

**ASHRAE STANDARD 62.1-2004:
VENTILATION COMPLIANCE EVALUATION**



**TRY STREET TERMINAL BUILDING
620 SECOND AVENUE
PITTSBURGH, PA**

PREPARED FOR:
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MECHANICAL OPTION
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TRY STREET TERMINAL BUILDING
TECHNICAL ASSIGNMENT 1

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EXECUTIVE SUMMARY

The Try Street Terminal Building project involves renovations to the 10 story, 230,000 square foot building originally constructed in 1910. Although the main function is to provide apartments for the Art Institute of Pittsburgh, other features include: an atrium, exercise room, first-floor retail space and possibly a convenience store and casual dining restaurant.

The designed system is comprised of four make up air units (MAUs), four air handling units (AHUs), and a fan coil unit (FCU) to provide the required ventilation. The actual airflow rates listed below were designed according to the IBC 2003.

- The 4 MAUs have design supply airflow rates ranging from 4820 to 7550 cfm and totaling 23,825 cfm. These units serve the apartments, corridors and a limited amount of first floor space. The system is expected to be 80% effective based on the distribution of air.
- The 4 AHUs have design supply airflow rates ranging from 3000 to 8000 and totaling 20,000 cfm. These units serve the basement and first floor spaces which are primarily unassigned activity/study areas and unassigned commercial spaces, respectively. The system is expected to be 100% effective based on the distribution of air.
- A 10 ton FCU supplies 4000 cfm to the first floor exercise room. The system is expected to be 100% effective based on the distribution of air.

In this document The Try Street Terminal Building will be evaluated using ASHRAE Standard 62.1-2004 to determine whether or not the building's ventilation rates are compliant with the standard. The calculated ventilation rates will then be analyzed and compared to the design values. The following chart provides a brief summary of the results found in the analysis:

UNIT NAME	V _{ot}	OA SUPPLIED	COMPLIES WITH Std 62.1?
MAU-1	3461	5625	YES
MAU-2	1988	4820	YES
MAU-3	3049	7550	YES
MAU-4	2896	5830	YES
AHU-1	2193	2490	YES
AHU-2	907	1300	YES
AHU-3	2085	2220	YES
AHU-4	752	960	YES
FCU-6	2365	4000	YES



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STANDARD 62.1 CALCULATION PROCEDURES

The main purpose of ASHRAE Standard 62.1-2004 is to specify the minimum ventilation requirements and indoor air quality that will be considered acceptable to human occupants. For new buildings and renovations to existing buildings, the standard is intended to be used as a way to regulate the indoor air quality.

Acceptable indoor air quality is defined as air having no harmful concentrations of contaminants. The quality is also considered acceptable when 80% or more of the people exposed express no discomfort. According to the ASHRAE Standard, IAQ can be calculated using two possible procedures: the Indoor Air Quality (IAQ) Procedure or the Ventilation Rate Procedure (VRP).

The IAQ Procedure is a performance based analysis. The way this system works is by monitoring contaminant concentration levels and adjusting the outdoor air required based on these levels.

The VRP is a prescriptive method for calculating the required outdoor air. This ventilation rate is based on space type, occupancy level, and floor area.

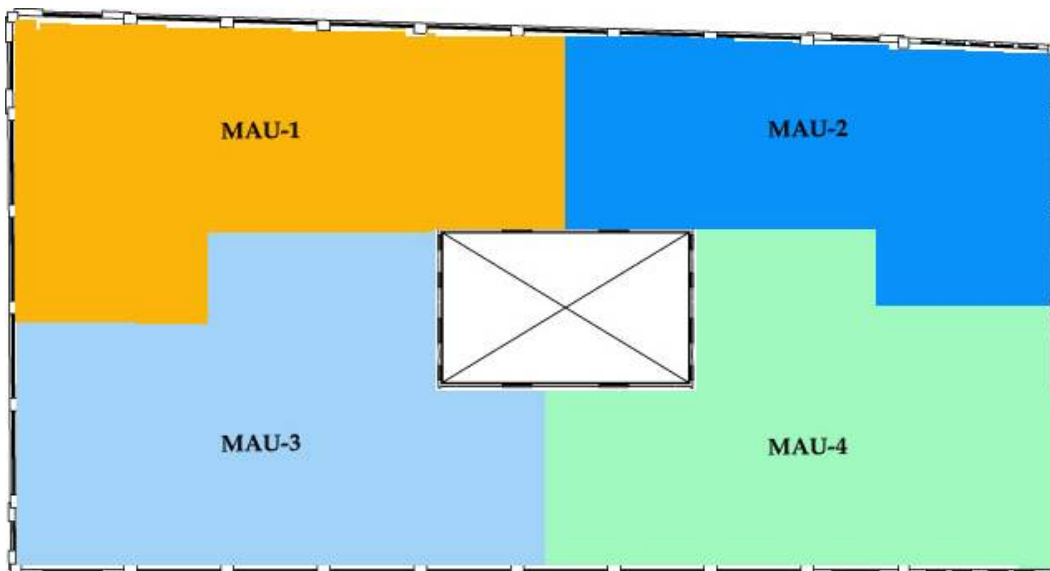
In conclusion, because the Indoor Air Quality Procedure is performance based a more thorough understanding of the air quality can be obtained from that method. However, for many of the building applications used, both procedures produce similar results. Therefore, the Ventilation Rate Procedure is more commonly used because it is a simpler, more cost effective method.



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BUILDING SYSTEMS OVERVIEW

The Try Street Terminal project includes the renovations to the 230,000 square foot building. Water source heat pumps fed by 2 boilers and a fluid cooler on the roof serve the apartments on the 1st through 9th floors. The required outdoor air for these apartments are brought in by 4 make up air units also located on the roof. A diagram is provided below to show the general distribution of the outdoor air supplied by these units. The 4 MAUs also serve the corridors on these floors.



The basement and first floor spaces are primarily served by the 4 air handling units located on the first floor. Since the majority of the spaces on these floors are unassigned a diagram can't be provided because the distribution of the air is unknown.

In addition to the units discussed above, a 10 ton FCU was designed. This unit supplies the required outdoor air to the exercise room located on the first floor.



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BUILDING ANALYSIS

In this section, the assumptions made for the building analysis will be found, as well as the calculation procedure performed and results.

○ ASSUMPTIONS

- Outdoor air is acceptable for ventilation
- Room air and supply air mixing is perfect
- Smoking is not permitted in the building
- Neglect ventilation for the following:
 - Mechanical Rooms
 - Electrical Rooms
 - Lavatory Spaces
 - Apartment Closets
 - Kitchens
 - Janitor Closets
 - Stairways
- Basement unassigned spaces are study lounge type spaces
- First floor unassigned space are commercial spaces
- Spaces without designated occupancy shall be determined by the default values for occupant density in Standard 62.1 Table 6-1



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○ CALCULATION PROCEDURE

This section of the analysis will provide the variables and equations used in the Ventilation Rate Procedure. A Program of Spaces spreadsheet describing the use, occupancy and area of each space will be provided. A spreadsheet for each system evaluated will also be included. Each system spreadsheet will display the outside air requirements by space and whether or not each system complies with the Standard 62.1 regulations.

VARIABLE	DESCRIPTION	UNITS USED
A_z	Zone Floor Area	ft ²
P_z	Zone Population	person
R_p	Outdoor Airflow Rate Required Per Person	cfm/person
R_a	Outdoor Airflow Rate Required Per Unit Area	cfm/ft ²
E_z	Zone Air Distribution Effectiveness	--
V_{bz}	Breathing Zone Outdoor Airflow	cfm
V_{oz}	Design Zone Outdoor Airflow	cfm
V_{pz}	Zone Primary Airflow	cfm
Z_p	Zone Primary Outdoor Air Fraction	--
P_s	System Population	person
D	Occupant Diversity	--
V_{ou}	Uncorrected Outdoor Air Intake	cfm
E_v	System Ventilation Efficiency	--
V_{ot}	Outdoor Air Intake Flow	cfm

EQUATIONS
$V_{OZ}=(P_z * R_p + A_z * R_a) / E_z$
$Z_p = V_{OZ} / V_{PZ}$
$D = P_s / \sum P_z$
$V_{OU} = D * \sum (R_p * P_z) + \sum (R_a * \sum A_z)$
$Z_p = V_{OU} / V_{PZ}$
$V_{OT} = V_{OU} / E_v$



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SPACE CHARACTERISTICS						
ZONE	ROOM NAME	ROOM NO.	P_z	A_z	R_p	R_a
	BASEMENT					
1	STAIR "A"	S001	N/A	180	N/A	N/A
2	STAIR "B"	S002	N/A	180	N/A	N/A
3	UNASSIGNED ASSUMED CONFERENCE/MEETING	001	310	6200	5	0.06
4	PUMP ROOM	002	N/A	560	N/A	N/A
5	RESTROOM	003	N/A	80	N/A	N/A
6	RESTROOM	004	N/A	120	N/A	N/A
7	UNASSIGNED ASSUMED CONFERENCE/MEETING	006	320	6400	5	0.06
8	STORAGE	007	N/A	2000	N/A	0.12
9	UTILITY/STORAGE	008	N/A	1100	N/A	0.12
10	ELECTRICAL	009	N/A	500	N/A	N/A
	COMMON AREAS					
11	ENTRY	101	2	120	5	0.06
12	STAIR "A"	S101 - S901	N/A	144	N/A	N/A
13	CORRIDOR	101A - 901	N/A	240	N/A	0.06
14	LOBBY	102	3	248	5	0.06
15	STAIR "B"	S102	N/A	162	N/A	N/A
16	DATA CLOSET	102A - 902	N/A	25	N/A	N/A
17	OFFICE	103	1	64	5	0.06
18	STAIR "C"	S103 - S903	N/A	192	N/A	N/A
19	CORRIDOR	103A - 903	N/A	288	N/A	0.06
20	MAIL ROOM	104	8	252	5	0.06
21	REFUSE CLOSET	104A - 904	N/A	36	N/A	N/A
22	CORRIDOR	105	N/A	260	N/A	0.06
23	CORRIDOR	105A - 905	N/A	460	N/A	0.06
24	ELECTRICAL ROOM	106	N/A	60	N/A	N/A
25	CORRIDOR	106A - 906	N/A	265	N/A	0.06
26	REFUSE CLOSET	107	N/A	30	N/A	N/A
27	CORRIDOR	107A - 907	N/A	266	N/A	0.06
28	CORRIDOR	108	N/A	368	N/A	0.06
29	LAUNDRY	108A - 908	N/A	160	N/A	N/A
30	DATA CLOSET	109	N/A	36	N/A	N/A
31	JANITOR CLOSET	109A - 709	N/A	80	N/A	N/A
32	TWO STORY LOBBY	110	50	1650	7.5	0.06
33	LAUNDRY	111	N/A	50	N/A	N/A
34	CORRIDOR	111A - 911	N/A	282	N/A	0.06
35	RESTROOM	112	N/A	64	N/A	N/A



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ZONE	ROOM NAME	ROOM NO.	P_z	A_z	R_p	R_a
36	REFUSE CLOSET	112A - 912	N/A	54	N/A	N/A
37	CONTROL	113	N/A	130	N/A	N/A
38	CORRIDOR	113A - 913	N/A	460	N/A	0.06
39	ENTRY TBD	114	4	400	5	0.06
40	CORRIDOR	114A - 914	N/A	320	N/A	0.06
41	UNASSIGNED COMMERCIAL SPACE ASSUMED RETAIL - SALES	115	59	3900	7.5	0.12
42	ELECTRICAL	115A - 915	N/A	60	N/A	N/A
43	MECHANICAL	116	N/A	180	N/A	N/A
44	REFUSE CLOSET	116A - 916	N/A	60	N/A	N/A
45	RESTROOM	117	N/A	80	N/A	N/A
46	MECHANICAL/ELECTRICAL	118	N/A	120	N/A	N/A
47	UNASSIGNED COMMERCIAL SPACE ASSUMED RETAIL - SALES	119	38	2500	7.5	0.12
48	RESTROOM	120	N/A	90	N/A	N/A
49	MECHANICAL/ELECTRICAL	121	N/A	154	N/A	N/A
50	EXERCISE ROOM	122	110	2750	20	0.06
51	CORRIDOR	123	N/A	456	N/A	0.06
52	REFUSE CLOSET	124	N/A	80	N/A	N/A
53	LAUNDRY	125	N/A	90	N/A	N/A
54	FIRE COMMAND CENTER	127	N/A	100	N/A	N/A
	SUITE 'A'					
55	KITCHEN	A101A - A901	N/A	120	N/A	N/A
56	CLOSET	A102A - A902	N/A	N/A	N/A	N/A
57	LIVING/DINING	A103A - A903	3	270	5	0.06
58	BATHROOM	A104A - A904	N/A	40	N/A	N/A
59	BATHROOM	A105A - A905	N/A	40	N/A	N/A
60	CORRIDOR	A106A - A906	N/A	70	N/A	N/A
61	BEDROOM	A107A - A907	2	170	5	0.06
62	CLOSET	A108A - A908	N/A	N/A	N/A	N/A
63	BEDROOM	A109A - A909	2	170	5	0.06
64	CLOSET	A110A - A910	N/A	N/A	N/A	N/A
65	CORRIDOR	A111A - A911	N/A	40	N/A	N/A
66	BATHROOM	A112A - A912	N/A	40	N/A	N/A
67	BEDROOM	A113A - A913	2	170		
68	CLOSET	A114A - A914	N/A	N/A	N/A	N/A



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SPACE CHARACTERISTICS						
ZONE	ROOM NAME	ROOM NO.	P_z	A_z	R_p	R_a
	SUITE 'B'					
69	KITCHEN	B101A - B901	N/A	128	N/A	N/A
70	CLOSET	B102A - B902	N/A	N/A	N/A	N/A
71	LIVING/DINING	B103A - B903	3	288	5	0.06
72	BEDROOM	B104A - B904	2	160	5	0.06
73	CLOSET	B105A - B905	N/A	N/A	N/A	N/A
74	BATHROOM	B106A - B906	N/A	40	N/A	N/A
75	BEDROOM	B107A - B907	2	270	5	0.06
76	CLOSET	B108A - B908	N/A	N/A	N/A	N/A
77	BATHROOM	B109A - B909	N/A	40	N/A	N/A
	SUITE 'C'					
78	KITCHEN	C101A - C901	N/A	128	N/A	N/A
79	CLOSET	C102A - C902	N/A	N/A	N/A	N/A
80	LIVING/DINING	C103A - C903	3	288	5	0.06
81	BEDROOM	C104A - C904	2	160	5	0.06
82	CLOSET	C105A - C905	N/A	N/A	N/A	N/A
83	BATHROOM	C106A - C906	N/A	40	N/A	N/A
84	BEDROOM	C107A - C907	2	270	5	0.06
85	CLOSET	C108A - C908	N/A	N/A	N/A	N/A
86	BATHROOM	C109A - C909	N/A	40	N/A	N/A
	SUITE 'D'					
87	KITCHEN	D101A - D901	N/A	96	N/A	N/A
88	CLOSET	D102A - D902	N/A	N/A	N/A	N/A
89	LIVING/DINING	D103A - D903	3	300	5	0.06
90	BEDROOM	D104A - D904	2	290	5	0.06
91	CLOSET	D1015 - D905	N/A	N/A	N/A	N/A
92	BATHROOM	D106A - D906	N/A	40	N/A	N/A
93	BEDROOM	D107A - D907	2	144	5	0.06
94	CLOSET	D108A - D908	N/A	N/A	N/A	N/A
95	BATHROOM	D109A - D909	N/A	40	N/A	N/A
96	CLOSET	D110A - D910	N/A	N/A	N/A	N/A



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SPACE CHARACTERISTICS						
ZONE	ROOM NAME	ROOM NO.	P_z	A_z	R_p	R_a
	SUITE 'E'					
97	KITCHEN	E101A - E901	N/A	128	N/A	N/A
98	CLOSET	E102A - E902	N/A	N/A	N/A	N/A
99	LIVING/DINING	E103A - E903	3	220	5	0.06
100	BEDROOM	E104A - E904	2	180	5	0.06
101	CLOSET	E105A - E905	N/A	N/A	N/A	N/A
102	BATHROOM	E106A - E906	N/A	40	N/A	N/A
103	BEDROOM	E107A - E907	2	228	5	0.06
104	CLOSET	E108A - E908	N/A	N/A	N/A	N/A
105	BATHROOM	E109A - E909	N/A	40	N/A	N/A
	SUITE 'F'					
106	KITCHEN	F101A - F901	N/A	168	N/A	N/A
107	CLOSET	F102A - F902	N/A	N/A	N/A	N/A
108	LIVING/DINING	F103A - F903	2	160	5	0.06
109	BEDROOM	F104A - F904	2	264	5	0.06
110	CLOSET	F105A - F905	N/A	N/A	N/A	N/A
111	BATHROOM	F106A - F906	N/A	40	N/A	N/A
112	BEDROOM	F107A - F907	2	120	5	0.06
113	CLOSET	F108A - F908	N/A	N/A	N/A	N/A
114	BATHROOM	F109A - F909	N/A	40	N/A	N/A
115	CLOSET	F110A - F910	N/A	N/A	N/A	N/A
	SUITE 'G'					
116	CORRIDOR	G201 - G701	N/A	50	N/A	N/A
117	LIVING/DINING	G202 - G702	3	264	5	0.06
118	CLOSET	G203 - G703	N/A	N/A	N/A	N/A
119	BEDROOM	G204 - G704	3	250	5	0.06
120	CLOSET	G205 - G705	N/A	N/A	N/A	N/A
121	CLOSET	G206 - G706	N/A	N/A	N/A	N/A
122	CORRIDOR	G208 - G708	N/A	50	N/A	N/A
123	BATHROOM	G210 - G710	N/A	40	N/A	N/A
124	KITCHEN	G211 - G711	N/A	200	N/A	N/A
125	CLOSET	G212 - G712	N/A	N/A	N/A	N/A
126	CLOSET	G214 - G714	N/A	N/A	N/A	N/A
127	CORRIDOR	G215 - G715	N/A	50	N/A	N/A
128	BATHROOM	G216 - G716	N/A	40	N/A	N/A
129	CLOSET	G218 - G718	N/A	N/A	N/A	N/A
130	BEDROOM	G219 - G719	3	200	5	0.06



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SPACE CHARACTERISTICS						
ZONE	ROOM NAME	ROOM NO.	P_z	A_z	R_p	R_a
	SUITE 'H'					
131	CORRIDOR	H201 - H701	N/A	50	N/A	N/A
132	CLOSET	H202 - H702	N/A	N/A	N/A	N/A
133	LIVING/DINING	H203 - H703	3	288	5	0.06
134	BEDROOM	H204 - H704	3	240	5	0.06
135	CLOSET	H205 - H705	N/A	N/A	N/A	N/A
136	CLOSET	H206 - H706	N/A	N/A	N/A	N/A
137	CORRIDOR	H208 - H708	N/A	50	N/A	N/A
138	BATHROOM	H210 - H710	N/A	40	N/A	N/A
139	KITCHEN	H211 - H711	N/A	192	N/A	N/A
140	CLOSET	H212 - H712	N/A	N/A	N/A	N/A
141	CLOSET	H214 - H714	N/A	N/A	N/A	N/A
142	CORRIDOR	H215 - H715	N/A	50	N/A	N/A
143	BATHROOM	H216 - H716	N/A	40	N/A	N/A
144	CLOSET	H218 - H718	N/A	N/A	N/A	N/A
145	BEDROOM	H219 - H719	3	240	5	0.06
	SUITE 'J'					
146	KITCHEN	J101 - J901	N/A	168	N/A	N/A
147	CLOSET	J102 - J902	N/A	N/A	N/A	N/A
148	LIVING/DINING	J103 - J903	2	160	5	0.06
149	BEDROOM	J104 - J904	2	240	5	0.06
150	CLOSET	J105 - J905	N/A	N/A	N/A	N/A
151	BATHROOM	J106 - J906	N/A	40	N/A	N/A
152	BEDROOM	J107 - J907	2	240	5	0.06
153	CLOSET	J108 - J908	N/A	N/A	N/A	N/A
154	BATHROOM	J109 - J909	N/A	40	N/A	N/A
	SUITE 'K'					
155	KITCHEN	K101 - K901	N/A	168	N/A	N/A
156	CLOSET	K102 - K902	N/A	N/A	N/A	N/A
157	LIVING/DINING	K103 - K903	2	168	5	0.06
158	BEDROOM	K104 - K904	2	252	5	0.06
159	CLOSET	K105 - K905	N/A	N/A	N/A	N/A
160	BATHROOM	K106 - K906	N/A	40	N/A	N/A
161	BEDROOM	K107 - K907	2	240	5	0.06
162	BATHROOM	K108 - K908	N/A	40	N/A	N/A
163	CLOSET	K109 - K909	N/A	N/A	N/A	N/A



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SPACE CHARACTERISTICS						
ZONE	ROOM NAME	ROOM NO.	P_z	A_z	R_p	R_a
	SUITE 'L'					
164	KITCHEN	L101A - L901	N/A	140	N/A	N/A
165	CLOSET	L102A - L902	N/A	N/A	N/A	N/A
166	LIVING/DINING	L103A - L903	2	148	5	0.06
167	BEDROOM	L104A - L904	2	240	5	0.06
168	BATHROOM	L105A - L905	N/A	40	N/A	N/A
169	CLOSET	L106A - L906	N/A	N/A	N/A	N/A
170	BEDROOM	L107A - L907	2	288	5	0.06
171	BATHROOM	L108A - L908	N/A	40	N/A	N/A
172	CLOSET	L109A - L909	N/A	N/A	N/A	N/A
	SUITE 'M'					
173	KITCHEN	M101 - M901	N/A	144	N/A	N/A
174	CLOSET	M102 - M902	N/A	N/A	N/A	N/A
175	LIVING/DINING	M103 - M903	2	192	5	0.06
176	BEDROOM	M104 - M904	2	192	5	0.06
177	CLOSET	M105 - M905	N/A	N/A	N/A	N/A
178	BATHROOM	M106 - M906	N/A	80	N/A	N/A
	SUITE 'N'					
179	CORRIDOR	N101 - N901	N/A	90	N/A	N/A
180	CLOSET	N102 - N902	N/A	N/A	N/A	N/A
181	KITCHEN	N103 - N903	N/A	100	N/A	N/A
182	LIVING/DINING	N104 - N904	4	336	5	0.06
183	BEDROOM	N105 - N905	2	160	5	0.06
184	CLOSET	N106 - N906	N/A	N/A	N/A	N/A
185	BATHROOM	N107 - N907	N/A	40	N/A	N/A
186	BEDROOM	N108 - N908	2	160	5	0.06
187	CLOSET	N109 - N909	N/A	N/A	N/A	N/A
188	BATHROOM	N110 - N910	N/A	40	N/A	N/A
189	BEDROOM	N111 - N911	2	160	5	0.06
190	CLOSET	N112 - N912	N/A	N/A	N/A	N/A
191	BATHROOM	N113 - N913	N/A	40	N/A	N/A
192	CLOSET	N114	N/A	N/A	N/A	N/A



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ZONE	ROOM NAME	ROOM NO.	P_z	A_z	R_p	R_a
	SUITE 'P'					
193	KITCHEN	P101A - P901	N/A	140	N/A	N/A
194	CLOSET	P102A - P902	N/A	N/A	N/A	N/A
195	LIVING/DINING	P103A - P903	4	341	5	0.06
196	BEDROOM	P104A - P904	2	160	5	0.06
197	CLOSET	P105A - P905	N/A	N/A	N/A	N/A
198	BATHROOM	P106A - P906	N/A	80	N/A	N/A
199	CORRIDOR	P107A - P907	N/A	50	N/A	N/A
200	BEDROOM	P108A - P908	2	160	5	0.06
201	CLOSET	P109A - P909	N/A	N/A	N/A	N/A
202	BATHROOM	P110A - P910	N/A	40	N/A	N/A
203	BEDROOM	P111A - P911	2	160	5	0.06
204	CLOSET	P112A - P912	N/A	N/A	N/A	N/A
205	BATHROOM	P113A - P913	N/A	40	N/A	N/A
	SUITE 'Q'					
206	LIVING/DINING	Q201 - Q901	3	300	5	0.06
207	CLOSET	Q202 - Q902	N/A	N/A	N/A	N/A
208	KITCHEN	Q203 - Q903	N/A	144	N/A	N/A
209	BEDROOM	Q204 - Q904	2	260	5	0.06
210	CLOSET	Q205 - Q905	N/A	N/A	N/A	N/A
211	CORRIDOR	Q206 - Q906	N/A	50	N/A	N/A
212	BATHROOM	Q207 - Q907	N/A	40	N/A	N/A
213	BEDROOM	Q208 - Q908	2	260	5	0.06
214	CLOSET	Q209 - Q909	N/A	N/A	N/A	N/A
215	BATHROOM	Q210 - Q910	N/A	40	N/A	N/A
216	CORRIDOR	Q211 - Q911	N/A	260	N/A	N/A
217	CLOSET	Q212 - Q912	N/A	N/A	N/A	N/A
218	BATHROOM	Q213 - Q913	N/A	40	N/A	N/A
219	CLOSET	Q214 - Q914	N/A	N/A	N/A	N/A
220	CLOSET	Q215 - Q915	N/A	N/A	N/A	N/A



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SPACE CHARACTERISTICS						
ZONE	ROOM NAME	ROOM NO.	P_z	A_z	R_p	R_a
	SUITE 'R'					
221	LIVING/DINING	R201 - R901	4	312	5	0.06
222	CLOSET	R202 - R702	N/A	N/A	N/A	N/A
223	CLOSET	R802 - R902	N/A	N/A	N/A	N/A
224	KITCHEN	R203 - R903	N/A	144	N/A	N/A
225	BEDROOM	R204 - R904	2	216	5	0.06
226	CLOSET	R205 - R905	N/A	N/A	N/A	N/A
227	CORRIDOR	R206 - R706	N/A	70	N/A	N/A
228	CORRIDOR	R806 - R906	N/A	N/A	N/A	N/A
229	BATHROOM	R207 - R907	N/A	40	N/A	N/A
230	BEDROOM	R208 - R908	2	225	5	0.06
231	CLOSET	R209 - R909	N/A	N/A	N/A	N/A
232	BATHROOM	R210 - R910	N/A	40	N/A	N/A
233	BEDROOM	R211 - R911	2	180	5	0.06
234	CLOSET	R212 - R912	N/A	N/A	N/A	N/A
235	BATHROOM	R213 - R913	N/A	40	N/A	N/A
236	CLOSET	R214 - R914	N/A	N/A	N/A	N/A
237	CLOSET	R215 - R915	N/A	N/A	N/A	N/A



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Make up air units

When calculating the required outdoor to be provided by the make up air units the breathing zone was calculated and then divided by a .8 air distribution effectiveness. Even though the make up air units are a 100% outdoor air system, an occupant diversity factor was included. The diversity factor was included because each bedroom and living room in each apartment will not be fully occupied at all times. Therefore, this factor was used to calculate the total corrected outdoor required.

MAU-1												
ZONE	ROOM NAME	ROOM NO.	P _z	D	A _z	R _p	R _a	V _{bz}	V _{oz}	V _{ou}	OA SUPPLIED	COMPLIES WITH Std 62.1?
	COMMON AREAS									38.28	300	YES
13	1/2 OF CORRIDOR	101A - 901	N/A	N/A	120	N/A	0.06	7.2	7.2			
19	CORRIDOR	103A - 903	N/A	N/A	288	N/A	0.06	17.28	17.28			
23	1/2 OF CORRIDOR	105A - 905	N/A	N/A	230	N/A	0.06	13.8	13.8			
	SUITE 'A'			0.67						76.8	100	YES
57	LIVING/DINING	A103A - A903	3		270	5	0.06	31.2	39			
61	BEDROOM	A107A - A907	2		170	5	0.06	20.2	25.25			
63	BEDROOM	A109A - A909	2		170	5	0.06	20.2	25.25			
67	BEDROOM	A113A - A913	2		170	5	0.06	20.2	25.25			
	SUITE 'B'			0.57						63.08	75	YES
71	LIVING/DINING	B103A - B903	3		288	5	0.06	32.28	40.35			
72	BEDROOM	B104A - B904	2		160	5	0.06	19.6	24.5			
75	BEDROOM	B107A - B907	2		270	5	0.06	26.2	32.75			
	SUITE 'C'			0.57						63.08	75	YES
80	LIVING/DINING	C103A - C903	3		288	5	0.06	32.28	40.35			
81	BEDROOM	C104A - C904	2		160	5	0.06	19.6	24.5			
84	BEDROOM	C107A - C907	2		270	5	0.06	26.2	32.75			
	SUITE 'D'			0.57						64.04	75	YES
89	LIVING/DINING	D103A - D903	3		300	5	0.06	33	41.25			
90	BEDROOM	D104A - D904	2		290	5	0.06	27.4	34.25			
93	BEDROOM	D107A - D907	2		144	5	0.06	18.64	23.3			
	SUITE 'P'			0.6						79.26	100	YES
195	LIVING/DINING	P103A - P903	4		341	5	0.06	40.46	50.58			
196	BEDROOM	P104A - P904	2		160	5	0.06	19.6	24.5			
200	BEDROOM	P108A - P908	2		160	5	0.06	19.6	24.5			
203	BEDROOM	P111A - P911	2		160	5	0.06	19.6	24.5			

D _{MAU}	V _{OT}	MAU-1	COMPLIES?
0.6	3461	5625	YES



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MAU-2												
ZONE	ROOM NAME	ROOM NO.	P _z	D	A _z	R _p	R _a	V _{bz}	V _{oz}	V _{ou}	OA SUPPLIED	COMPLIES WITH Std 62.1?
	COMMON AREAS									37.68	300	YES
23	1/2 OF CORRIDOR	105A - 905	N/A	N/A	230	N/A	0.06	13.8	13.8			
25	CORRIDOR	106A - 906	N/A	N/A	265	N/A	0.06	15.9	15.9			
27	1/2 OF CORRIDOR	107A - 907	N/A	N/A	133	N/A	0.06	7.98	7.98			
	SUITE 'E'			0.57						57.68	75	YES
99	LIVING/DINING	E103A - E903	3		220	5	0.06	28.2	35.25			
100	BEDROOM	E104A - E904	2		180	5	0.06	20.8	26			
103	BEDROOM	E107A - E907	2		228	5	0.06	23.68	29.6			
	SUITE 'F'			0.67						52.64	75	YES
108	LIVING/DINING	F103A - F903	2		160	5	0.06	19.6	24.5			
109	BEDROOM	F104A - F904	2		264	5	0.06	25.84	32.3			
112	BEDROOM	F107A - F907	2		120	5	0.06	17.2	21.5			
	SUITE 'G'			0.67						72.84	95	YES
117	LIVING/DINING	G202 - G702	3		264	5	0.06	30.84	38.55			
119	BEDROOM	G204 - G704	3		250	5	0.06	30	37.5			
130	BEDROOM	G219 - G719	3		200	5	0.06	27	33.75			

D _{MAU}	V _{OT}	MAU-2	COMPLIES?
0.64	1988	4820	YES



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MAU-3												
ZONE	ROOM NAME	ROOM NO.	P _z	D	A _z	R _p	R _a	V _{bz}	V _{oz}	V _{ou}	OA SUPPLIED	COMPLIES WITH Std 62.1?
	COMMON AREAS									37.68	300	YES
22	CORRIDOR	105	N/A	N/A	260	N/A	0.06	15.6	15.6			
28	CORRIDOR	108	N/A	N/A	368	N/A	0.06	22.08	22.08			
	COMMON AREAS									474	1600	YES
32	TWO STORY LOBBY	110	50	N/A	1650	7.5	0.06	474	474			
	COMMON AREAS									40.2	300	YES
13	1/2 OF CORRIDOR	101A - 901	N/A	N/A	120	N/A	0.06	7.2	7.2			
38	1/2 OF CORRIDOR	113A - 913	N/A	N/A	230	N/A	0.06	13.8	13.8			
40	CORRIDOR	114A - 914	N/A	N/A	320	N/A	0.06	19.2	19.2			
	SUITE 'L'			0.67						60.56	75	YES
166	LIVING/DINING	L103A - L903	2		148	5	0.06	18.88	23.6			
167	BEDROOM	L104A - L904	2		240	5	0.06	24.4	30.5			
170	BEDROOM	L107A - L907	2		288	5	0.06	27.28	34.1			
	SUITE 'M'			0.50						33.04	50	YES
175	LIVING/DINING	M103 - M903	2		192	5	0.06	21.52	26.9			
176	BEDROOM	M104 - M904	2		192	5	0.06	21.52	26.9			
	SUITE 'N'			0.60						78.96	100	YES
182	LIVING/DINING	N104 - N904	4		336	5	0.06	40.16	50.2			
183	BEDROOM	N105 - N905	2		160	5	0.06	19.6	24.5			
186	BEDROOM	N108 - N908	2		160	5	0.06	19.6	24.5			
189	BEDROOM	N111 - N911	2		160	5	0.06	19.6	24.5			
	SUITE 'Q'			0.57						69.2	100	YES
206	LIVING/DINING	Q201 - Q901	3		300	5	0.06	33	41.25			
209	BEDROOM	Q204 - Q904	2		260	5	0.06	25.6	32			
213	BEDROOM	Q208 - Q908	2		260	5	0.06	25.6	32			

D _{MAU}	V _{OT}	MAU-3	COMPLIES?
0.59	3049	7550	YES



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MAU-4												
ZONE	ROOM NAME	ROOM NO.	P _z	D	A _z	R _p	R _a	V _{bz}	V _{oz}	V _{ou}	OA SUPPLIED	COMPLIES WITH Std 62.1?
	COMMON AREAS									66.06	300	YES
27	1/2 OF CORRIDOR	107A - 907	N/A	N/A	133	N/A	0.06	7.98	7.98			
34	CORRIDOR	111A - 911	N/A	N/A	282	N/A	0.06	16.92	16.92			
38	1/2 OF CORRIDOR	113A - 913	N/A	N/A	230	N/A	0.06	13.8	13.8			
51	CORRIDOR	123	N/A	N/A	456	N/A	0.06	27.36	27.36			
	SUITE 'H'			0.67						76.08	95	YES
133	LIVING/DINING	H203 - H703	3		288	5	0.06	32.28	40.35			
134	BEDROOM	H204 - H704	3		240	5	0.06	29.4	36.75			
145	BEDROOM	H219 - H719	3		240	5	0.06	29.4	36.75			
	SUITE 'J'			0.67						58.4	75	YES
148	LIVING/DINING	J103 - J903	2		160	5	0.06	19.6	24.5			
149	BEDROOM	J104 - J904	2		240	5	0.06	24.4	30.5			
152	BEDROOM	J107 - J907	2		240	5	0.06	24.4	30.5			
	SUITE 'K'			0.67						59.6	75	YES
157	LIVING/DINING	K103 - K903	2		168	5	0.06	20.08	25.1			
158	BEDROOM	K104 - K904	2		252	5	0.06	25.12	31.4			
161	BEDROOM	K107 - K907	2		240	5	0.06	24.4	30.5			
	SUITE 'R'			0.60						85.98	100	YES
221	LIVING/DINING	R201 - R901	4		312	5	0.06	38.72	48.4			
225	BEDROOM	R204 - R904	2		216	5	0.06	22.96	28.7			
230	BEDROOM	R208 - R908	2		225	5	0.06	23.5	29.38			
233	BEDROOM	R211 - R911	2		180	5	0.06	20.8	26			

D _{MAU}	V _{OT}	MAU-4	COMPLIES?
0.65	2896	5830	YES



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Air handling units

When calculating the required outdoor air to be provided by the air handling units the breathing zone was calculated and then divided by an air distribution effectiveness of one. Because the spaces served by these units are unassigned, the outdoor air fraction could not be calculated using the primary airflow to each zone because the distribution is unknown. However, the approximate percent of outdoor air for each unit was found because it was known from the IBC 2003 that 0.3 cfm/ft² was required for commercial/retail spaces. Therefore, the approximate fraction of outdoor air for AHUs 1-4 is 0.42, 0.26, 0.37, and 0.32 respectively.

AHU-1												
ZONE	ROOM NAME	ROOM NO.	P _z	A _z	R _p	R _a	V _{bz}	V _{oz}	V _{ot}	OA SUPPLIED	COMPLIES WITH Std 62.1?	
	BASEMENT								2193	2490	YES	
3	1/2 THE UNASSIGNED ASSUMED CONFERENCE/MEETING	001	155	3100	5	0.06	961	961				
7	1/2 THE UNASSIGNED ASSUMED CONFERENCE/MEETING	006	160	3200	5	0.06	992	992				
8	STORAGE	007	N/A	2000	N/A	0.12	240	240				

AHU-2												
ZONE	ROOM NAME	ROOM NO.	P _z	A _z	R _p	R _a	V _{bz}	V _{oz}	V _{ot}	OA SUPPLIED	COMPLIES WITH Std 62.1?	
	COMMON AREAS								906.5	1300	YES	
11	ENTRY	101	2	120	5	0.06	17.2	17.2				
14	LOBBY	102	3	248	5	0.06	29.88	29.88				
17	OFFICE	103	1	64	5	0.06	8.84	8.84				
20	MAIL ROOM	104	8	252	5	0.06	55.12	55.12				
39	ENTRY TBD	114	4	400	5	0.06	44	44				
41	1/2 THE UNASSIGNED COMMERCIAL SPACE ASSUMED RETAIL - SALES	115	30	1950	7.5	0.12	459	459				
47	1/2 THE UNASSIGNED COMMERCIAL SPACE ASSUMED RETAIL - SALES	119	19	1250	7.5	0.12	292.5	292.5				



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AHU-3											
ZONE	ROOM NAME	ROOM NO.	P_z	A_z	R_p	R_a	V_{bz}	V_{oz}	V_{ot}	OA SUPPLIED	COMPLIES WITH Std 62.1?
BASEMENT									2085	2220	YES
3	1/2 THE UNASSIGNED ASSUMED CONFERENCE/MEETING	001	155	3100	5	0.06	961	961			
7	1/2 THE UNASSIGNED ASSUMED CONFERENCE/MEETING	006	160	3200	5	0.06	992	992			
9	UTILITY/STORAGE	008	N/A	1100	N/A	0.12	132	132			

AHU-4											
ZONE	ROOM NAME	ROOM NO.	P_z	A_z	R_p	R_a	V_{bz}	V_{oz}	V_{ot}	OA SUPPLIED	COMPLIES WITH Std 62.1?
COMMON AREAS									751.5	960	YES
41	1/2 THE UNASSIGNED COMMERCIAL SPACE ASSUMED RETAIL - SALES	115	30	1950	7.5	0.12	459	459			
47	1/2 THE UNASSIGNED COMMERCIAL SPACE ASSUMED RETAIL - SALES	119	19	1250	7.5	0.12	292.5	292.5			

Fan Coil Unit

When calculating the required outdoor to be provided by the fan coil units, the breathing zone was calculated and then divided by an air distribution effectiveness of one.

FCU-8											
ZONE	ROOM NAME	ROOM NO.	P_z	A_z	R_p	R_a	V_{bz}	V_{oz}	V_{ot}	OA SUPPLIED	COMPLIES WITH Std 62.1?
COMMON AREAS									2365	4000	YES
50	EXERCISE ROOM	122	110	2750	20	0.06	2365	2365			



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CONCLUSION

Comparing the outdoor air required to the outdoor air provided by each system proved that all the units comply with ASHRAE Standard 62.1. Each make up unit, each air handling unit and the fan coil unit were sized more than adequately in order to achieve an acceptable indoor air quality level.



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