90		91	2	5	0.06	15	90	0.172

341	exam 2	90		80	2	5	0.06	15	90	0.164
344	exam 4	90		90	2	5	0.06	15	90	0.171
345	patient toilet	50	125	42	0	0	0	0	50	0.000
346	patient toilet	50	125	43	0	0	0	0	50	0.000
347	exam 5	90		102	2	5	0.06	16	90	0.179
348	exam 6	90		92	2	5	0.06	16	90	0.172
349	exam 7	90		92	2	5	0.06	16	90	0.172
350	sink area	50		88	1	5	0.06	10	50	0.206
351	exam 8	90		92	2	5	0.06	16	90	0.172
352	exam 9	90		101	2	5	0.06	16	90	0.178
353	techs	115		73	3	5	0.06	19	115	0.169
354	techs	115		72	2	5	0.06	14	115	0.125
356	ekg area	120		84	1	10	0.18	25	120	0.209
357	exam 10	90		102	2	5	0.06	16	90	0.179
358	exam 11	90		93	2	5	0.06	16	90	0.173
359	exam 12	90		92	2	5	0.06	16	90	0.172
360	exam 15	90		92	2	5	0.06	16	90	0.172
361	exam 14	90		93	2	5	0.06	16	90	0.173
362	exam 13	90		102	2	5	0.06	16	90	0.179
366	exam 16	90		98	2	5	0.06	16	90	0.176
367	exam 17	90		92	2	5	0.06	16	90	0.172
368	exam 18	90		92	2	5	0.06	16	90	0.172
369	exam 19	90		102	2	5	0.06	16	90	0.179
370	sub-waiting	350		156	10	7.5	0.06	84	350	0.241
371	exam 21	90		88	2	5	0.06	15	90	0.170
372	exam 20	90		87	2	5	0.06	15	90	0.169
374	research files	60		97	0	5	0.06	6	60	0.097
375	supply closet	50		42	0	0	0.12	5	50	0.101

Max Zp	0.544
Pz(total)	384
Vou	4161
D	1
Ev	0.6
Vot	6935

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Room	Function	design cfm supply	exhaust	area (Az)	Occupancy (Pz)	OA required (Rp)	OA required (Ra)	Vbz	Vpz	Zp
129	office	550		230	5	5	0.06	39	550	0.071
128a	toilet	0	75	52	0	0	0	0	0	-
127	exam room	160		115	3	5	0.06	22	160	0.137
126	exam room	265		113	3	5	0.06	22	265	0.082
125	treatment room	470		141	3	10	0.12	47	470	0.100
124	exam room	160		122	3	5	0.06	22	160	0.140
122	exam room	160		122	3	5	0.06	22	160	0.140
121	treatment room	470		141	3	10	0.12	47	470	0.100
128	exec reception	665		338	7	5	0.06	55	665	0.083
131	conference/library	955		518	42	5	0.12	272	955	0.285
120	exam room	265		112	3	5	0.06	22	265	0.082
119	exam room	160		115	3	5	0.06	22	160	0.137
115	exam room	160		115	3	5	0.06	22	160	0.137
114	exam room	265		112	3	5	0.06	22	265	0.082
113	exam room	470		141	3	5	0.06	23	470	0.050
112	exam room	160		122	3	5	0.06	22	160	0.140
106	exam room	160		122	3	5	0.06	22	160	0.140
105	exam room	265		112	3	5	0.06	22	265	0.082
104	exam room	470		141	3	5	0.06	23	470	0.050
103	exam room	160		122	3	5	0.06	22	160	0.140
102	waiting room	1595		808	40	7.5	0.06	348	1595	0.218
101	patient toilet	0	100	76	0	0	0	0	0	-
116	soiled utility	0	100	33	0	0	0	0	0	-
111	staff toilet	0	75	50	0	0	0	0	0	-
110	patient toilet	0	75	50	0	0	0	0	0	-
108	clean utility	100		56	0	0	0.06	3	100	0.034
107	front office	365		320	6	5	0.06	49	365	0.135
100	entry vestibule	150		245	2	5	0.06	25	150	0.165
130	office	270		170	5	5	0.06	35	270	0.130
132	office	360		124	3	5	0.06	22	360	0.062
133	office	270		132	3	5	0.06	23	270	0.085
134	office	240		118	3	5	0.06	22	240	0.092
140	md mgr office	95		85	1	5	0.06	10	95	0.106
139	office	130		115	3	5	0.06	22	130	0.168
138	office	130		112	3	5	0.06	22	130	0.167
137	inf mgr office	95		85	1	5	0.06	10	95	0.106

c-7	corridor	105		488	0	0	0.06	29	105	0.279
c-1	corridor	290		918	0	0	0.06	55	290	0.190

Max Zp	0.285
Pz(total)	172
Vou	1448
D	1
Ev	0.8
Vot	1810

References

ANSI/ASHRAE Standard 62.1-2007. ASHRAE Inc. Atlanta, GA. 2007