

Mechanical Technical Report 1

ASHRAE Standard 62.1 Ventilation Compliance



Miller Children's Hospital Pediatric Inpatient Addition
Long Beach, CA

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1. Executive Summary

The Ventilation Rate Procedure as described in section 6 of ASHRAE 62.1 is used to calculate the required outdoor air supplied for the Miller Children’s Hospital Pediatric Inpatient Addition. The Pediatric Inpatient Addition has 7 air handling units supplying a constant air volume with heat coils for each of the spaces.

The Pediatric Inpatient Addition is a 4-story, 127,000 sq. ft. building attached to the existing Miller Children’s Hospital. The building consists of 7 operating rooms, 27 patient rooms, a neonatal intensive care unit, physicians’ rooms, offices, conference rooms, a gift shop, and sanctuary. The mechanical penthouse is located on the roof, housing all 7 AHUs and supplies to each of the 4 levels through two centrally-located mechanical shafts.

The ventilation rates have been determined using ASHRAE 62.1 for each space based on zone population, area, and function and then combined for each AHU. Using the mechanical drawings, the design airflows were calculated for each space and then combined for each AHU. The results can be seen in Table 1. Also an analysis of section 5 requirements of ASHRAE 62.1 reveals compliance in the area of systems and equipment to prevent re-entry of contaminated air and mold growth.

Table 1: Standard 62.1 Compliance Summary

AHU	Min OA Req'd (cfm)	Max OA Supplied (cfm)	ASHRAE 62.1 Compliance
1	3,173	20,000	Yes
2	2,764	7,000	Yes
3	3,837	15,000	Yes
4	4,691	20,000	Yes
5	9,786	18,000	Yes
6	5,862	20,000	Yes
7	5,769	11,000	Yes

Table 1 is a summary of the OA requirements per ASHRAE 62.1 and the supplied OA by the AHU for each of the 7 units located in the Miller Children’s Hospital Inpatient Addition. Each AHU more than complies with the standard.

2. Building Overview

The Pediatric Inpatient Addition to Miller Children’s Hospital is a 4-story, 127,000 sq. ft. facility. Operating rooms are located on the ground floor, which is actually below grade. The first floor consists of the main lobby with gift shop and sanctuary, conference and office spaces, and physicians’ rooms. The second floor houses the neonatal intensive care unit. Finally, the patient rooms are located on the third floor with mechanical penthouse on the roof above.

The mechanical penthouse houses the 7 AHUs, which supply air to the 4 levels of the building through two centrally-located mechanical shafts. Figures 1 through 4 show the areas for each AHU.

Figure 1: Ground Level

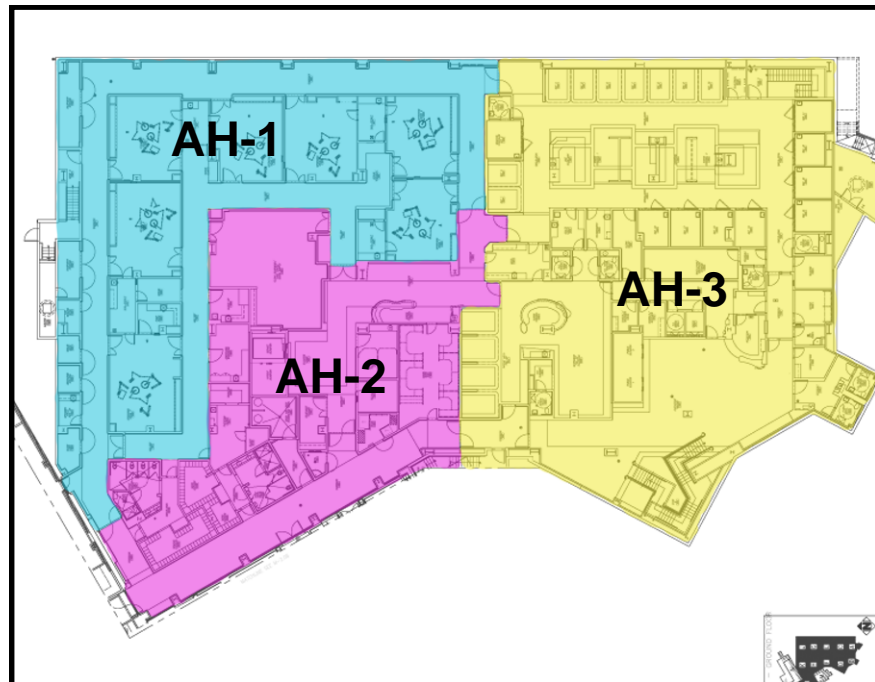


Figure 2: Level 1

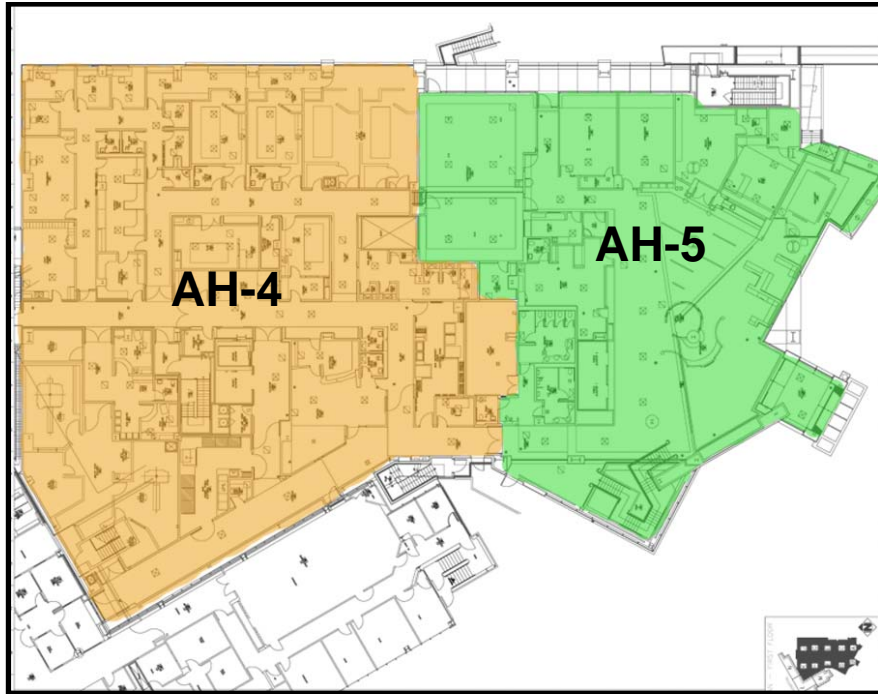


Figure 3: Level 2

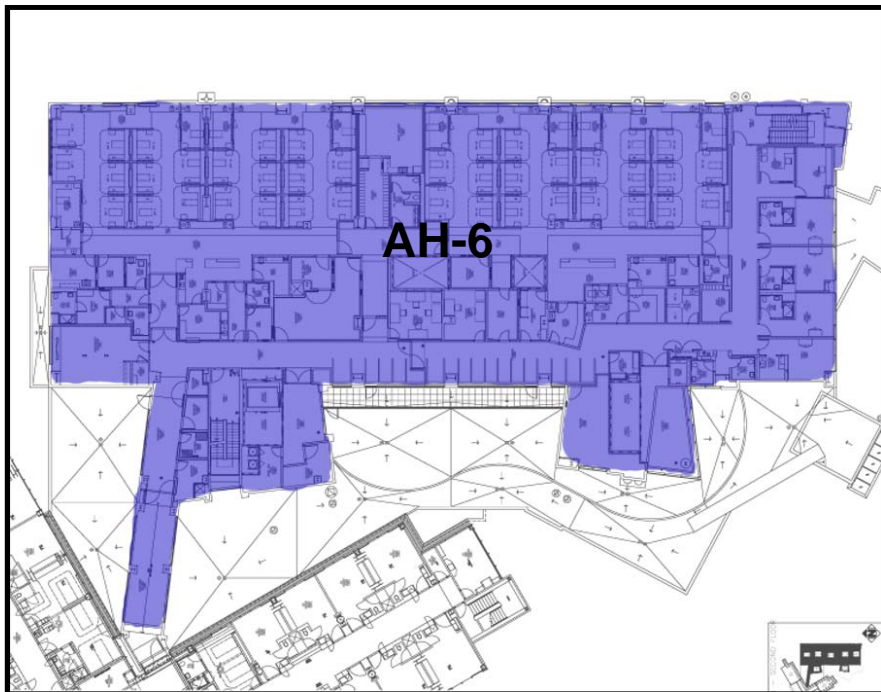
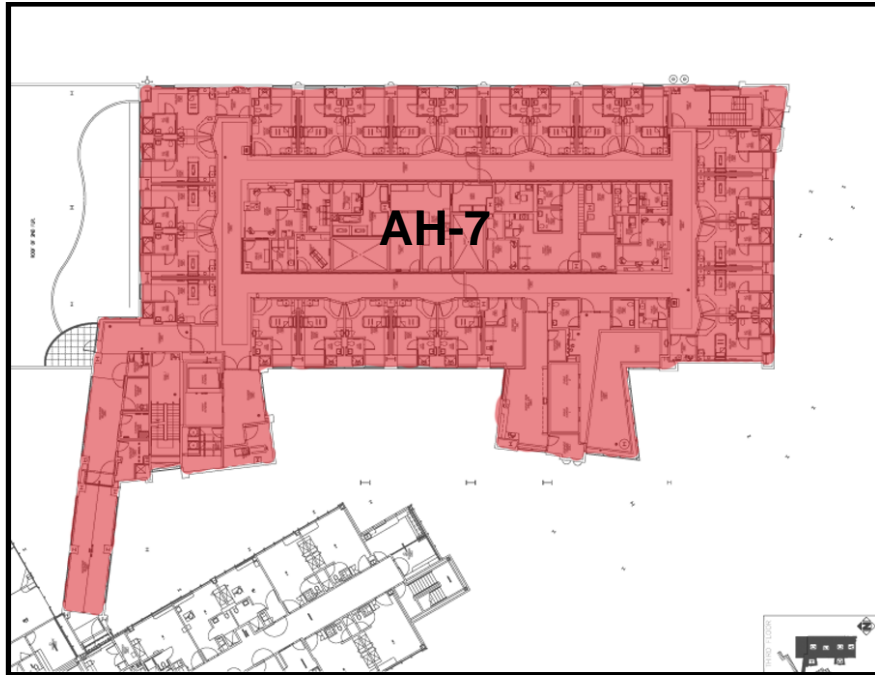


Figure 4: Level 3



The following figures illustrate the service of each AHU separated by levels. Notice in Figure 1: Ground Level that the operating rooms are served by a separate AHU (AHU-1). This unit uses a HEPA filtration system due to the critical nature of these spaces.

The existing Miller Children’s Hospital also went through renovations due to the addition. An existing AHU located on the ground level is used to serve the renovated spaces. For reasons discussed in the Mechanical Systems Summary, this unit (AHU-8 on the mechanical AHU schedule) was not included in the scope of this report but was included in the drawing package.

3. Mechanical Systems Summary

The 7 AHUs discussed in the previous section supply a constant air volume with hot water reheat coils for each of the spaces. The building has 145 reheat coils with a 180°F entering water temperature. The reason for using a CAV system with reheat instead of a VAV system in the Pediatric Inpatient Addition is because sensitive pressure differences must be maintained between certain spaces for safety to prevent the spread of hazardous air contaminants, ruling out the possibility of modulating air

volume. The roof mechanical room houses (2) 2000 MBH boilers that supply hot water to AH-3 and reheat coils throughout the building. AH-3 is a 100% OA unit because it partially serves the operating room level of the building. Twenty-one fan coil units serve spaces throughout the building such as electrical rooms, elevator machine rooms, and telecom rooms. The entering water temperature is 45°F and is supplied from the chillers located in the central plant.

The existing Miller Children's Hospital is considered a non-conforming building by California code. This means that although the existing central plant has enough capacity to serve the addition, the two systems had to be completely separated from one another. Therefore, the Pediatric Inpatient Addition has its own central plant, which was part of a separate drawing package. Essentially, the two buildings are completely disconnected from one another. Because the existing AHU is located in Miller Children's Hospital and serves only Miller Children's Hospital, it was not included in the ASHRAE 62.1 analysis of this report.

4. Systems and Equipment Requirements

Section 5 of ASHRAE 62.1 requires certain measures be taken to ensure that mechanical equipment be installed in such a way as to prevent mold growth and prevent re-entry of air contaminants back into the system. Table 5-1 in section 5.6 requires a minimum distance of 15 feet be maintained between OA air intakes and exhaust air under significantly contaminated exhaust conditions (See Appendix B). Figure 5 on the next page highlights this separation and after measuring the distances, the units do, in fact, comply with this standard.

Section 5.15.2 requires that pipes, ducts, and other surfaces that are susceptible to condensation be insulated as to prevent mold growth. Located in the general notes on the first sheet of the mechanical drawings, the mechanical engineer specifies that these surfaces be insulated. This follows the ASHRAE standard. In addition to pipe insulation, the standard has strict specifications regarding drain pans. Also within the general notes are requirements to maintain certain sized drip pans as to comply with

Restrooms: 0.5 cfm/sf

Locker Rooms: 0.5 cfm/sf

6. Ventilation Calculation Procedure

The ventilation calculation procedure is thoroughly outlined in section 6 of ASHRAE Standard 62.1 and is summarized below. See Appendix B for ASHRAE 62.1 Tables.

Breathing Zone Outdoor Airflow

The design outdoor air required (V_{bz}) for the breathing zone is calculated using this equation:

$$V_{bz} = R_p * P_z + R_a * A_z$$

A_z is the zone area

P_z is the zone population

R_p is the outdoor airflow required per person (ASHRAE 62.1 Table 6-1)

R_a is the outdoor airflow required per square foot (ASHRAE 62.1 Table 6-1)

Zone Outdoor Airflow

The design zone outdoor airflow (V_{oz}) is the OA that must be provided to the zone by the AHU calculated using this equation:

$$V_{oz} = V_{bz} / E_z$$

V_{bz} is the design outdoor air required

E_z is the zone air distribution effectiveness (ASHRAE 62.1 Table 6-2), and is considered to be equal to 1.0 for ceiling supply of cool air

Outdoor Air Intake

For AHUs with 100% outdoor air, such as AH-3, the following equation should be used to calculate the outdoor air intake flow (V_{ot}):

$$V_{ot} = \sum_{\text{all zones}} V_{oz}$$

For AHUs with multiple-zone recirculating systems, V_{ot} must be calculated using the equation:

$$V_{ot} = V_{ou}/E_v$$

V_{ou} is the uncorrected outdoor air intake, and for the purposes of this application, is considered to be equal to V_{bz} summed over all the zones for each AHU, since D , the occupant diversity, is equal to 1.0

E_v is the system ventilation efficiency (ASHRAE 62.1 Table 6-3)

The zone primary outdoor air fraction (Z_p) must be determined in order to apply values of E_v from Table 6-3 mentioned earlier. The equation for Z_p is:

$$Z_p = V_{oz}/V_{pz}$$

V_{pz} is the zone primary airflow from the AHU including outdoor air and recirculated return air

For values of Z_p for which ASHRAE 62.1 Table 6-3 do not apply (values greater than 0.55), Appendix A must be used. E_v must then be calculated using zone ventilation efficiency (E_{vz}) and the minimum value of these will be used for E_v . To calculate E_{vz} , the following equation will be used:

$$E_{vz} = 1 + X_s - Z_d$$

X_s is the average outdoor air fraction and is given as $V_{ou}/\sum V_{pz}$

Z_d is the discharge outdoor air fraction and is given as V_{oz}/V_{dz}

For this calculation, the minimum E_{vz} value that was calculated was 0.42. Therefore, the E_v value used is 0.42 for the spaces that do not apply to Table 6-3. This value seems reasonable and is probably an overestimate for calculating the OA quantities. The spaces include mostly restrooms, locker rooms, and smaller rooms for which there is no ventilation supplied directly to the space, but rather rely on infiltration from

surrounding spaces to maintain proper ventilation. Once the outdoor air intake flow (Vot) is calculated for each space, and then summed, the values can then be compared with the supply air flow rates for each of the 7 AHUs.

7. Results

As a result of the ventilation calculation procedure outlined in section 6, Table 2 shows that all 7 AHUs comply with the minimum OA requirements per ASHRAE Standard 62.1. Also illustrated in the table is the maximum primary outdoor air fraction (Zp) for each AHU, areas for each AHU, and the minimum OA required for the intake as calculated above. The unit capacity, which is the maximum amount of OA that can be supplied (assuming 100% OA) is significantly greater than the minimum OA required by ASHRAE. One thing to note is that the minimum OA supplied for AHUs 1, 3, 4, and 6 will be sufficient to properly ventilate the spaces. AHUs 2, 5, and 7 will require slightly more OA than the minimum amount to properly ventilate the spaces.

Table 2: Ventilation Results Summary

AHU	Area Served (sf)	Min OA Req'd (cfm)	Summary		ASHRAE 62.1 Compliance	Max Zp
			Unit Capacity (cfm)	Min OA Supplied (cfm)		
1	9733	3,173	20,000	6,000	Yes	0.30
2	7284	2,764	7,000	1,500	Yes	0.77
3	12217	3,837	15,000	15,000	Yes	0.40
4	14324	4,691	20,000	5,000	Yes	1.70
5	8757	9,786	18,000	4,000	Yes	0.68
6	15320	5,862	20,000	6,000	Yes	0.83
7	17019	5,769	11,000	5,000	Yes	0.60
Total	84654	35,882	111,000	42,500		

Table 2 is a summary of the ventilation calculation procedure results. The table shows that all seven AHUs comply with ASHRAE Standard 62.1. The unit capacity, which is the maximum amount of OA that can be supplied (assuming 100%) is significantly greater than the minimum OA required by ASHRAE.

One observation is that the unit capacities are significantly larger than what is required for proper ventilation for Standard 62.1. A reason for this is that California abides by codes set forth by the Office of Statewide Health Planning and Development (OSHPD) for many aspects of the design and construction process in regards to hospitals and

medical facilities. In some cases these codes could be stricter than ASHRAE standards, requiring more ventilation than ASHRAE Standard 62.1 requires.

See Appendix A for detailed ventilation calculation results.

8. References

ASHRAE. 2007, ANSI/ASHRAE, Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality. American Society of Heating Refrigeration and Air Conditioning Engineers, Inc., Atlanta, GA. 2007.

JBA Consulting Engineers. 2006, Mechanical Construction Documents. JBA Consulting Engineers, Costa Mesa, CA. 2006.

Appendix A: Ventilation Calculation Results

Table 3: Ventilation Results AH-1

		AH-1									
Room #	Room Name	Area (sf)	Design Supply (cfm)	Occupant Density/100 0 sf	Max Occupancy	Rp	Ra	Req'd OA (cfm)	Zp	Ev	OA Intake (cfm)
G409	Operating Room 1	501	1600	20	10	30	0	301	0.19	1.00	301
G408	Sub-sterile	105	650	20	2	15	0	32	0.05	1.00	32
G406	Hallway	175	200	0	0	0	0.06	11	0.05	1.00	11
G407	Scrub Vestibule	237	200	20	5	15	0	71	0.36	0.70	102
G410	Operating Room 2	492	1660	20	10	30	0	295	0.18	0.90	328
G006	Corridor	292	170	0	0	0	0.06	18	0.10	1.00	18
G411	Sub-sterile	117	650	20	2	15	0	35	0.05	1.00	35
G405	Hallway	385	300	0	0	0	0.06	23	0.08	1.00	23
G402	Hallway	748	600	0	0	0	0.06	45	0.07	1.00	45
G401	Hallway	237	300	0	0	0	0.06	14	0.05	1.00	14
G412	Operating Room 3	581	1800	20	12	30	0	349	0.19	0.90	387
G005	Corridor	1223	1350	0	0	0	0.06	73	0.05	1.00	73
G413	Operating Room 4	523	1700	20	10	30	0	314	0.18	0.90	349
G414	Sub-sterile	108	550	20	2	15	0	32	0.06	1.00	32
G415	Operating Room 5	535	1800	20	11	30	0	321	0.18	0.90	357
G416	Operating Room 6	599	2000	20	12	30	0	359	0.18	0.90	399
G403	Scrub	100	100	20	2	15	0	30	0.30	0.80	38
G419	Pump Room	106	270	0	0	0	0.12	13	0.05	1.00	13
G417	Sub-Sterile	139	500	20	3	15	0	42	0.08	1.00	42
G418	Operating Room 7	633	2100	20	13	30	0	380	0.18	0.90	422
G004	Corridor	1267	760	0	0	0	0.06	76	0.10	1.00	76
G508	Equipment Storage	169	150	0	0	0	0.12	20	0.14	1.00	20
G506	Equipment Storage	127	100	0	0	0	0.12	15	0.15	1.00	15
G505	C.R. Reading Room	62	80	10	1	5	0.12	11	0.13	1.00	11
G504	Soiled Linen	60	65	0	0	0	0.12	7	0.11	1.00	7
G503	Biohazard Holding	60	65	0	0	0	0.12	7	0.11	1.00	7
G502	Specimen Hold/Pick-up	66	75	0	0	0	0.12	8	0.11	1.00	8
G501	Clean Linen	86	50	0	0	0	0.12	10	0.21	1.00	10
Total		9733	19845		94			2911			3173

Table 4: Ventilation Results AH-2

		AH-2												
Room #	Room Name	Area (sf)	Design Supply (cfm)	Occupant Density/100 0 sf	Max Occupancy	Rp	Ra	Req'd OA (cfm)	Zp	Ev	OA Intake (cfm)	Xs	Zd	Evz
G421	Clean Equip/Clean Supply	1096	1000	0	0	0	0.12	132	0.13	1.00	132			
G320	Clean-up	124	170	20	2	15	0	37	0.22	0.90	41			
G319	Anesthesia Workroom	210	300	20	4	15	0	63	0.21	0.90	70			
G318	Dictation	72	100	5	0	5	0.06	6	0.06	1.00	6			
G317	Physician Lounge	199	320	25	5	5	0.06	37	0.12	1.00	37			
G314	Staff Womens Toilet	244	150	-	4	-	-	122	0.81	0.42	290	0.23	0.81	0.42
G314C	Circulation	128	50	0	0	0	0.06	8	0.15	1.00	8			
G314A	Womens Lockers	206	200	-	4	-	-	103	0.52	0.60	172			
G315C	Circulation	83	0	0	0	0	0.06	5	-	0.42	12	0.23	-	-
G315A	Mens Lockers	153	130	-	3	-	-	77	0.59	0.42	182	0.23	0.59	0.64
G315D	Mens Lockers	67	50	-	2	-	-	34	0.67	0.42	80	0.23	0.67	0.56
G002	Corridor	1434	1020	0	0	0	0.06	86	0.08	1.00	86			
G315	Staff Mens Toilet	230	150	-	5	-	-	115	0.77	0.42	274	0.23	0.77	0.46
G316	Vestibule	99	100	0	0	0	0.06	6	0.06	1.00	6			
G321	EVS	41	70	0	0	0	0.12	5	0.07	1.00	5			
G313	Equipment Storage	133	150	0	0	0	0.12	16	0.11	1.00	16			
G307	Trash & Linen Term Rm	155	50	0	0	0	0.12	19	0.37	0.70	27			
G301	Elevator Lobby	554	400	150	83	5	0.06	449	1.12	0.42	1068	0.23	1.12	0.11
G305	Corridor	366	200	0	0	0	0.06	22	0.11	1.00	22			
G303	Corridor	702	600	0	0	0	0.06	42	0.07	1.00	42			
G310	Inpatient Holding	200	300	50	10	7.5	0.06	87	0.29	0.80	109			
G311	Telecom	123	0	0	0	0	0.06	7	-	0.42	18	0.23	-	-
G312	Electrical Room	109	0	0	0	0	0.06	7	-	0.42	16	0.23	-	-
G308	Admin. Work Area	556	1100	5	3	5	0.06	47	0.04	1.00	47			
Total		7284	6610		126			1530			2764			

Table 5: Ventilation Results AH-3

Room #	Room Name	Area (sf)	Design Supply (cfm)	AH-3		Rp	Ra	Req'd OA (cfm)	Zp	Ev	OA Intake (cfm)
				Occupant Density/1000 sf	Max Occupancy						
G105	Public Womens Toilet	54	0	-	1	-	-	70	-	1.00	70
G104	Public Mens Toilet	55	0	-	1	-	-	70	-	1.00	70
G103	Vestibule	171	200	0	0	0	0.06	10	0.05	1.00	10
G108	Consultation	108	170	5	1	5	0.06	9	0.05	1.00	9
G102	Occupant Waiting	2255	2600	50	113	7.5	0.06	981	0.38	1.00	981
G106	Reception	113	220	30	3	5	0.06	24	0.11	1.00	24
G001	Corridor	221	230	0	0	0	0.06	13	0.06	1.00	13
G117	Patient Hold Pre-Op	900	1270	50	45	7.5	0.06	392	0.31	1.00	392
G119	Outpatient Pre-op Playroom	870	940	50	44	7.5	0.06	378	0.40	1.00	378
G120	Patient Toilet	50	0	-	1	-	-	25	-	1.00	25
G121	Toy Cleaning	58	300	20	1	15	0	17	0.06	1.00	17
G211	Meds	206	550	10	2	5	0.18	47	0.09	1.00	47
G214	Patient Toilet	53	0	-	1	-	-	27	-	1.00	27
G208	Nurse Control	3915	4715	20	78	15	0	1175	0.25	1.00	1175
G219	Negative Pressure	132	130	20	3	15	0	40	0.30	1.00	40
G220	Patient Toilet	48	0	-	1	-	-	24	-	1.00	24
G212	Soiled Utility	123	150	0	0	0	0.12	15	0.10	1.00	15
G213	Nourishment	92	210	20	2	15	0	28	0.13	1.00	28
G215	Womens Toilet	53	0	-	1	-	-	27	-	1.00	27
G216	Clean Utility	154	230	0	0	0	0.12	18	0.08	1.00	18
G115	Consult./Interview	67	150	5	0	5	0.06	6	0.04	1.00	6
G114	Consult./Interview	83	150	5	0	5	0.06	7	0.05	1.00	7
G112	Dress	43	50	10	1	5	0.06	8	0.15	1.00	8
G113	Dress	43	50	10	1	5	0.06	8	0.15	1.00	8
G111	Hallway	427	600	0	0	0	0.06	26	0.04	1.00	26
G237	Bay 18	104	130	20	2	15	0	31	0.24	1.00	31
G236	Bay 17	110	130	20	2	15	0	33	0.25	1.00	33
G235	Bay 16	100	130	20	2	15	0	30	0.23	1.00	30
G206	Wheelchair/Equip Storage	284	300	0	0	0	0.12	34	0.11	1.00	34
G234	Bay 15	110	130	20	2	15	0	33	0.25	1.00	33
G239	Vestibule	40	0	0	0	0	0.06	2	-	1.00	2
G205	Mens Toilet	48	0	-	1	-	-	24	-	1.00	24
G107	Vestibule	161	175	0	0	0	0.06	10	0.06	1.00	10
G238	Circulation	161	200	0	0	0	0.06	10	0.05	1.00	10
G109	EVS	56	75	0	0	0	0.12	7	0.09	1.00	7
G110	Office	123	150	5	1	5	0.06	10	0.07	1.00	10
G233	Telecom	122	0	0	0	0	0.06	7	-	1.00	7
G232	Patient Toilet	57	0	-	1	-	-	29	-	1.00	29
G231	Bay 14	117	130	20	2	15	0	35	0.27	1.00	35
G230	Bay 13	118	130	20	2	15	0	35	0.27	1.00	35
G229	Bay 12	95	130	20	2	15	0	29	0.22	1.00	29
G228	Bay 11	117	130	20	2	15	0	35	0.27	1.00	35
Total		12217	14855		320			3837			3837

Table 6: Ventilation Results AH-4

Room #	Room Name	Area (sf)	Design Supply (cfm)	Occupant Density/ 1000 sf	AH-4			Req'd OA (cfm)	Zp	Ev	OA Intake (cfm)	Xs	Zd	Evz
					Max Occupancy	Rp	Ra							
1409	Office	146	460	5	1	5	0.06	12	0.03	1.00	12			
1408	Office	115	220	5	1	5	0.06	10	0.04	1.00	10			
1410	Office	124	230	5	1	5	0.06	11	0.05	1.00	11			
1411	Office	137	230	5	1	5	0.06	12	0.05	1.00	12			
1407	Conference	405	820	50	20	5	0.06	126	0.15	1.00	126			
1316	Staff Work	284	380	50	14	5	0.06	88	0.23	0.90	98			
1314	Clean Utility	66	75	0	0	0	0.06	4	0.05	1.00	4			
1412	Hallway	176	0	0	0	0	0.06	11	-	0.42	25	0.21	-	-
1413	Hallway	92	170	0	0	0	0.06	6	0.03	1.00	6			
1406	Hallway	305	300	0	0	0	0.06	18	0.06	1.00	18			
1313	Soiled Linen	85	50	0	0	0	0.12	10	0.20	0.90	11			
1417	Mens Staff Toilet	48	0	-	1	-	-	24	-	0.42	57	0.21	-	-
1416	Womens Staff Toilet	48	0	-	1	-	-	24	-	0.42	57	0.21	-	-
1415	Reading/Vending	428	540	25	11	5	0.06	79	0.15	1.00	79			
1403	Staff Lounge	389	500	25	10	5	0.06	72	0.14	1.00	72			
1414	Physician/Consultation	205	240	50	10	5	0.06	64	0.26	0.80	79			
1317	Hallway	272	235	0	0	0	0.06	16	0.07	1.00	16			
1401	Exitway	549	600	0	0	0	0.06	33	0.05	1.00	33			
1310B	Control	57	165	20	1	15	0	17	0.10	1.00	17			
1310	R&F Room 1	358	660	20	7	15	0	107	0.16	0.90	119			
1310A	Patient Toilet	62	0	20	1	15	0	19	-	0.42	44	0.21	-	-
1312	EVS	47	50	0	0	0	0.12	6	0.11	1.00	6			
1311	Hallway	630	590	0	0	0	0.06	38	0.06	1.00	38			
1321	Plain Film	293	300	10	3	5	0.12	50	0.17	0.90	55			
1322	Control	82	140	20	2	15	0	25	0.18	0.90	27			
1323	Wheelchair/Stretcher Storage	88	50	0	0	0	0.12	11	0.21	0.90	12			
1309B	Control	57	165	20	1	15	0	17	0.10	1.00	17			
1309	R&F Room 1	358	660	20	7	15	0	107	0.16	0.90	119			
1309A	Patient Toilet	59	0	-	1	-	-	30	-	0.42	70	0.21	-	-
1315	Tech./Work	188	300	20	4	15	0	56	0.19	0.90	63			
1320	Child Life	94	110	20	2	15	0	28	0.26	0.80	35			
1319	Patient Holding	209	240	20	4	15	0	63	0.26	0.80	78			
1318	Hallway	617	470	0	0	0	0.06	37	0.08	1.00	37			
1324	Plain Film	278	300	10	3	5	0.12	47	0.16	0.90	53			
1325	Control	91	150	20	2	15	0	27	0.18	0.90	30			
1306	Hallway	217	110	0	0	0	0.06	13	0.12	1.00	13			
1222	Sub-waiting	243	210	50	12	7.5	0.06	106	0.50	0.60	176			
1218	Dress	28	30	10	1	5	0.06	7	0.22	0.90	7			
1220	Dress	28	30	10	1	5	0.06	7	0.22	0.90	7			
1219	Dress	31	30	10	1	5	0.06	7	0.23	0.90	8			
1216	Dress	29	30	10	1	5	0.06	7	0.22	0.90	7			
1217	Dress	29	30	10	1	5	0.06	7	0.22	0.90	7			
1215	Dress	61	40	10	1	5	0.06	7	0.17	0.90	7			
1509	Vestibule	160	110	0	0	0	0.06	10	0.09	1.00	10			
1510	Peds Ultrasound	154	230	20	3	15	0	46	0.20	0.90	51			
1502	Vestibule	75	100	0	0	0	0.06	5	0.05	1.00	5			
1512	Tech./Work	102	0	20	2	15	0	31	-	0.42	73	0.21	-	-
1511	Patient Toilet	50	0	-	1	-	-	25	-	0.42	60	0.21	-	-
1515	Sub-waiting	90	170	50	5	7.5	0.06	39	0.23	0.90	44			
1513	Peds Ultrasound	128	230	20	3	15	0	38	0.17	0.90	43			
1503	Pneumatic Tube Blower Room	69	130	0	0	0	0.06	4	0.03	1.00	4			
1001	Elevator Lobby	462	220	150	69	5	0.06	374	1.70	0.42	891			
1002	Corridor	1136	1150	0	0	0	0.06	68	0.06	1.00	68			
1508	Trash & Linen Chute Room	64	50	0	0	0	0.12	8	0.15	1.00	8			
1301	Pediatric Waiting	695	740	50	35	7.5	0.06	302	0.41	0.70	432			
1302	Reception/Scheduling	187	300	30	6	5	0.06	39	0.13	1.00	39			
1303	Womens Public Toilet	49	0	-	1	-	-	25	-	0.42	58	0.21	-	-
1304	Mens Public Toilet	49	0	-	1	-	-	25	-	0.42	58	0.21	-	-
1305	Hallway	319	235	0	0	0	0.06	19	0.08	1.00	19			
1003	Corridor	316	250	0	0	0	0.06	19	0.08	1.00	19			
1308	R & F Suite (Future)	1272	0	20	25	15	0	382	-	0.42	909	0.21	-	-
1505	Main Normal Elec Power Rm	508	0	0	0	0	0.06	30	-	0.42	73	0.21	-	-
1202	Main Emerg Elec Power Rm	331	0	0	0	0	0.06	20	-	0.42	47	0.21	-	-
Total		14324	13825		276			2970			4691			

Table 7: Ventilation Results AH-5

Room #	Room Name	Area (sf)	Design Supply (cfm)	Occupant Density/1000 sf	AH-5			Req'd OA (cfm)	Zp	Ev	OA Intake (cfm)	Xs	Zd	Evz
					Max Occupancy	Rp	Ra							
1212	Conference/Education	1807	3050	50	90	5	0.06	560	0.18	0.90	622			
1201	Family Toilet	54	0	0	1	-	-	50	-	0.42	119	0.37	-	-
1214	AV Storage	124	50	0	0	0	0.12	15	0.30	0.80	19			
1012	Hallway	167	165	0	0	0	0.06	10	0.06	1.00	10			
1107	Conference	488	960	50	24	5	0.06	151	0.16	0.90	168			
1211	Kitchen	148	300	25	4	5	0.06	27	0.09	1.00	27			
1213	EVS	52	50	0	0	0	0.12	6	0.12	1.00	6			
1210	Public Toilet	49	0	-	1	-	-	25	-	0.42	58	0.37	-	-
1209	Waiting Area	568	700	50	28	7.5	0.06	247	0.35	0.80	309			
1103	Gift Shop	389	420	15	6	7.5	0.12	90	0.22	0.90	100			
1102	Sanctuary	481	1700	120	58	5	0.06	317	0.19	0.90	353			
1005	Lobby	4136	4900	150	620	5	0.06	3350	0.68	0.42	7977			
1006	Entry Vestibule	294	1000	0	0	0	0.06	18	0.02	1.00	18			
Total		8757	13295		833			4867			9786			

Table 8: Ventilation Results AH-6

Room #	Room Name	Area (sf)	Design Supply (cfm)	Occupant Density/100 0 sf	AH-6			Req'd OA (cfm)	Zp	Ev	OA Intake (cfm)	Xs	Zd	Evz
					Max Occupancy	Rp	Ra							
2502	Transport Storage	77	40	0	0	0	0.12	9	0.23	0.90	10			
2501	Biohazard Holding	43	40	0	0	0	0.12	5	0.13	1.00	5			
2504	Trash and Linen Closet	117	50	0	0	0	0.12	14	0.28	0.90	16			
2005	Equipment Storage	136	50	0	0	0	0.12	16	0.33	0.90	18			
2004	Elevator Lobby	260	310	150	39	5	0.06	211	0.68	0.42	501	0.27	0.68	0.59
2403	Vestibule	139	80	0	0	0	0.06	8	0.10	1.00	8			
2424	Nurse Station	126	130	20	3	15	0	38	0.29	0.80	47			
2419	Nurse Station	73	100	20	1	15	0	22	0.22	0.90	24			
2423	Dictation	46	50	5	0	5	0.06	4	0.08	1.00	4			
2420	Scrub	110	90	20	2	15	0	33	0.37	0.70	47			
2421	EVS	79	80	0	0	0	0.12	9	0.12	1.00	9			
2422	Mens Staff Toilet	48	0	-	1	-	-	24	-	0.42	57	0.27	-	-
2418	MEDS.	102	130	10	1	5	0.18	23	0.18	0.90	26			
2416	Soiled Isolette Holding/Cleaning	130	140	0	0	0	0.12	16	0.11	1.00	16			
2417	Equipment Storage	467	200	0	0	0	0.12	56	0.28	0.80	70			
2413	Negative Pressure	101	140	20	2	15	0	30	0.22	0.90	34			
2414	Negative Pressure	101	140	20	2	15	0	30	0.22	0.90	34			
2407C	Nurse Station (NICU)	1489	1080	20	30	15	0	447	0.41	0.70	638			
2415	Negative Pressure	93	160	20	2	15	0	28	0.17	0.90	31			
2322	Staff Lounge/Kitchen	403	740	25	10	5	0.06	75	0.10	1.00	75			
2321	Lockers	147	110	-	1	-	-	74	0.67	0.42	175	0.27	0.67	0.60
2320	Womens Staff Toilet	145	150	-	1	-	-	73	0.48	0.60	121			
2319	Vestibule	447	310	0	0	0	0.06	27	0.09	1.00	27			
2323	Assistant Managers Office	239	285	5	1	5	0.06	20	0.07	1.00	20			
2302	Negative Pressure	94	160	20	2	15	0	28	0.18	0.90	31			
2301A	Nurse Control	1479	1580	20	30	15	0	444	0.28	0.70	634			
2303	Negative Pressure	101	160	20	2	15	0	30	0.19	0.90	34			
2304	Negative Pressure	103	160	20	2	15	0	31	0.19	0.90	34			
2318	Equipment Storage	118	120	0	0	0	0.12	14	0.12	1.00	14			
2301	NICU 2	309	135	20	6	15	0	93	0.69	0.42	221	0.27	0.69	0.58
2317	Physician Office	191	200	5	1	5	0.06	16	0.08	1.00	16			
2316	Clean Utility	145	85	0	0	0	0.12	17	0.20	0.90	19			
2311	Coordinator	120	105	5	1	5	0.06	10	0.10	1.00	10			
2007	Corridor	1186	1200	0	0	0	0.06	71	0.06	1.00	71			
2102	Lactation Consultant	73	90	5	0	5	0.06	6	0.07	1.00	6			
2104	Telecom Room	421	0	0	0	5	0.06	25	-	0.42	60	0.27	-	-
2101	Elevator Lobby	483	1250	150	72	5	0.06	391	0.31	0.80	489			
2103	Phone Alcove	38	50	0	0	0	0	0	0.00	1.00	0			
2212	Electrical Room	15	0	0	0	0	0.06	1	-	0.42	2	0.27	-	-
2211	Public Womens Toilet	51	50	-	1	-	-	26	0.51	0.42	61	0.27	0.51	0.76
2314	Nurse Station	127	120	20	3	15	0	38	0.32	0.80	48			
2312	Scrub	104	70	20	2	15	0	31	0.45	0.70	45			
2324	Dictation	36	50	5	0	5	0.06	3	0.06	1.00	3			
2315	Team Report	116	105	5	1	5	0.06	10	0.09	1.00	10			
2308	Family Lactation	106	130	20	2	15	0	32	0.24	0.90	35			
2307	Resp Therapy Storage	100	50	0	0	0	0.12	12	0.24	0.90	13			
2306	Mens Staff Toilet	57	50	-	1	-	-	29	0.57	0.42	68	0.27	0.57	0.70
2309	Soiled Utility	88	80	0	0	0	0.12	11	0.13	1.00	11			
2310	MEDS.	99	130	10	1	5	0.18	23	0.18	0.90	25			
2313	Nurse Station	296	300	20	6	15	0	89	0.30	0.80	111			
2301B	Nurse Control	418	300	20	8	15	0	125	0.42	0.70	179			
2301C	Nurse Control	1493	1460	20	30	15	0	448	0.31	0.80	560			
2305	Negative Pressure	102	160	20	2	15	0	31	0.19	0.90	34			
2210	Public Mens Toilet	50	50	-	1	-	-	25	0.50	0.42	60	0.27	0.50	0.77
2208	Kitchen/Laundry	58	40	0	0	0	0.12	7	0.17	0.90	8			
2209	Family Living	221	290	20	4	25	0	111	0.38	0.70	158			
2207	Family Overnight	218	285	20	4	25	0	109	0.38	0.70	156			
2207A	Family T/S	66	40	-	1	-	-	33	0.83	0.42	79	0.27	0.83	0.45
2206	Family Overnight	217	285	20	4	25	0	109	0.38	0.70	155			
2206A	Family T/S	66	40	-	1	-	-	33	0.83	0.42	79	0.27	0.83	0.45
2205	Family Overnight	236	285	20	5	25	0	118	0.41	0.70	169			
2205A	Family T/S	66	40	-	1	-	-	33	0.83	0.42	79	0.27	0.83	0.45
2008	Corridor	652	255	0	0	0	0.06	39	0.15	1.00	39			
2204	Social Workers Office	115	110	5	1	5	0.06	10	0.09	1.00	10			
2203	CNS Office	168	250	5	1	5	0.06	14	0.06	1.00	14			
Total		15320	14925		292			4017			5862			

Table 9: Ventilation Results AH-7

Room #	Room Name	Area (sf)	Design Supply (cfm)	Occupant Density/100 0 sf	AH-7			Req'd OA (cfm)	Zp	Ev	OA Intake (cfm)	Xs	Zd	Evz
					Max Occupancy	Rp	Ra							
3405	Isolation Room	259	385	10	3	25	0	65	0.17	1.00	65			
3405A	T/S	60	50	-	1	-	-	30	0.60	0.42	71	0.22	0.60	0.62
3404	Patient Room	234	210	10	2	25	0	59	0.28	0.80	73			
3404A	T/S	60	50	-	1	-	-	30	0.60	0.42	71	0.22	0.60	0.62
3403	Patient Room	234	210	10	2	25	0	59	0.28	0.80	73			
3403A	T/S	60	50	-	1	-	-	30	0.60	0.42	71	0.22	0.60	0.62
3402	Patient Room	234	210	10	2	25	0	59	0.28	0.80	73			
3402A	T/S	60	50	-	1	-	-	30	0.60	0.42	71	0.22	0.60	0.62
3401	Patient Room	237	210	10	2	25	0	59	0.28	0.80	74			
3401A	T/S	60	50	-	1	-	-	30	0.60	0.42	71	0.22	0.60	0.62
3406	Anteroom	78	115	10	1	25	0	20	0.17	0.90	22			
3301	Patient Room	232	260	10	2	25	0	58	0.22	0.90	64			
3301A	T/S	38	50	-	1	-	-	19	0.38	0.70	27			
3302	Patient Room	224	260	10	2	25	0	56	0.22	0.90	62			
3302A	T/S	38	50	-	1	-	-	19	0.38	0.70	27			
3303	Patient Room	224	260	10	2	25	0	56	0.22	0.90	62			
3303A	T/S	38	50	-	1	-	-	19	0.38	0.70	27			
3304	Patient Room	224	260	10	2	25	0	56	0.22	0.90	62			
3304A	T/S	38	50	-	1	-	-	19	0.38	0.70	27			
3305	Patient Room	224	260	10	2	25	0	56	0.22	0.90	62			
3305A	T/S	38	50	-	1	-	-	19	0.38	0.70	27			
3306	Patient Room	224	260	10	2	25	0	56	0.22	0.90	62			
3306A	T/S	38	50	-	1	-	-	19	0.38	0.70	27			
3307	Patient Room	224	260	10	2	25	0	56	0.22	0.90	62			
3307A	T/S	38	50	-	1	-	-	19	0.38	0.70	27			
3308	Patient Room	224	260	10	2	25	0	56	0.22	0.90	62			
3308A	T/S	38	50	-	1	-	-	19	0.38	0.70	27			
3309	Patient Room	224	260	10	2	25	0	56	0.22	0.90	62			
3309A	T/S	38	50	-	1	-	-	19	0.38	0.70	27			
3015	Pedestrian Walkway	563	700	0	0	0	0.06	34	0.05	1.00	34			
3605	Equipment Storage	94	70	0	0	0	0.12	11	0.16	0.90	13			
3603	Electrical Room	69	0	0	0	0	0.06	4	-	0.42	10	0.22	-	-
3602	Transport Storage	77	40	0	0	0	0.12	9	0.23	0.90	10			
3601	Biohazard Holding	36	25	0	0	0	0.12	4	0.17	0.90	5			
3014	Pedestrian Walkway	358	250	0	0	0	0.06	21	0.09	1.00	21			
3003	Corridor	266	250	0	0	0	0.06	16	0.06	1.00	16			
3604	Trash & Linen Closet	115	50	0	0	0	0.12	14	0.28	0.80	17			
3005	Equipment Storage	135	160	0	0	0	0.12	16	0.10	1.00	16			
3004	Elevator Lobby	243	340	150	36	5	0.06	197	0.58	0.42	469	0.22	0.58	0.64
3013	Corridor	821	500	0	0	0	0.06	49	0.10	1.00	49			
3012	Corridor	588	340	0	0	0	0.06	35	0.10	1.00	35			
3114	Patient Room	225	270	10	2	25	0	56	0.21	0.90	63			
3114A	T/S	37	50	-	1	-	-	19	0.37	0.70	26			
3113	Patient Room	219	270	10	2	25	0	55	0.20	0.90	61			
3113A	T/S	38	50	-	1	-	-	19	0.38	0.70	27			
3112	Patient Room	221	270	10	2	25	0	55	0.20	0.90	61			
3112A	T/S	38	50	-	1	-	-	19	0.38	0.70	27			
3111	Patient Room	220	270	10	2	25	0	55	0.20	0.90	61			
3111A	T/S	38	50	-	1	-	-	19	0.38	0.70	27			
3110	Patient Room	220	270	10	2	25	0	55	0.20	0.90	61			
3110A	T/S	38	50	-	1	-	-	19	0.38	0.70	27			
3109	EVS	47	60	0	0	0	0.12	6	0.09	1.00	6			
3108	Physicians Work Room	184	200	5	1	5	0.06	16	0.08	1.00	16			
3006	Corridor	559	340	0	0	0	0.06	34	0.10	1.00	34			
3522	Soiled Utility	66	90	0	0	0	0.12	8	0.09	1.00	8			
3521	Formula Prep	62	120	20	1	15	0	19	0.16	0.90	21			
3523	Nurse Station	227	300	20	5	15	0	68	0.23	0.90	76			
3524	Work Room	71	80	5	0	5	0.06	6	0.08	1.00	6			
3520	Treatment	117	130	5	1	5	0.06	10	0.08	1.00	10			
3519	Meds	117	150	10	1	5	0.18	27	0.18	0.90	30			
3518	Coordinators Office	81	100	5	0	5	0.06	7	0.07	1.00	7			
3517	Equipment Storage	184	120	0	0	0	0.12	22	0.18	0.90	25			
3516	Telecom	166	0	0	0	0	0.06	10	-	0.42	24	0.22	-	-
3515	Clean Utility	320	260	0	0	0	0.12	38	0.15	1.00	38			
3514	Linen	99	70	0	0	0	0.12	12	0.17	0.90	13			
3512	Consultation Social Worker	90	100	5	0	5	0.06	8	0.08	1.00	8			
3513	Storage	40	20	0	0	0	0.12	5	0.24	0.90	5			
3511	Manager Office	104	130	5	1	5	0.06	9	0.07	1.00	9			
3508	Kitchen	67	150	25	2	5	0.06	12	0.08	1.00	12			
3507	Staff Lounge/Lockers	302	500	25	8	5	0.06	56	0.11	1.00	56			
3509	Womens Staff Toilet	49	0	-	1	-	-	25	-	0.42	58	0.22	-	-
3510	Mens Staff Toilet	49	0	-	1	-	-	25	-	0.42	58	0.22	-	-

AH-7 Continued

3505	Soiled Utility	123	80	0	0	0	0.12	15	0.18	0.90	16			
3504	Nourishment	65	120	20	1	15	0	20	0.16	0.90	22			
3502	Work Room	57	80	5	0	5	0.06	5	0.06	1.00	5			
3503	Meds	70	150	10	1	5	0.18	16	0.11	1.00	16			
3501	Nurse Station	210	300	20	4	15	0	63	0.21	0.90	70			
3011	Corridor	502	340	0	0	0	0.06	30	0.09	1.00	30			
3007	Corridor	587	340	0	0	0	0.06	35	0.10	1.00	35			
3107	Activity Room Child Life	459	680	25	11	10	0.18	197	0.29	0.42	470	0.22	0.29	0.93
3115	Equipment Storage	70	50	0	0	0	0.12	8	0.17	0.80	11			
3103	Equipment Storage	50	40	0	0	0	0.12	6	0.15	1.00	6			
3104	Public Toilet	71	0	-	1	-	-	36	-	0.42	85	0.22	-	-
3101	Elevator Lobby	820	1770	150	123	5	0.06	664	0.38	0.70	949			
3105	Public Toilet	61	0	-	1	-	-	31	-	0.42	73	0.22	-	-
3106	Kitchen	81	150	25	2	5	0.06	15	0.10	1.00	15			
3008	Corridor	540	340	0	0	0	0.06	32	0.10	1.00	32			
3201	Patient Room	232	270	10	2	25	0	58	0.21	0.90	64			
3201A	T/S	60	50	-	1	-	-	30	0.60	0.42	71	0.22	0.60	0.62
3202	Patient Room	234	270	10	2	25	0	59	0.22	0.90	65			
3202A	T/S	60	50	-	1	-	-	30	0.60	0.42	71	0.22	0.60	0.62
3203	Patient Room	234	270	10	2	25	0	59	0.22	0.90	65			
3203A	T/S	60	50	-	1	-	-	30	0.60	0.42	71	0.22	0.60	0.62
3204	Patient Room	234	270	10	2	25	0	59	0.22	0.90	65			
3204A	T/S	60	50	-	1	-	-	30	0.60	0.42	71	0.22	0.60	0.62
3205	Isolation Room	236	385	10	2	25	0	59	0.15	1.00	59			
3205A	T/S	60	50	-	1	-	-	30	0.60	0.42	71	0.22	0.60	0.62
3206	Anteroom	64	115	10	1	25	0	16	0.14	1.00	16			
Total		16902	17895		283			3980			5725			

Appendix B: ASHRAE Standard 62.1 Tables

Figure 6: ASHRAE Standard 62.1 Table 5-1

Object	Minimum Distance, ft (m)
Significantly contaminated exhaust (Note 1)	15 (5)
Noxious or dangerous exhaust (Notes 2 and 3)	30 (10)
Vents, chimneys, and flues from combustion appliances and equipment (Note 4)	15 (5)
Garage entry, automobile loading area, or drive-in queue (Note 5)	15 (5)
Truck loading area or dock, bus parking/idling area (Note 5)	25 (7.5)
Driveway, street, or parking place (Note 5)	5 (1.5)
Thoroughfare with high traffic volume	25 (7.5)
Roof, landscaped grade, or other surface directly below intake (Notes 6 and 7)	1 (0.30)
Garbage storage/pick-up area, dumpsters	15 (5)
Cooling tower intake or basin	15 (5)
Cooling tower exhaust	25 (7.5)

Figure 7: ASHRAE Standard 62.1 Table 6-2

Air Distribution Configuration	E_z
Ceiling supply of cool air.	1.0
Ceiling supply of warm air and floor return.	1.0
Ceiling supply of warm air 15°F (8°C) or more above space temperature and ceiling return.	0.8
Ceiling supply of warm air less than 15°F (8°C) above space temperature and ceiling return provided that the 150 fpm (0.8 m/s) supply air jet reaches to within 4.5 ft (1.4 m) of floor level. <i>Note:</i> For lower velocity supply air, $E_z = 0.8$.	1.0
Floor supply of cool air and ceiling return provided that the 150 fpm (0.8 m/s) supply jet reaches 4.5 ft (1.4 m) or more above the floor. <i>Note:</i> Most underfloor air distribution systems comply with this proviso.	1.0
Floor supply of cool air and ceiling return, provided low-velocity displacement ventilation achieves unidirectional flow and thermal stratification.	1.2
Floor supply of warm air and floor return.	1.0
Floor supply of warm air and ceiling return.	0.7
Makeup supply drawn in on the opposite side of the room from the exhaust and/or return.	0.8
Makeup supply drawn in near to the exhaust and/or return location.	0.5

Figure 8: ASHRAE Standard 62.1 Table 6-3

TABLE 6-3 System Ventilation Efficiency	
Max (Z_p)	E_v
≤0.15	1.0
≤0.25	0.9
≤0.35	0.8
≤0.45	0.7
≤0.55	0.6
>0.55	Use Appendix A