CONSULTANT REPORT

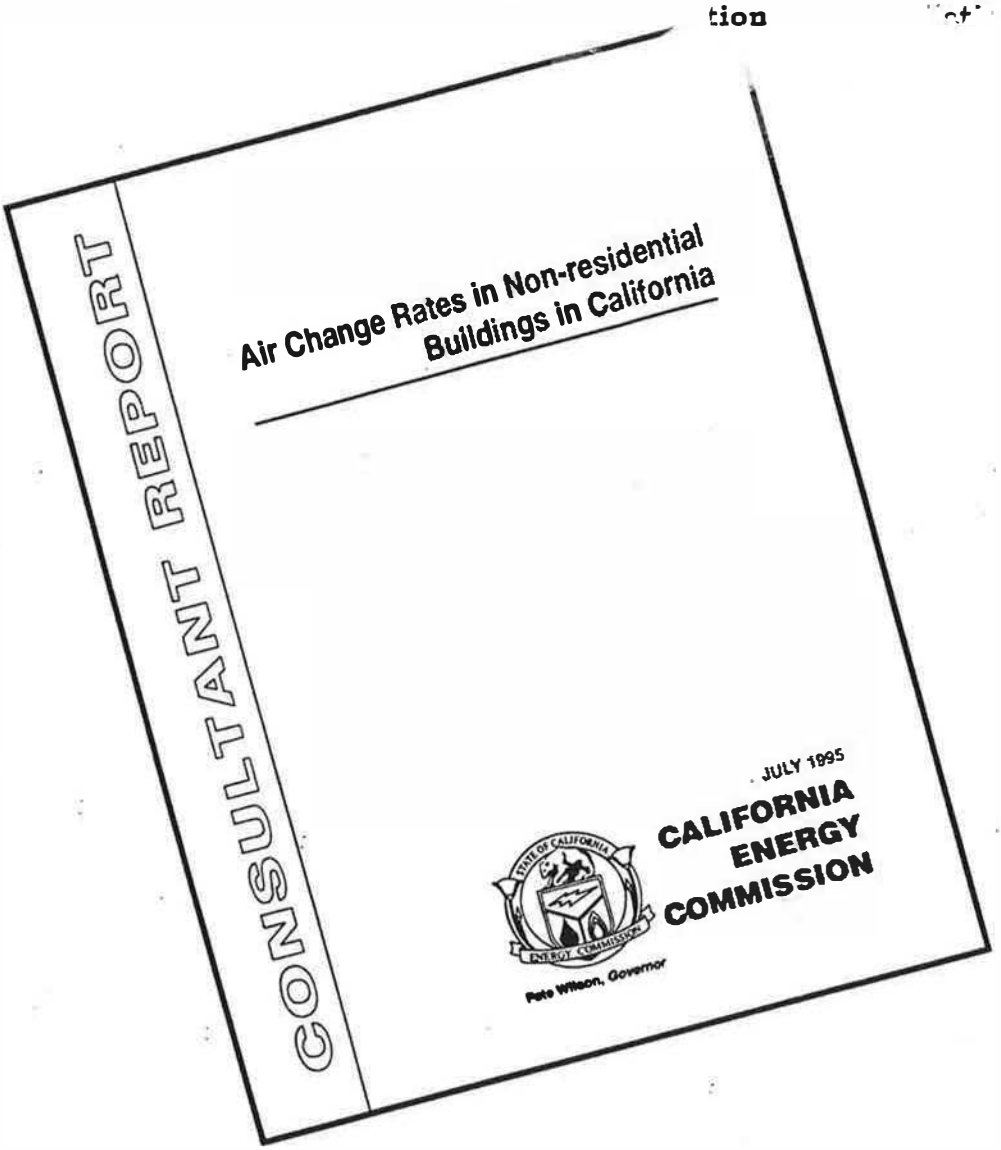
Air Change Rates in Non-residential Buildings in California

JULY 1995

CALIFORNIA ENERGY COMMISSION

Pete Wilson, *Governor*

P400-91-034BCN



CALIFORNIA ENERGY COMMISSION

Prepared for:

California Energy Commission

Prepared by:

Lagus Applied Technology, Inc.
San Diego, CA
Contract No. 400-91-034

Tony Wong, *Contract Manager*
John Sugar, *Manager*

EFFICIENCY TECHNOLOGY OFFICE

E. Ross Deter, *Deputy Director*

ENERGY EFFICIENCY DIVISION

Acknowledgement

This project was carried out by Lagus Applied Technology, Inc. with the assistance of the firms SDV/ACCI Inc., Pentech Services Inc., JRE Engineering Inc. and Klemm Analysis Group Inc. The project leader was Dr. Richard A. Grot of Lagus Applied Technology. The field testing teams were lead by Dr. Richard A. Grot and Dr. Peter L. Lagus of Lagus Applied Technology. The authors wish to acknowledge the labors of Melanie Evans of SDV/ACCI in the scheduling and arranging of the site visits and the efforts of Jeff Brown of SDV/ACCI, Robert Winn of Pentech Services and John Erickson of JRE Engineering, their technicians and data specialists in the performance of the field tests. The statistical analysis of the data was performed by Sue Wan and Barry Milcarek of Klemm Analysis Group. The efforts of the California Energy Commission project manager, Tony Wong, also were essential for successful fulfillment of the project.

Legal Notice

This report was prepared as the result of work sponsored by the California Energy Commission. It does not necessarily represent the views of the Energy Commission, its employees, or the State of California. The Energy Commission, the State of California, its employees, contractors, and subcontractors make no warranty, expressed or implied, and assume no legal liability for the information in the report; nor does any party represent that the use of this information will not infringe upon privately owned rights.

California Energy Commission

Executive Summary

This report describes results from the first group of field measurements of the air change rate in 49 non-residential buildings in the State of California. The air change rate measurements were made using a tracer gas method. Procedures were based on protocols developed in "Protocol for Measuring the Air Change Rate in Non-residential Buildings." Purpose of the tests was to obtain preliminary data for determining the effect of the various California Energy Codes on the air change rates in non-residential buildings.

The buildings were tested under two operating conditions: (1) normal occupied operating conditions of the building for the existing occupancy and weather conditions during the tests and (2) minimum outside air operating setting possible for the building's HVAC control system. Three tracer gas methods were used: the tracer decay method, the constant injection method and the buildup/decay method. Results of the tests produced: (1) total air change rate of the building during the conditions of the tests, (2) air change rate due to the operation of the building's HVAC system, (3) air change rate due to air infiltration and leakage and (4) the percent of outside air supplied by the building's HVAC system

Data indicated that:

- Vintage 2 buildings (those built or retrofitted to the 1987 and.or current California Energy Code) have lower total air change rates than Vintage 1 buildings (those built prior to the 1987 California Energy Codes).

- Vintage 2 buildings have lower infiltration rates than Vintage 1 buildings but this difference in infiltration rates does not account for more than 30 percent of the difference in total air change rate between the two classes.

- On the average, air infiltration is from 25 percent to 42 percent of the total building air change air.

Table of Contents

1. Introduction

This report describes results of the first group of field measurements of the air change rate in 49 non-residential buildings in the State of California. Measurements of the air change rate were made using a tracer gas method. Procedures for the measurements were based on the protocols developed in the report "Protocol for Measuring the Air Change Rate in Non-residential Buildings."[1] Purpose of the tests was to obtain preliminary data for determining the effect of the various California Energy Codes on the air change rates in non-residential buildings. Test protocol was designed for a one- or two-day period by a team of field technicians experienced with tracer gas measurements, field data collection in buildings and building HVAC systems. The protocol was designed so that the measurements were non-intrusive to the occupants of the buildings.

The buildings were to be tested under two operating conditions: (1) normal occupied operating conditions of the building for existing occupancy and weather conditions during the tests and (2) minimum outside air operating setting possible for the building's HVAC control system. Three tracer gas methods were used: the tracer decay method, the constant injection method and the buildup/decay method. Results of the tests produced: (1) total air change rate of the building during the conditions of the tests, (2) air change rate due to the operation of the building's HVAC system, (3) air change rate due to air infiltration and leakage and (4) percent of outside air supplied by the building's HVAC system.

A tracer gas measurement of the building air change rate is performed by introducing a gaseous tracer (for this study sulfur hexafloride, SF_6 was used), which is not normally present in either the interior air of the building or the exterior ambient air, into the building and measuring its rate of buildup and/or decay. For most North American buildings, a tracer gas test is the only accurate method to determine the total outside air entering a building. Several reasons for this are: 1) most North American buildings mix the outside

[1] Grot, R.A. and Lagus, P.L. , "Protocol for Measuring Air Change Rate in Non-residential Buildings", contract #400-91-034, Task I report, Californian Energy Commission, Publication number P400-91-034ACN

air with recirculated air from the building and provide no access to measure the outside air directly using standard air testing and balancing procedures, 2) much of the outside air supplied to even a mechanically ventilated building comes through paths other than the mechanical system's ducts such as windows, leakage of the envelope, doorways and other entrance ways, 3) short circuiting and by-passing of the mechanically supplied outside air often occurs and 4) there is often unintentional re-entrainment and recirculation of exhausted building air. A properly performed tracer test can overcome these shortcomings and provide a measurement of the actual outside air provided to the building.

The basis of a tracer gas test is the principle of conservation of mass: the conservation of mass for the air entering and leaving the building and the conservation of mass for the tracer specie introduced into the building. Tracer gas evaluations are usually performed using one of three methods: 1.) the tracer decay method, 2.) the constant injection method and 3.) the constant concentration method. In this project a fourth method was added: 4.) the buildup/decay method which is a hybrid of the tracer decay and constant injection method.

In the tracer decay method (see Figure 1-1), a tracer is injected once into the building for a short period of time, allowed to mix with the building air and its rate of decay is measured. The tracer decay method produces a direct measurement of the building's air change rate. With proper sampling, the percent outside air in the HVAC system's supply air can also be determined.

In the constant injection method, a tracer is injected continuously using a metering device and the buildup of tracer is measured until an equilibrium value is obtained. By sampling in the building's HVAC system airflows (see Figure 1-2 and Figure 1-3), this method can also produce a direct measurement of the mechanical system's supply flow rate, the percent of outside air in the supply air and the air infiltration to the building's occupied space measured as a percent of the mechanical system's supply air flow.

The constant concentration method uses a feedback control strategy to control the injection of tracer into the building so that the tracer concentration in the building remains constant. This method requires

sophisticated injection and monitoring equipment and long test preparation and equipment installation. It was, therefore, not used in this project.

In the buildup/decay method, a constant metered injection of tracer is done for a period of time (approximately two hours) and the concentration buildup measured during the injection; the injection is then turned off and the tracer decay measured. The equilibrium values of the tracer concentrations can be predicted from the buildup and decay data without waiting for equilibrium to occur. This method overcomes some of the shortcomings of the tracer decay method and the constant injection method and produces both a direct measurement of the air change rate, outside air flow rate and with proper sampling the percent of outside air in the supply air, the percent of air infiltration and the HVAC system's supply flow rate.

The choice of which method to use depends on the building's configuration and the availability of accurate tracer gas metering equipment and monitoring equipment. For buildings with many isolated zones, air change rates of less than one air change per hour, buildings with many packaged units servicing large open spaces, or buildings without mechanical ventilation, the tracer decay method is the only practical method. For buildings with few (less than five) zones and high air change rates the constant injection or the building/decay method produces more information in a shorter period of time.

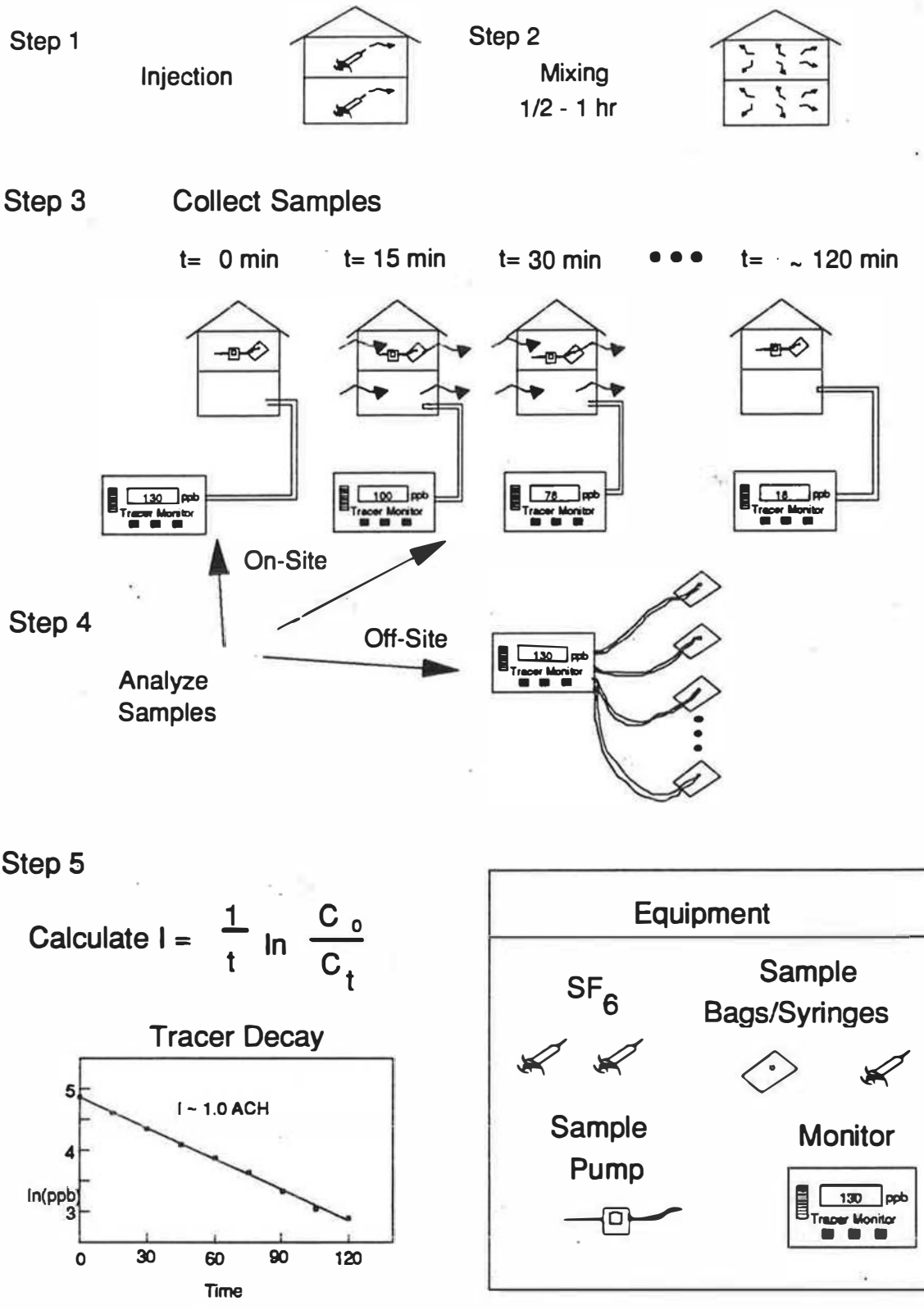
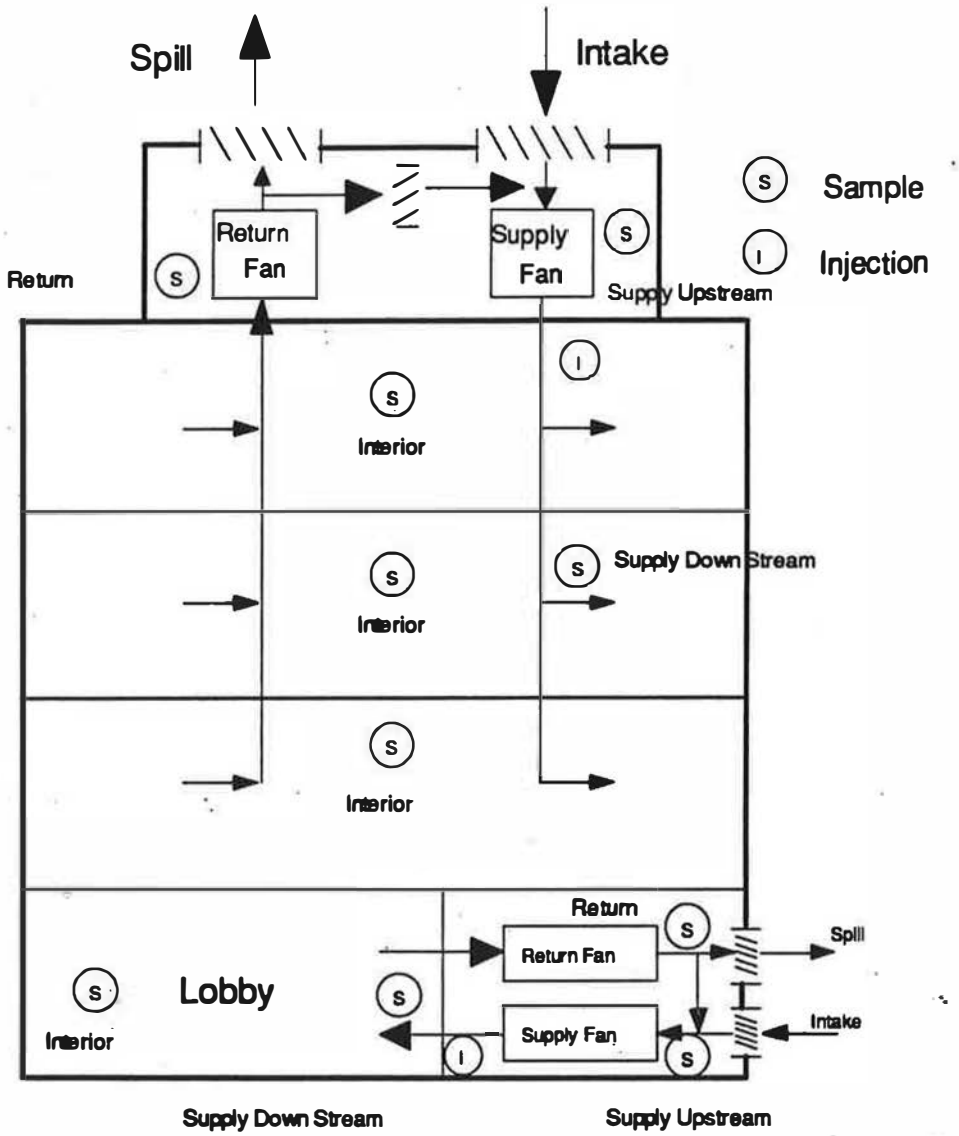


Figure 1-1. Schematic of the Tracer Decay Test

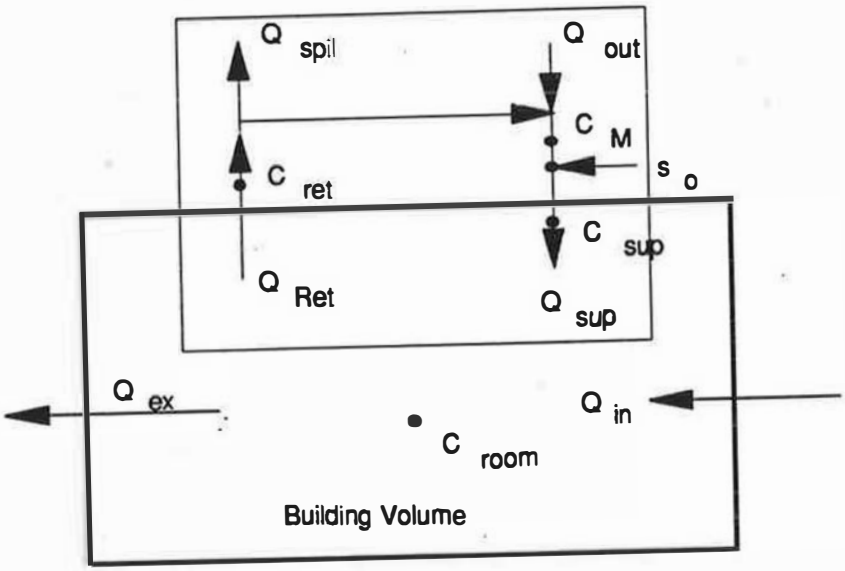


Schematic of Building Ventilation System

Figure 1-2. A Schematic of A HVAC System Showing Typical Tracer Sampling and Injection Locations

Air Handling System

with recirculation



Equations

Percent Outside Air

$$\% = 1 - \frac{C_M}{C_{Ret}}$$

Air Infiltration

$$Q_{in} = Q_{sup}\left(\frac{C_{sup}}{C_{room}} - 1\right)$$

Supply Airflow

$$Q_{sup} = \frac{s_o}{C_{sup} - C_M}$$

Figure 1-3. Schematic of a Zone of a Building Served by a Air Handler.

Equation for infiltration is valid only after equilbrium has been obtained. The equations for the percent of outside air and the supply air flow rate require only simultaneous measurement of the respective tracer concentrations.

2. Description of Sample of Buildings Tested

Buildings tested in this project were located in four climate zones in the state of California: north coast, north interior valley, south coast and south interior valley. The approximate location of these climate zones is shown in Figure 2-1. The study's original design was to select 12 buildings from each climate zone. Classes of buildings to be tested were schools, office buildings and retail buildings. The sample of buildings in each climate zone was to be divided equally into the three building classes producing a sample of four buildings in each class for each climate zone. The retail and office building categories were further divided by size: small buildings consisting of buildings of less than 40,000 sq. feet and large buildings with areas greater than 40,000 sq. feet. Each building was further classified according to vintage: Vintage 1 buildings being those built before the 1987 California Energy Code, Vintage 2 buildings being those built or retrofitted to the 1987 and/or current California Energy Code.

Table 2-1 shows the sample of buildings actually tested in the project. The numbers in Table 2-1 correspond to the identification index assigned to each tested buildings. The letter after the number in the table indicates a specific building in a complex of buildings (such as a school campus, community college, office building complex, school district, etc.).

The initial list of candidate buildings for the field phase of the project was provided under a previous contract to the California Energy Commission[1]. It was originally intended that this list would consist of 300 buildings from which the 48 to be tested would be chosen. The actual list of buildings provided for this study contained only 88 buildings and the current project team augmented the list as required (buildings with numbers over 88).

The project tested a total of 49 buildings of which 13 were in the northern coastal zone, 15 in the northern interior zone, 7 in the southern coastal zone and 14 in the southern interior zone. There were 14 schools, 22 office buildings , 13 retail buildings, 28 Vintage 1 buildings and 21 Vintage 2 buildings in the sample

[1] This selection was performed by the Berkeley Solar Group under Commission contract #400-90-028

tested. It should be emphasized that this sample is not a randomly selected sample but more a sample of convenience. There are several reasons for this. The original list seems to have come from previous utility energy projects. The sample originally contained mostly buildings in the northern climate zones. There was no statistical quality control on the sample selection nor checking for biases due to rejection by building owners to participate in the study.

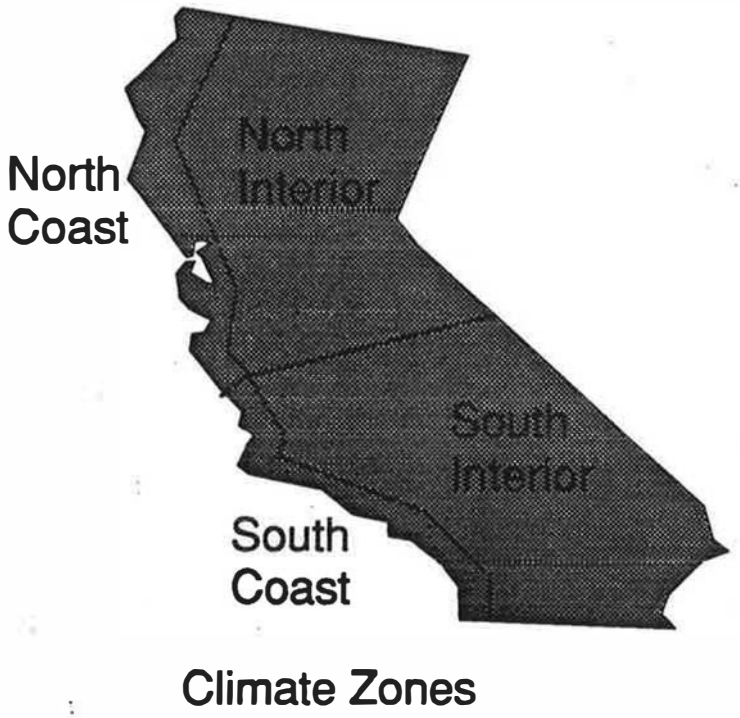


Figure 2-1. Approximate Location of Climate Zones Used in Study

3. Recommended Building Ventilation Rates

Buildings in this study were constructed under different recommended ventilation requirements. The recommended values in various versions of ASHRAE Standard 62 - Ventilation for Acceptable Indoor Air Quality are given in Table 3-1.

Table 3-1 ASHRAE Recommended Ventilation Rates

	ASHRAE 62-1973		ASHRAE 62-1981		ASHRAE 62-1989
	Minimum	**Recommended**	**Non-smoking**	**Smoking**	
Office Space	15 cfm /person	15-20 cfm/person	5 cfm/person	20 cfm/person	20 cfm/person
Office Conference	25 cfm/person	30-40 cfm/person	7 cfm/person	35 cfm/person	20 cfm/person
Retail	7 cfm per person	10-15 cfm/person	5 cfm/person	25 cfm/person	0.3 [1] cfm/sq.ft.
Classrooms	5 cfm/person	5-10 cfm/person	5 cfm/person	35 cfm/person	15 cfm/person

The air change rates required to provide the minimum recommended ventilation rates for a building depends on the configuration.

Table 3-2, Table 3-3 and Table 3-4 give the minimum area per occupant required to satisfy the current ASHRAE 62-1989 Standard for measured air change rates for offices, schools and retail buildings. The ASHRAE standard also specifies a maximum occupancy density of 7 persons per 1000 sq. ft. for office and 50 persons per 1000 sq. ft. for schools. With typical occupancy, the current ASHRAE standard would require an air change rate of about 0.8 air changes per hour for an office, about 3 air changes per hour for a classroom and about 1.2 air changes per hour for retail space(assuming a 15-foot ceiling height).

[1] This is the value for the first floor and the basement area of retail buildings. It is also the value for retail areas selling clothes. The value for other floors is 0.2 cfm/sq. ft.

The ASHRAE Standard is based on occupancy. Buildings also have contaminant sources which are due to the outgasing of building materials and furnishings which do not depend on occupancy. Many of these sources have loadings which are proportional to the size of the building and the levels from such contaminants vary inversely with the air change rate.

For air changes rates below about 0.8, the levels of the contaminants increase rapidly for small decreases in air change rate (such as the minimum area curves in Table 3-2). Therefore, it is not advisable to have spaces with air change rates blow about 0.8 air changes per hour even with low occupant densities unless special care have been take to limit the non-occupant related sources of contaminants.

Table 2-1. Classification of Building Tested

CEC Air Change Study - Buildings Tested

Northern Coast									
			# of Bldgs	13					
Schools		Small Buildings				Large Buildings			
		Offices		Retail		Offices		Retail	
Vintage 1	Vintage 2	Vintage 1	Vintage 2	Vintage 1	Vintage 2	Vintage 1	Vintage 2	Vintage 1	Vintage 2
CEC 5A	CEC 7	CEC 3	CEC 8A	CEC 13		CEC 16		CEC 20	
CEC 5B		CEC 5C	CEC 15	CEC 17					
		CEC 8B	CEC 89						
2	1	3	3	2		1		1	

Northern Interior									
			# of Bldgs	15					
Schools		Small Buildings				Large Buildings			
		Offices		Retail		Offices		Retail	
Vintage 1	Vintage 2	Vintage 1	Vintage 2	Vintage 1	Vintage 2	Vintage 1	Vintage 2	Vintage 1	Vintage 2
CEC 28B	CEC 32	CEC 38A		CEC 28A	CEC 37B	CEC 90			CEC 43
CEC 28C	CEC 34	CEC 38B		CEC 35B					
CEC 35A		CEC 38C		CEC 37A					
				CEC 45					
3	2	3		4	1	1			1

Southern Coast									
			# of Bldgs	7					
Schools		Small Buildings				Large Buildings			
		Offices		Retail		Offices		Retail	
Vintage 1	Vintage 2	Vintage 1	Vintage 2	Vintage 1	Vintage 2	Vintage 1	Vintage 2	Vintage 1	Vintage 2
CEC 64			CEC 65A				CEC 52		CEC 98
CEC 65B							CEC 102		
							CEC 103		
2			1				3		1

Southern Interior									
			# of Bldgs	14					
Schools		Small Buildings				Large Buildings			
		Offices		Retail		Offices		Retail	
Vintage 1	Vintage 2	Vintage 1	Vintage 2	Vintage 1	Vintage 2	Vintage 1	Vintage 2	Vintage 1	Vintage 2
CEC 57A	CEC 79A	CEC 79B	CEC 56	CEC 70			CEC 101	CEC 50	CEC 97
CEC 79D	CEC 78B	CEC 100	CEC 57B						
			CEC 78A						
			CEC 79B						
2	2	2	4	1			1	1	1

Table 3-2. Minimum Area Per Occupant for 20 cfm per Person (Office Spaces)

Minimum Area per Occupant (Sq. ft. per Person) Required Ventilation Rate 20 cfm per person				
	Ceiling Height			
ACH	8	9	10	12
0.25	600	533	480	400
0.50	300	267	240	200
0.75	200	178	160	133
1.00	150	133	120	100
1.25	120	107	96	80
1.50	100	89	80	67
1.75	86	76	69	57
2.00	75	67	60	50
2.25	67	59	53	44
2.50	60	53	48	40
2.75	55	48	44	36
3.00	50	44	40	33

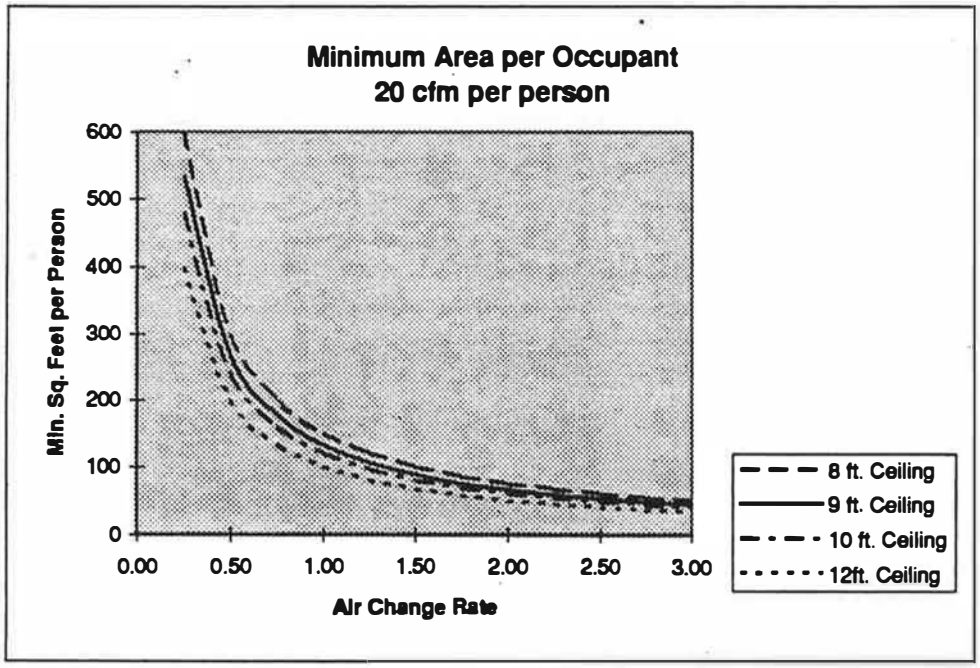


Table 3-3. Minimum Area per Occupant for 15 cfm per Person (Classrooms)

Minimum Area per Occupant (Sq. ft. per Person) Required Ventilation Rate 15 cfm per person				
	Ceiling Height			
ACH	8	9	10	12
0.25	450	400	360	300
0.50	225	200	180	150
0.75	150	133	120	100
1.00	113	100	90	75
1.25	90	80	72	60
1.50	75	67	60	50
1.75	64	57	51	43
2.00	56	50	45	38
2.25	50	44	40	33
2.50	45	40	36	30
2.75	41	36	33	27
3.00	38	33	30	25

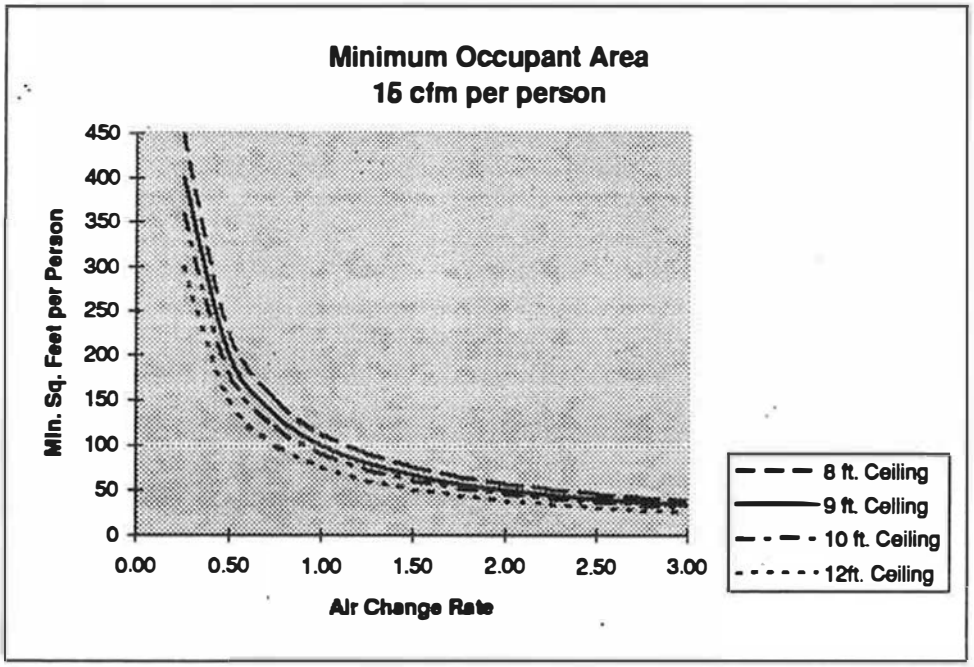


Table 3-4. Air Change Rates for Retail Spaces

Air Change Rate Required for 0.3 cfm/sq. ft.	
Ceiling Height	ACH
8	2.25
10	1.8
12	1.5
15	1.2

4. Statistical Analysis of the Data

Data collected in this phase of the project have been analyzed using descriptive statistical analysis techniques. Results of this analysis are described in this chapter, divided into sections which handle several different groupings of the data. Section 4.1 describes the analysis of the total building air change rate data. Section 4.2 describes the analysis of the air infiltration air change rate data. Section 4.3 analyzes the data collected for the class of office buildings. Section 4.4 treats the data for the retail buildings. Section 4.5 discusses the data for the schools and section 4.6 contains an analysis of the individual location air change rates measured .

Statistical analysis performed consisted of developing box plots and stem-leaf diagrams describing the air change rates by various building characteristics. In the following sections, the box plots and a table summarizing the stem-leaf analysis are given. The box plots show the dispersion (or range) with the median displayed as a white line within the black box, which defines a quartile around the median. The "whiskers" in each plot are the first set of lines beyond the black box and are 1.5 times the quartile range. Everything beyond this range is considered an "outlier" and is shown as horizontal lines in the box plots.

The table below each figure lists the number of observations in the data set (the column N), the median value of the observations (the value at which there an equal number of observations above and below the value), the lower and upper quartile values (25 percent of the observation lie between the median and a quartile), the mean (or average value of the observations) and the "outliers" given by the stem and leaf analysis (2 interquartile ranges or beyond). Because of the difference in quartile ranges used, the box plots will indicate one or more "outliers" than the (more stringent) stem and leaf (table) listings.

4.1 Building Air Change Rates

This section discusses the total air change rate data for the whole set of non-residential buildings studied. The total change rate is the building total air change rate and is the sum of that induced by the mechanical system and infiltration. The data analyzed are for the minimum damper settings for each building and it is the average of the air change rates of the zones of the building. Though the project gathered both minimum and normal operating condition air change rates, most buildings were tested at a time when they were being operated at minimum damper settings. Those that were not operating at the minimum setting were placed in such a state. Thus, the data in this report represent the minimum operating conditions of the HVAC system.

Figure 4-1 and Table 4-1 show the data for the building total air change rate by building class. The office buildings have the lowest median air change rate, 1.09 air changes per hour. This is what one would expect since the analysis of Section 3 showed that ASHRAE recommended minimum ventilation rates lead to lower air change rates for offices than for retail buildings or schools. The median value for retail buildings is 1.79 air changes per hour and the median for schools is 2.24 air changes per hour. The dotted lines in the figures represent the air change rates resulting from the current ASHRAE standard for offices (0.8) and for schools (3.0). Note that the majority of office buildings and retail buildings have minimum total air change rates greater than those resulting from the ASHRAE requirements. However, the majority of the schools are being operated below the minimum ventilation rates recommended by the current ASHRAE standard for acceptable indoor air quality.

Figure 4-2 and Table 4-2 show the climatic zone variation of the total building air change rate. It would seem from the data that only the southern coast climate zone differs from the other three climatic zones. This climate zone has the smallest sample size and also the largest percentage of Vintage 2 buildings.

Figure 4-3 and Table 4-3 show the variation of the total building air change rate with building vintage. The median for Vintage 1 buildings is 1.88 air changes per hour and for Vintage 2 buildings 1.16 - about

30% lower than Vintage 1 buildings. Note that the two outliers of 6.97 and 7.49 air hours per hour are Vintage 1 buildings.

Figure 4-4 and Table 4-4 show the variation of the total air change rates by both class and size. For most of these cells, the size of the cell sample and the range of variation in the air change rates make it difficult to determine if there are statistical differences. Small offices and schools seem clearly to be different; however it would be a mistake to attempt to assume the others are; though small retail and small offices would be judged different if the sample of small retail were larger and it was not for the fact that the cell small retail had only one Vintage 2 building.

All the data categories in Tables and Fiqures 4.1 to 4.4 show a large variation in measured air change rates, most with the high quartile air change rate being at least twice the low quartile air change rate. Despite sample size limits, nine "cell groups" show marked positive skew. Summaries for office, Vintage 2 and North Coast show median air change rates very close to the lower quartile. Six "cell groups" air characterized by positive outliers: Vintage 1, North Coast, North Interior, School, Retail and Small Retail.

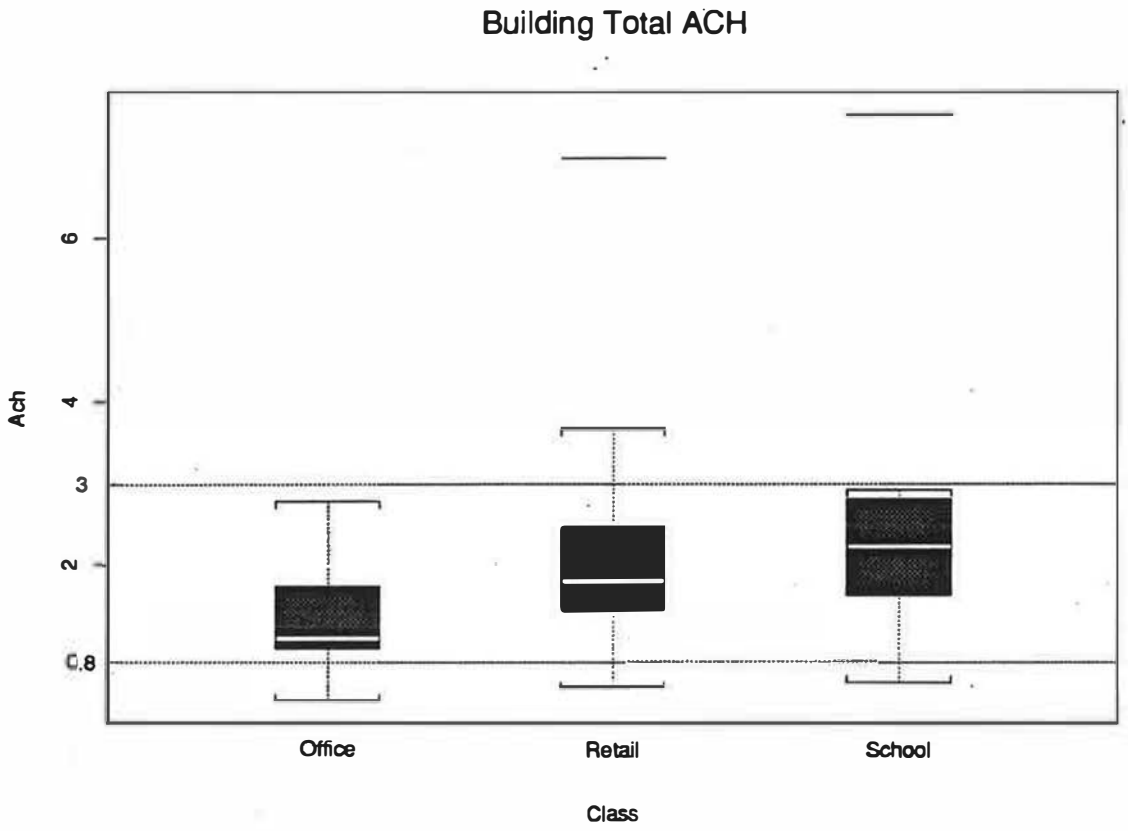


Figure 4-1. Building Total Air Change Rate by Building Class

Table 4-1. Building Total Air Change Rate by Building Class

	N	Median	Quartiles		Mean	Outliers
School	14	2.24	1.63	2.82	2.45	7.49
Office	22	1.09	0.97	1.74	1.35	
Retail	13	1.79	1.42	2.47	2.22	6.97

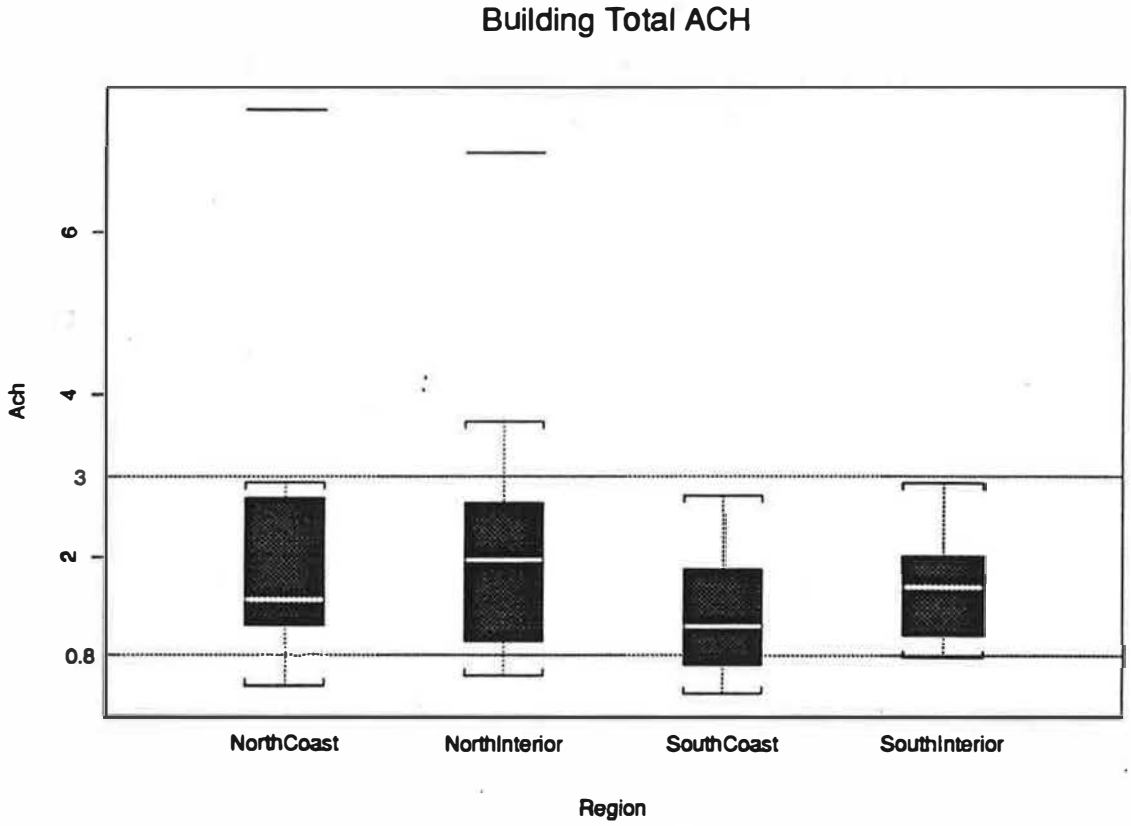


Figure 4-2. Building Total Air Change Rate by Climate Region

Table 4-2. Building Total Air Change Rate by Climate Region

	N	Median	Quartiles	Mean	Outliers
North Coast	13	1.47	1.16 2.74	2.17	7.49
North Interior	15	1.96	0.97 2.67	2.20	6.97
South Coast	7	1.14	0.68 1.85	1.32	
South Interior	14	1.63	1.05 2.02	1.67	

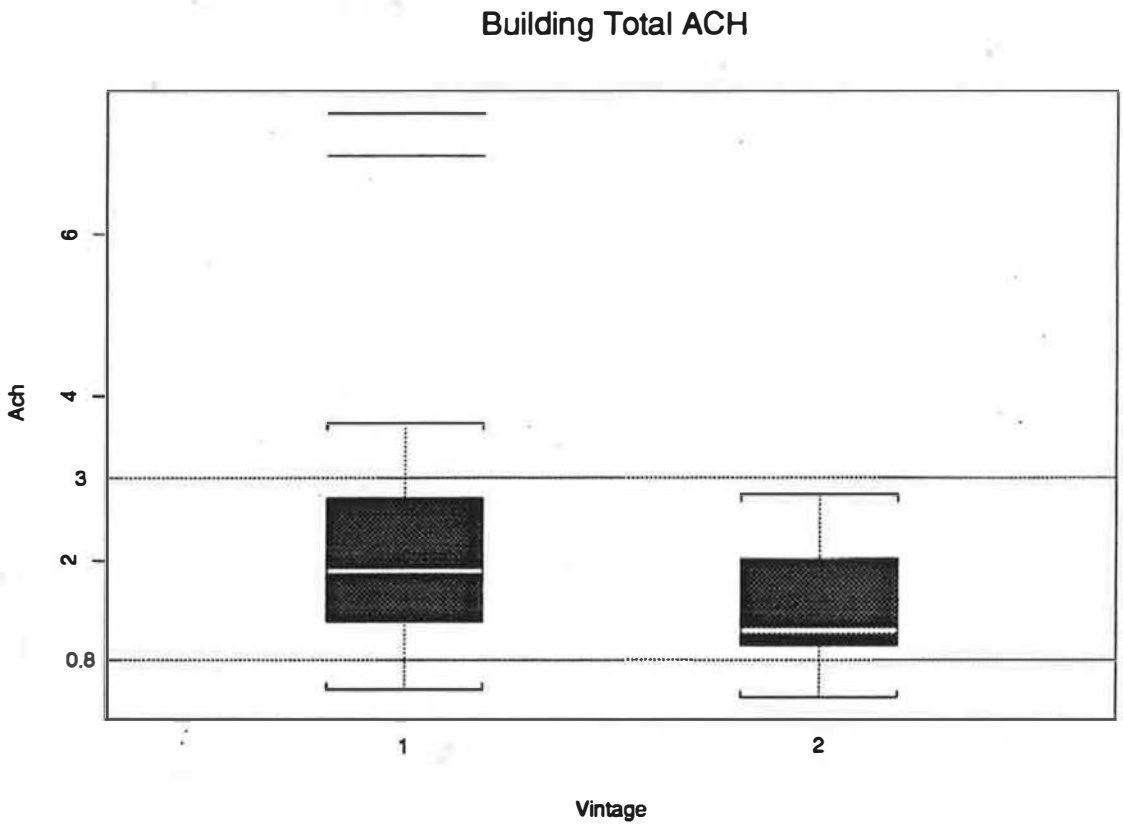


Figure 4-3. Total Building Air Change Distribution Rate by Vintage

Table 4-3. Total Building Air Change Rate Distribution by Vintage

	N	Median	Quartiles	Mean	Outliers
Vintage 1	28	1.88	1.27 2.75	2.24	6.97 7.49
Vintage 2	21	1.16	0.98 2.02	1.43	

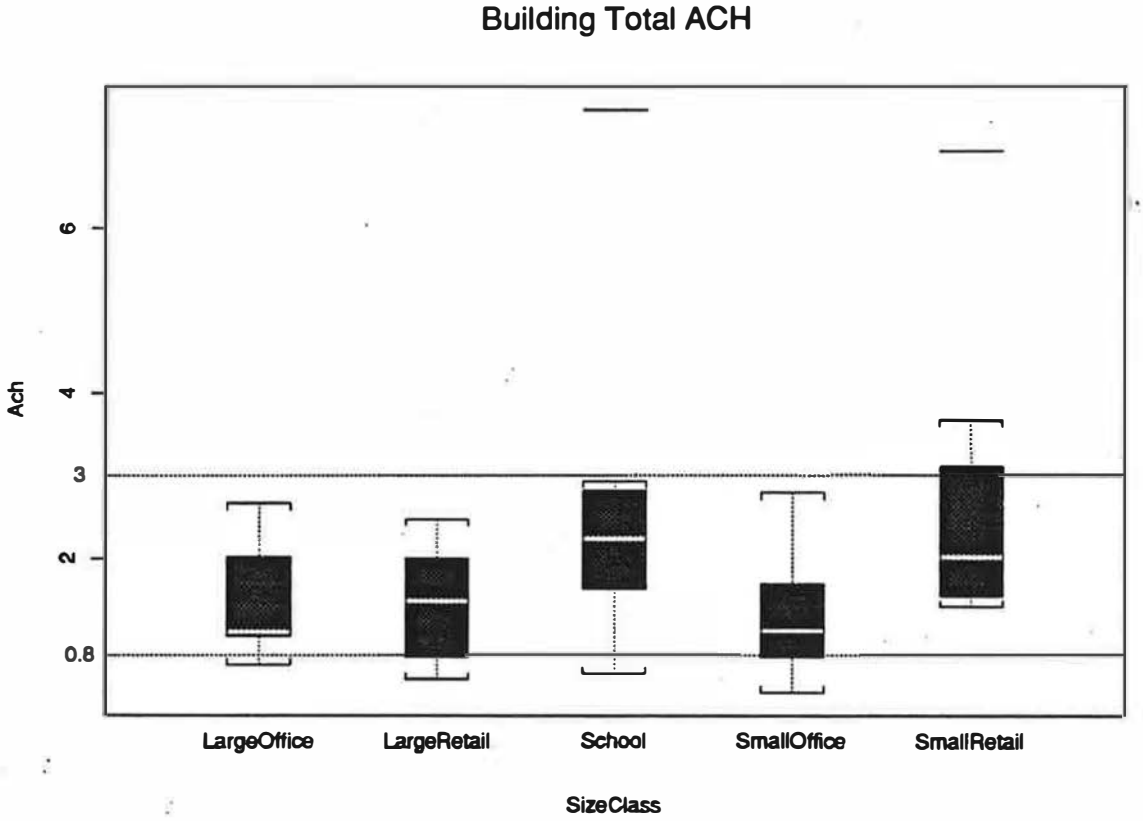


Figure 4-4. Total Building Air Change Rate Distribution by Size and Building Class

Table 4-4. Total Building Air Change Rate Distribution by Size and Building Class

	N	Median	Quartiles	Mean	Outliers
Large Office	6	1.09	1.04 2.02	1.43	
Large Retail	5	1.47	0.77 2.00	1.44	
School	14	2.24	1.63 2.82	2.45	7.49
Small Office	16	1.11	0.77 1.69	1.32	
Small Retail	8	2.01	1.54 3.11	2.71	6.97

4.2 Building Infiltration Rates

This section discusses the analysis of the building air infiltration rates. The project team was able to measure the air infiltration rate in 40 of the 49 buildings tested. The reason that for nine buildings the infiltration rate could not be measured was that these buildings were too complex to use the buildup/decay method which could be used during normal occupancy and it was not possible to obtain access to the buildings during hours when the HVAC system could be sealed or shut-off and thus tested by the decay method without violating California minimum ventilation requirements.

Figure 4-5 and Table 4-5 summarize the building air infiltration rates by building type. School and office buildings have almost identical median air infiltration rates of 0.32 and 0.31 air changes per hour, respectively. Retail buildings have a median air infiltration rate of 1.12. The distribution for schools shows a greater variation than either offices or retail; its high quartile about 6 times its low quartile. However, offices have three outliers. For offices the median air infiltration rate is about 30 percent of the median of total air change rate for offices, about 15 percent for schools and about 60 percent for retail buildings. However, the retail buildings with air infiltration measurements are mostly Vintage 1 buildings and so this ratio is somewhat artificially high.

Figure 4-6 and Table 4-6 show the distribution of air infiltration rates by both building class and size. The data show no retail or office differences by building size, although samples are very small for all but the small retail category.

Figure 4-7 and Table 4-7 show the variation in air infiltration rates by climate zone. The north coast climate zone has the highest median infiltration rate, 0.91 air changes per hour, compared with 0.41 for the north interior climate zone and 0.29 air change rates per hour for the south coast and south interior climate zones. Note that the south interior zone has a very skewed distribution.

Figure 4-8 and Table 4-8 show the distribution of air infiltration rates by building vintage. Vintage 1 buildings have a median infiltration rate of 0.51 air changes per hour, while Vintage 2 buildings have a

median infiltration rate of 0.31. With these sample sizes, results from significance tests are difficult to interpret. It should be noted, however, that the difference in total building air change rate between Vintage 1 and Vintage 2 buildings noted in Section 4.1 (1.88 and 1.16 respectively) cannot be explained by the difference in air infiltration since the ratio of the air infiltration to total air change is approximately the same for both vintages, with mean ratios of 35 percent and 33 percent respectively.

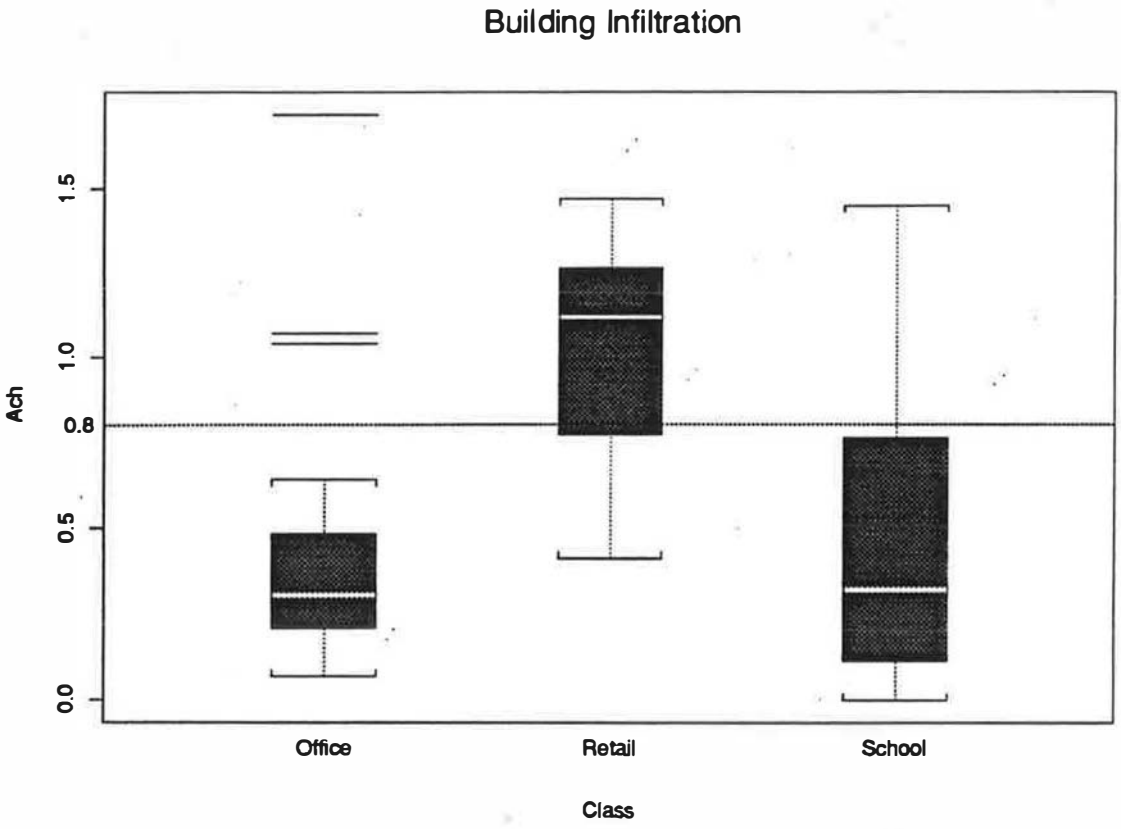


Figure 4-5. Building Infiltration Rate Distribution by Building Class

Table 4-5. Building Infiltration Rate Distribution by Building Class

	N	Median	Quartiles	Mean	Outliers
Office	20	0.31	0.21 0.48	0.43	1.04 1.07 1.72
Retail	8	1.12	0.77 1.27	1.02	
School	12	0.32	0.12 0.76	0.46	

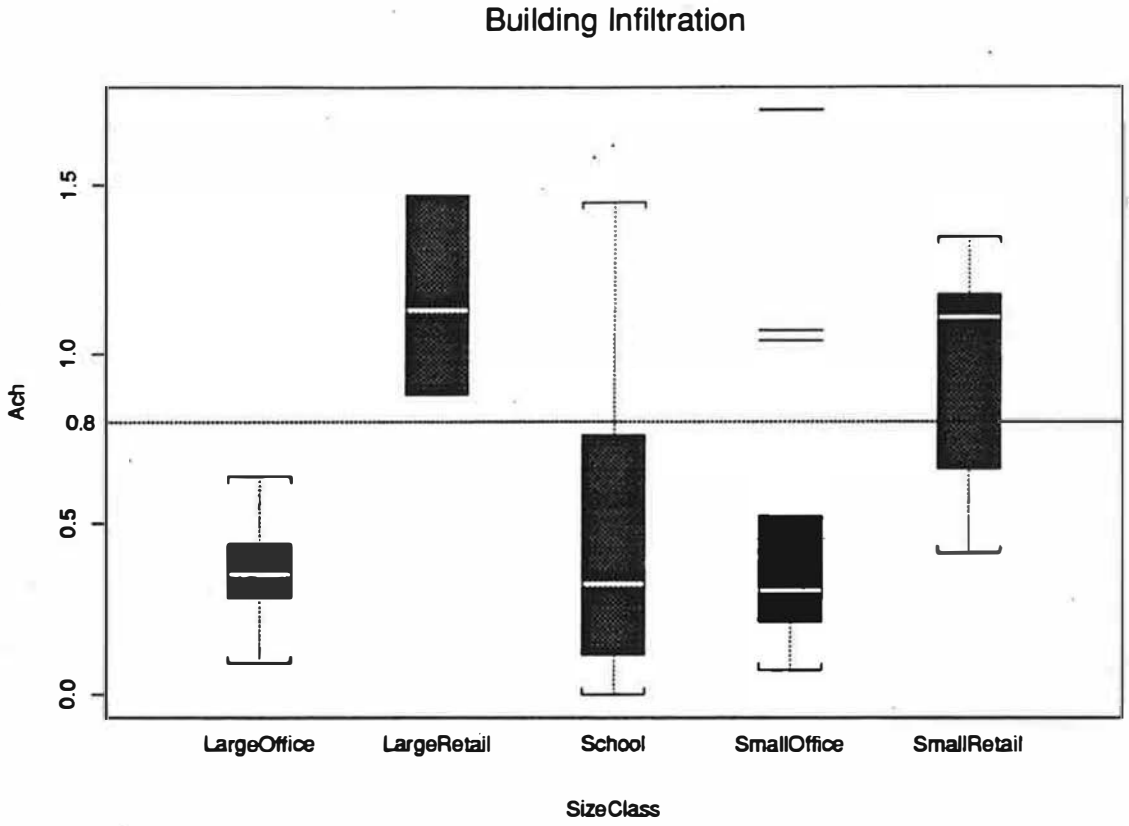


Figure 4-6. Building Infiltration Rate Distribution by Size and Class

Table 4-6. Building Infiltration Rate Distribution by Class and Size

	N	Median	Quartiles	Mean	Outliers
Large Office	5	0.35	0.28 0.44	0.36	
Large Retail[1]	3	1.13	0.88 1.47	1.16	
School	12	0.32	0.12 0.76	0.46	
Small Office	15	0.30	0.21 0.52	0.46	1.72
Small Retail	5	1.11	0.66 1.18	0.94	

[1] Contains no Vintage 2 buildings

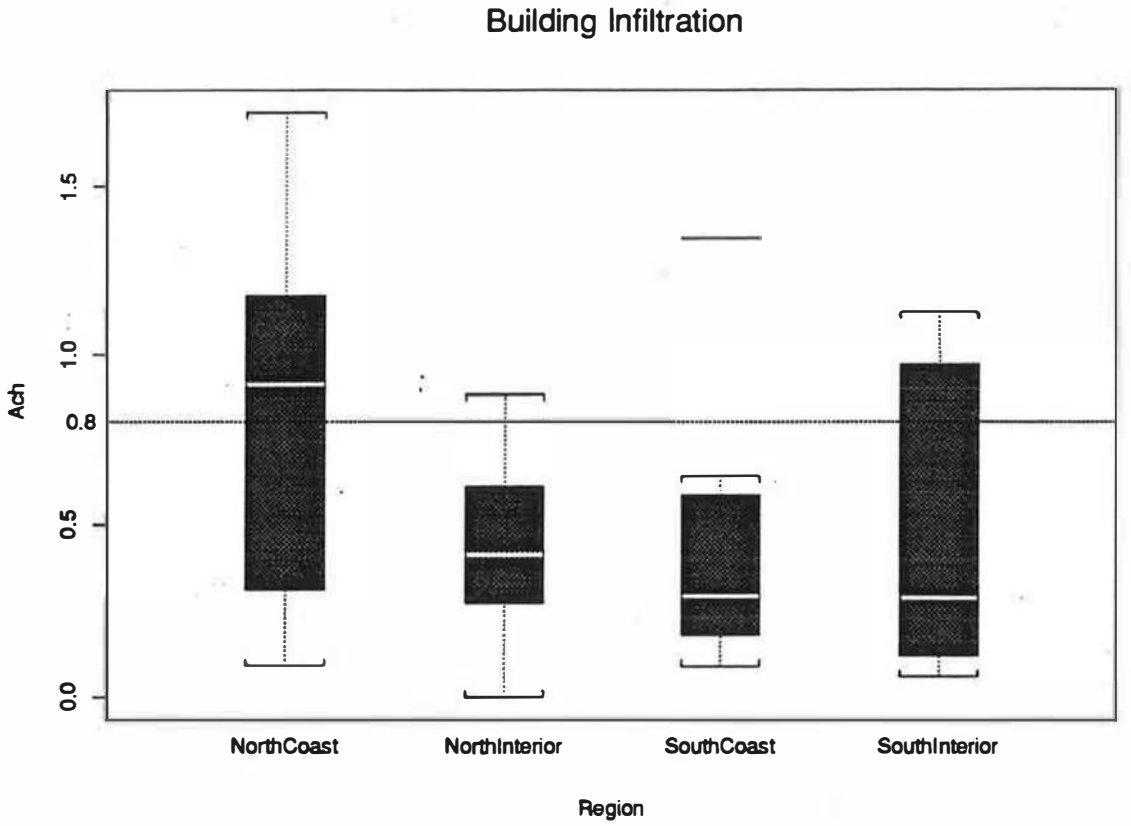


Figure 4-7. Building Infiltration Rate Distribution by Climate Region

Table 4-7. Building Infiltration Rate Distribution by Climate Region

	N	Median	Quartiles	Mean	Outliers
North Coast	13	0.91	0.31 1.18	0.81	
North Interior	9	0.41	0.27 0.61	0.42	
South Coast	6	0.29	0.18 0.59	0.44	
South Interior	12	0.29	0.12 0.97	0.45	

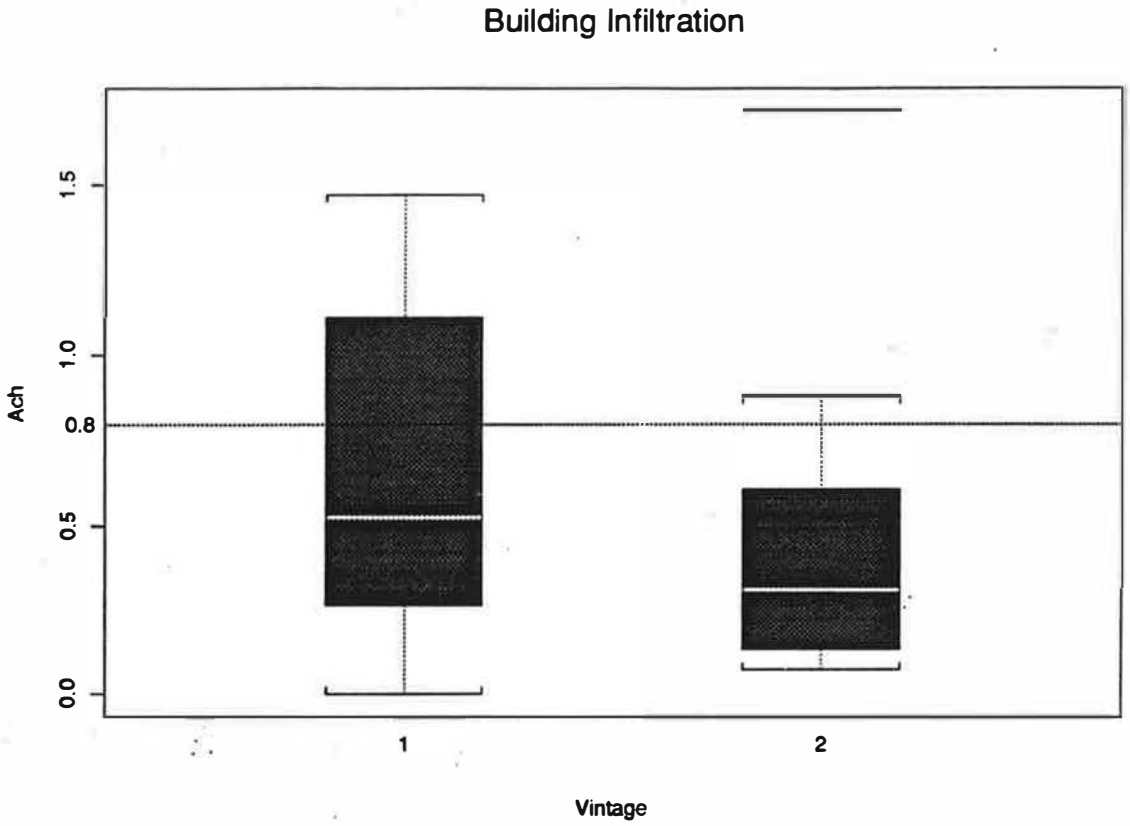


Figure 4-8. Building Infiltration Rate Distribution by Vintage

Table 4-8. Building Infiltration Rate Distribution by Vintage

	N	Median	Quartiles	Mean	Outliers
Vintage 1	22	0.53	0.26 1.11	0.68	
Vintage 2	18	0.31	0.13 0.61	0.41	1.72

4.3 Office Buildings

This section discusses the data for the 22 office buildings tested.

Air Change Rates

Figure 4-9 and Table 4-9 show the variation in total air change rate for office buildings. Though large differences are evident in median values across climate region, small sample sizes rule out the use of formal significance testing.

Figure 4-10 and Table 4-10 show the distribution in total air change rates for office buildings by vintage. The medians of the two distributions are almost the same; however, the Vintage 2 office building distribution, with 20 percent more measurements, is skewed toward the higher values.

Figure 4-11 and Table 4-11 show the variation in total building air change rate by building size for office buildings. The median of the two distributions are nearly the same with large buildings showing positive skew (based on fewer observations).

Figure 4-12 and Table 4-12 show the number and percent of office buildings with total air change rates below a certain value. About 9 percent of the sample had total air change rates less than 0.5 air changes per hour and 22 percent of office buildings had total air change rates less than 0.8 which would provide the minimum ASHRAE recommended ventilation rate for typical occupancy. Note also from Figure 4-12 that about 35 percent of the office building have total air change rates greater than 1.5 ACH (40 cfm per person at typical occupancy) and about 25 percent have total air change rates greater than 2.0 ACH (greater than 50 cfm per person at typical occupancy). As mentioned earlier, these are the values at minimum HVAC operating conditions indicating that a large number of the offices are being ventilated at more than twice the recommended ASHRAE minimum requirements.

Air Infiltration Rates

Figure 4-13 and Table 4-13 show the variation in the air infiltration rates for office buildings by climate region. A doubling in medians is accompanied by larger variations in north coast than south interior rates.

Figure 4-14 and Table 4-14 shows the variation by vintage in the air infiltration rates for offices. Median air infiltration rates for the 2 samples are the same but the interquaartile range for Vintage 2 buildings is shifted toward the lower end of the scale.

Figure 4-15 and Table 4-15 show the distributions of office building air infiltration rates by building size. There is no difference in the two distributions, although "small" has three times the number of measurements as "large".

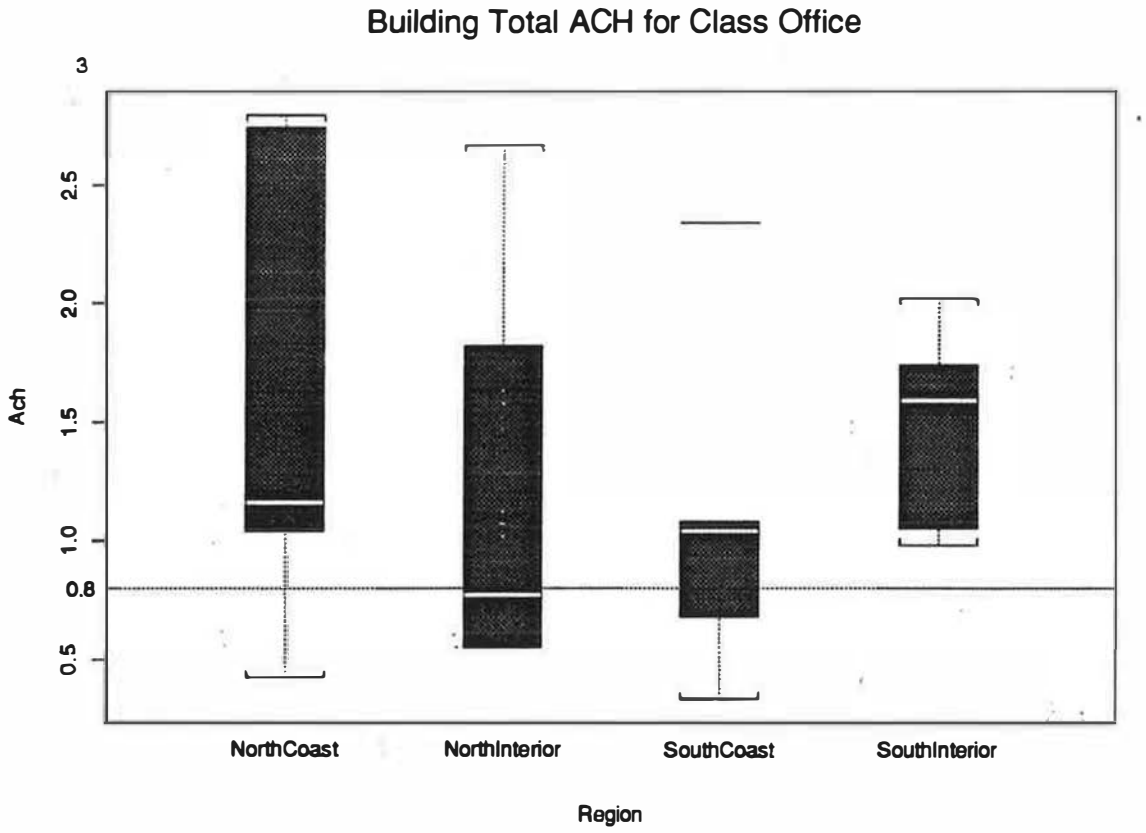


Figure 4-9. Office Building Total Air Change Rate Distribution by Climate Region

Table 4-9. Office Building Total Air Change Rate by Climate Region

	N	Median	Quartiles	Mean	Outliers
North Coast	7	1.16	1.04 2.74	1.49	
North Interior	4	0.77	0.56 1.82	1.19	
South Coast	4	1.04	0.68 1.98	1.10	2.34
South Interior	7	1.59	1.05 1.74	1.50	

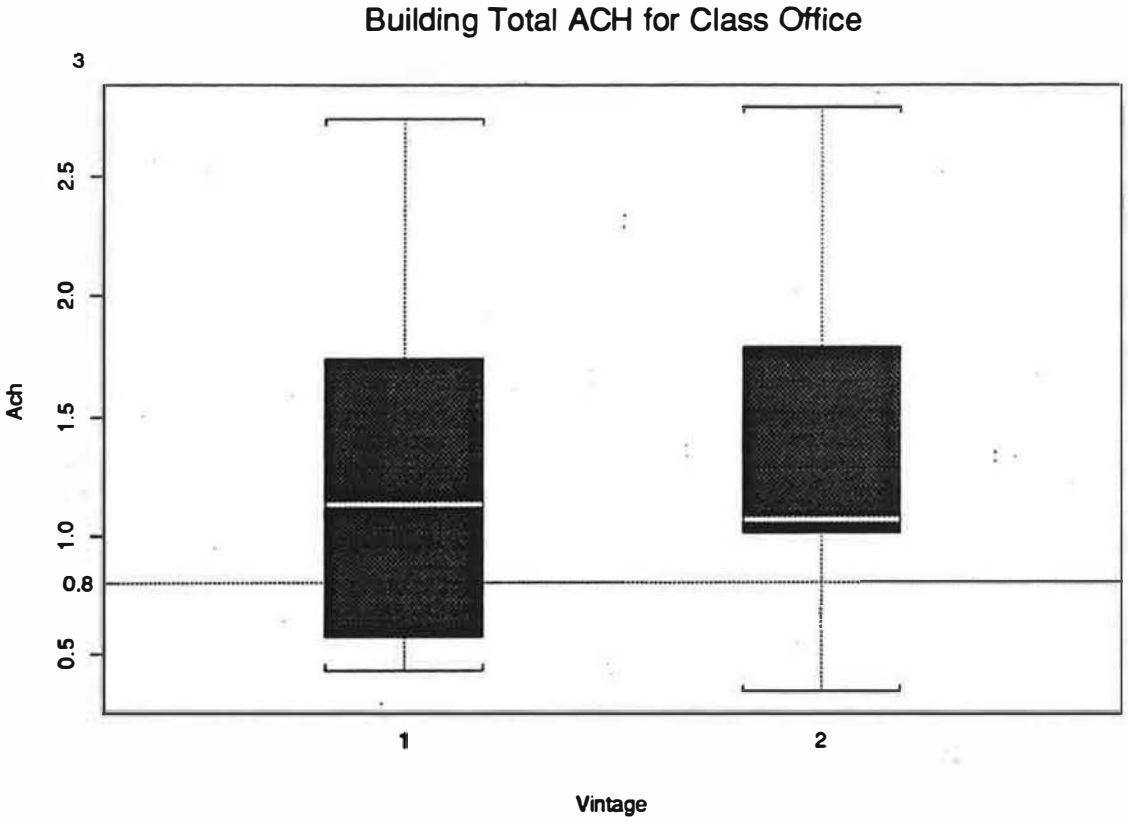


Figure 4-10. Office Building Total Air Change Rate Distribution by Vintage

Table 4-10. Office Building Total Air Change Rate Distribution by Vintage

	N	Median	Quartiles	Mean	Outliers
Vintage 1	10	1.13	0.57 1.74	1.36	
Vintage 2	12	1.07	1.01 1.79	1.34	

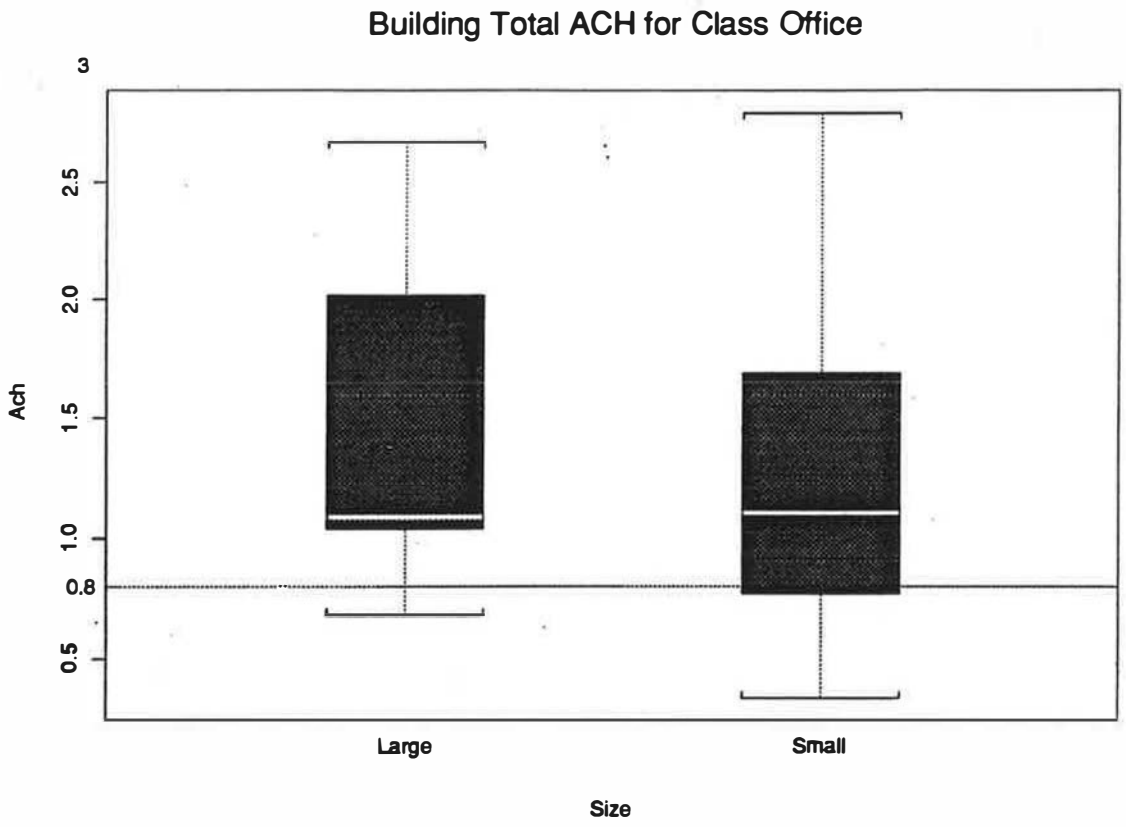


Figure 4-11. Office Building Total Air Change Disribution by Size

Table 4-11. Office Building Total Air Change Rate by Size

	N	Median	Quartiles	Mean	Outliers
Large	6	1.04	1.04 2.02	1.43	
Small	16	1.10	0.77 1.69	1.32	

Table 4-12 Number of Office Buildings with Low Air Change Rates

Office Buildings			
Number of Buildings with Total Ach Less Than	**All**	**Vintage 1**	**Vintage 2**
< 0.5	2	1	1
< 0.75	5	3	2
Sample Number	22	10	12

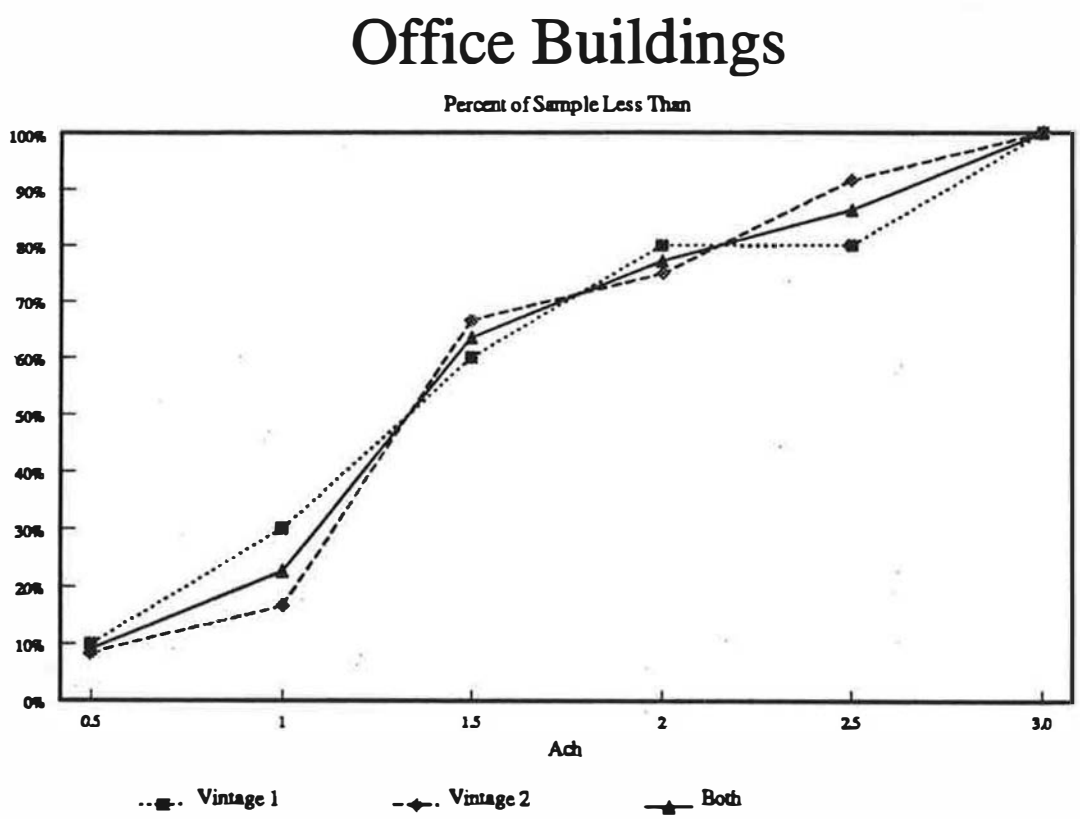


Figure 4-12 Percent of Office Buildings Below a Certain Air Change Rate

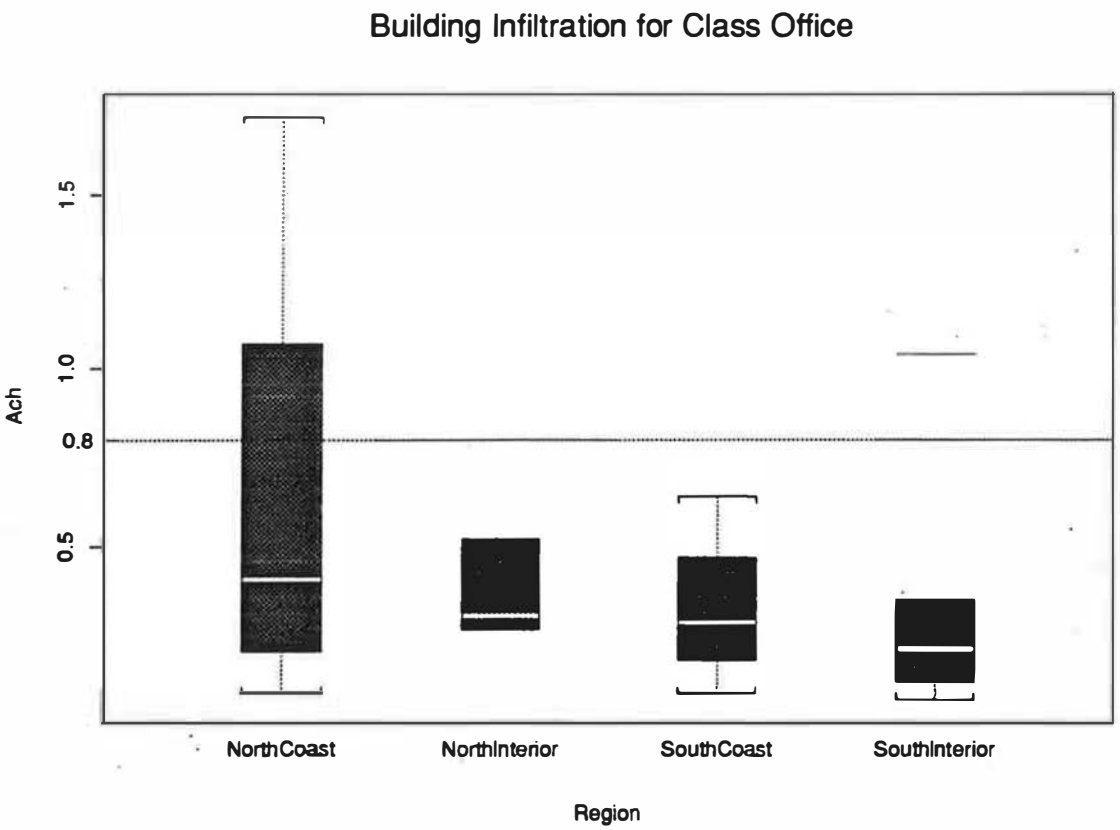


Figure 4-13. Office Building Infiltration Rate Distribution by Climate Region

Table 4-13. Office Building Infiltration Rates by Climate Region

	N	Median	Quartiles	Mean	Outliers
North Coast	7	0.41	0.21 1.07	0.61	
North Interior	3	0.31	0.27 0.52	0.37	
South Coast	4	0.29	0.19 0.47	0.33	
South Interior	6	0.22	0.12 0.35	0.34	1.04

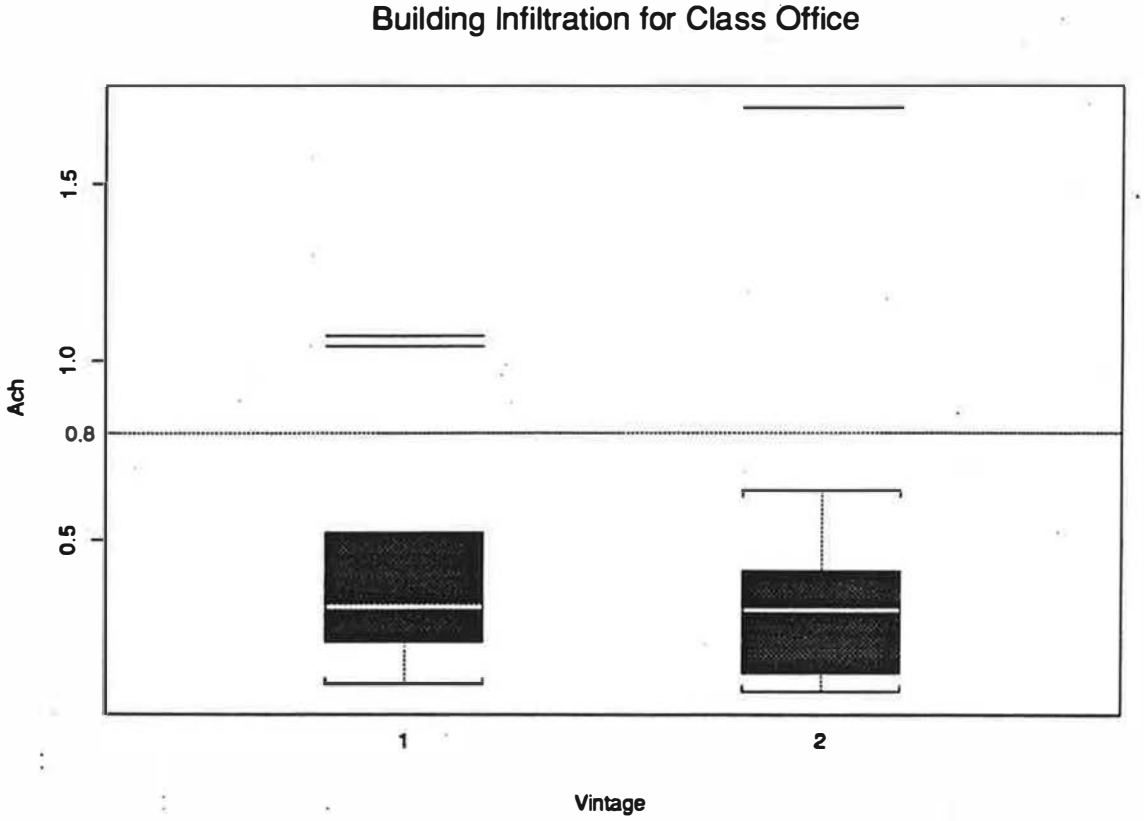


Figure 4-14. Office Buildng Infiltration Rate Distribution by Vintage

Table 4-14. Office Building Infiltration Rate Distribuiton by Vintage

	N	Median	Quartiles	Mean	Outliers
Vintage 1	9	0.31	0.21 0.52	0.46	
Vintage 2	11	0.30	0.12 0.41	0.41	1.72

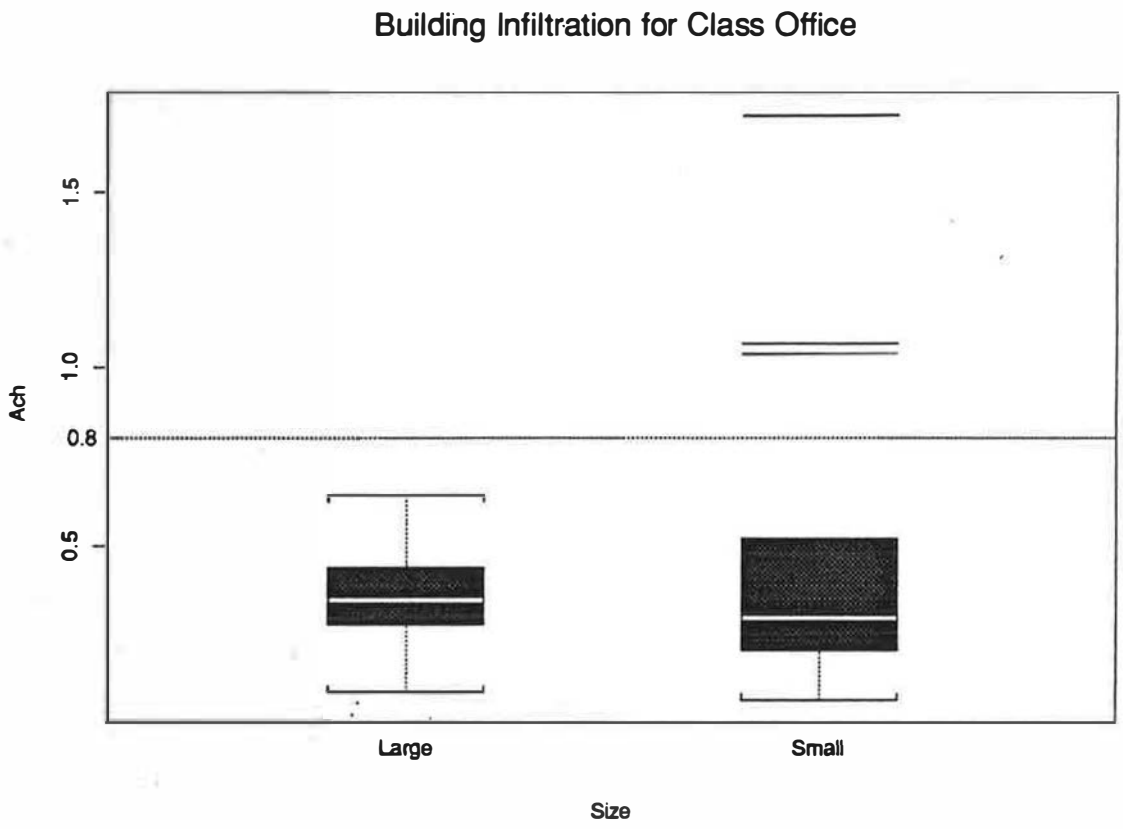


Figure 4-15. Office Building Infiltration Rate Distribution by Size

Table 4-15. Office Building Infiltration Rate Distribution by Size

	N	Median	Quartiles	Mean	Outliers
Large	5	0.35	0.28 0.44	0.36	
Small	15	0.30	0.21 0.52	0.46	1.72

4.4 Retail Buildings

This section discusses the data collected for retail buildings. This is probably the least likely class for which any reliable conclusions can be drawn. It is unlikely that the buildings tested are representative of all retail buildings in California. The small sample contains a church conference and meeting building, a nursing home, a funeral home, two automobile dealerships, a truck stop, community college common buildings (bookstore, cafeteria, etc.), a large non-mechanically ventilated store and 3 large modern detached retail store. There were no malls, neither large nor strip, no restaurants, movie theaters, etc.

Air Change Rates

Figure 4-16 and Table 4-16 show the variation in total air change rates by climate region for the class of retail buildings. The sample size for each cells is too small be draw any conclusions. Figure 4-17 and Table 4-17 show the variation in total air change rates for the retail buildings for the two vintage classes. Total air change rates for Vintage 2 retail buildings are lower than those for Vintage 1 buildings.

Figure 4-18 and Table 4-18 show the difference in total air change rates between the large and small retail buildings. A median air change rate of 1.47 is shown for the large retail buildings compared to a median of 2.01 air changes per hour for the small retail buildings.

Figure 4-19 and Table 4-19 show the number and percent of retail buildings with total air change rates below a certain value. Note than half (2 of 4) of the Vintage 2 retail buildings have total air change rates less than 1 air change per hour (these are two large modern retail stores) and than more than 30 percent of the Vintage 1 retail buildings have total air change rates greater than 2.5 air changes per hour. As indicated in Figure 4-17. Retail Building Total Air Change Rate Distribution by Vintage, Vintage 1 retail buildings include an outlier of 6.97 (the truck stop).

Air Infiltrtion Rates

Figure 4-20 and Table 4-20 show the distribution of retail buildings for the measured infiltration rates by climatic zone. Sample sizes are too small for interpretation

Figure 4-21 and Table 4-21 the distributions according to building vintage. Again, samples are too small for interpretation. The mean for the Vintage 1 category (or "cell group") is pulled down by one very low measurement.

Figure 4-22 and Table 4-22 show the distributions according to building size. Samples are too small for interpretation.

Overall, these results suggest that there are some retail buildings with very high infiltration rates and the Vintage 1 retail buildings in this sample have higher air change rate than the Vintage 2 buildings.

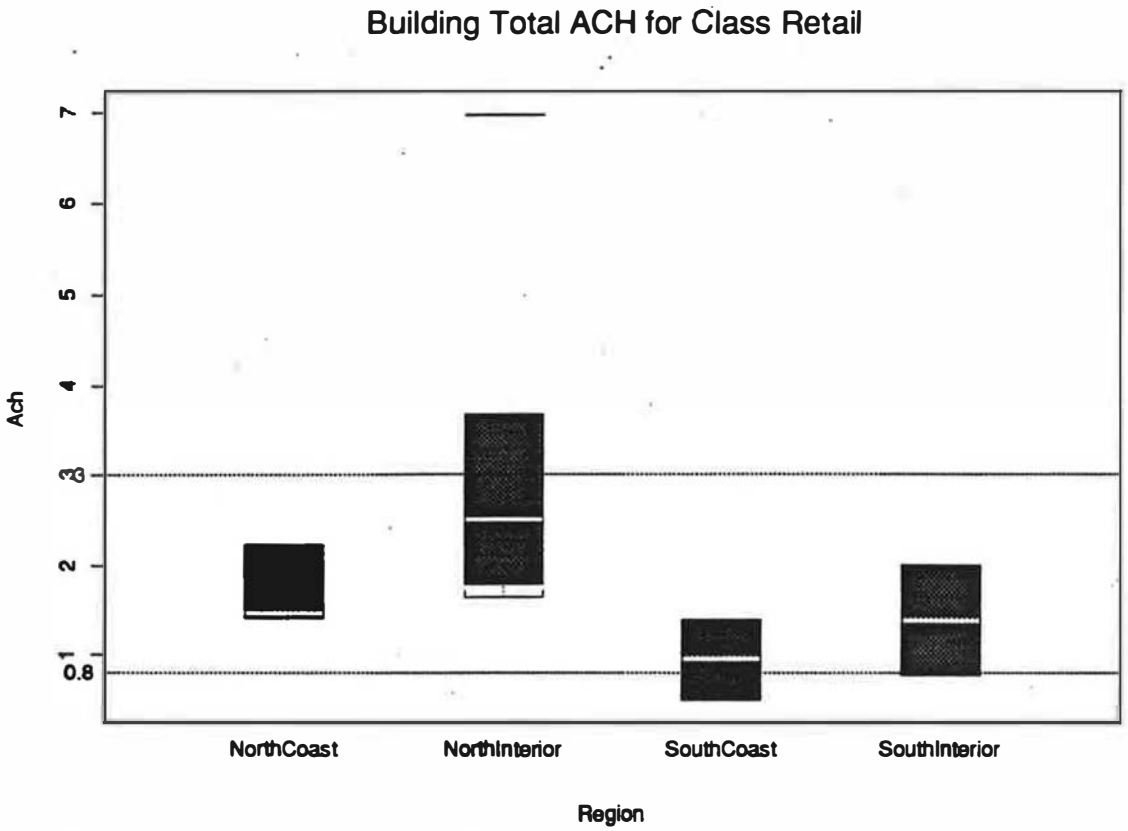


Figure 4-16. Retail Building Total Air Change Rate Distribution by Climate Region

Table 4-16. Retail Building Total Air Change Rate by Climate Region

	N	Median	Quartiles	Mean	Outliers
North Coast	3	1.47	1.42 2.23	1.71	
North Interior	6	2.51	1.79 3.67	3.18	6.97
South Coast	2	0.95	0.50 1.40	0.95	
South Interior	2	1.39	0.77 2.00	1.38	

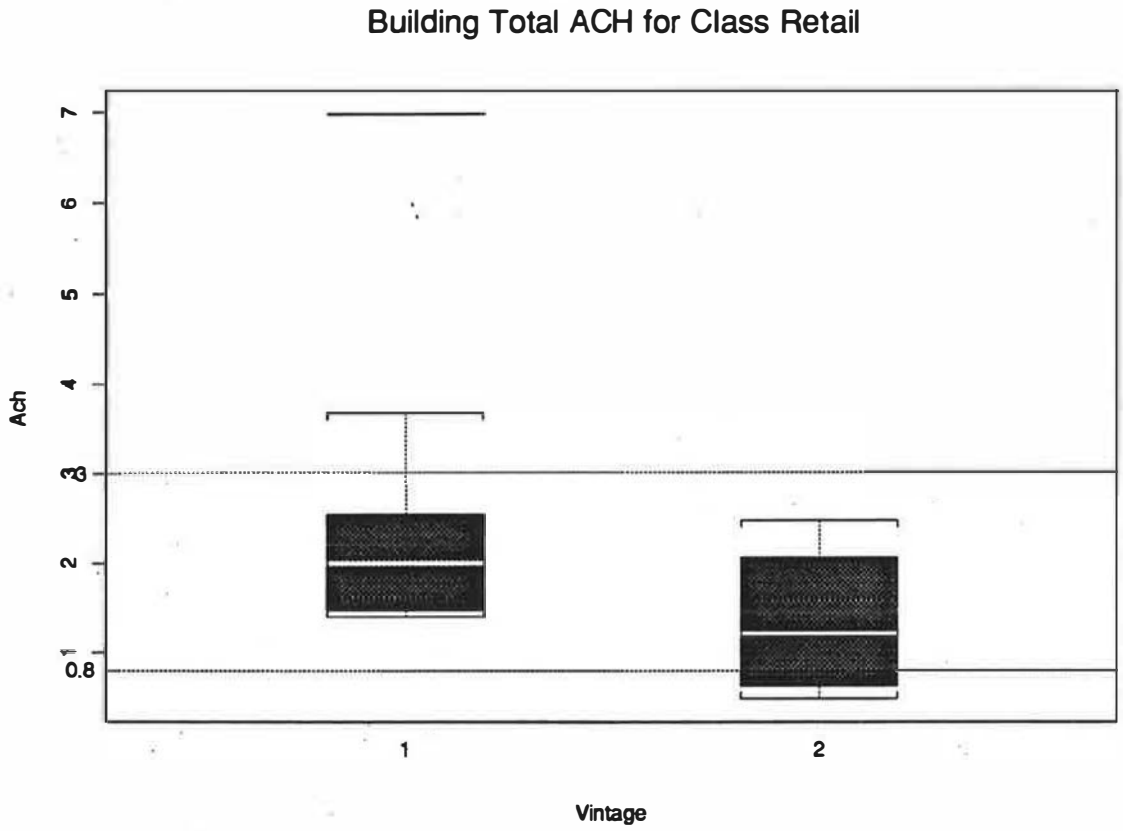


Figure 4-17. Retail Building Total Air Change Rate Distribution by Vintage

Table 4-17. Retail Building Total Air Change Rate by Vintage

	N	Median	Quartiles	Mean	Outliers
Vintage 1	9	2.00	1.47 2.54	2.61	6.97
Vintage 2	4	1.21	0.64 2.06	1.35	

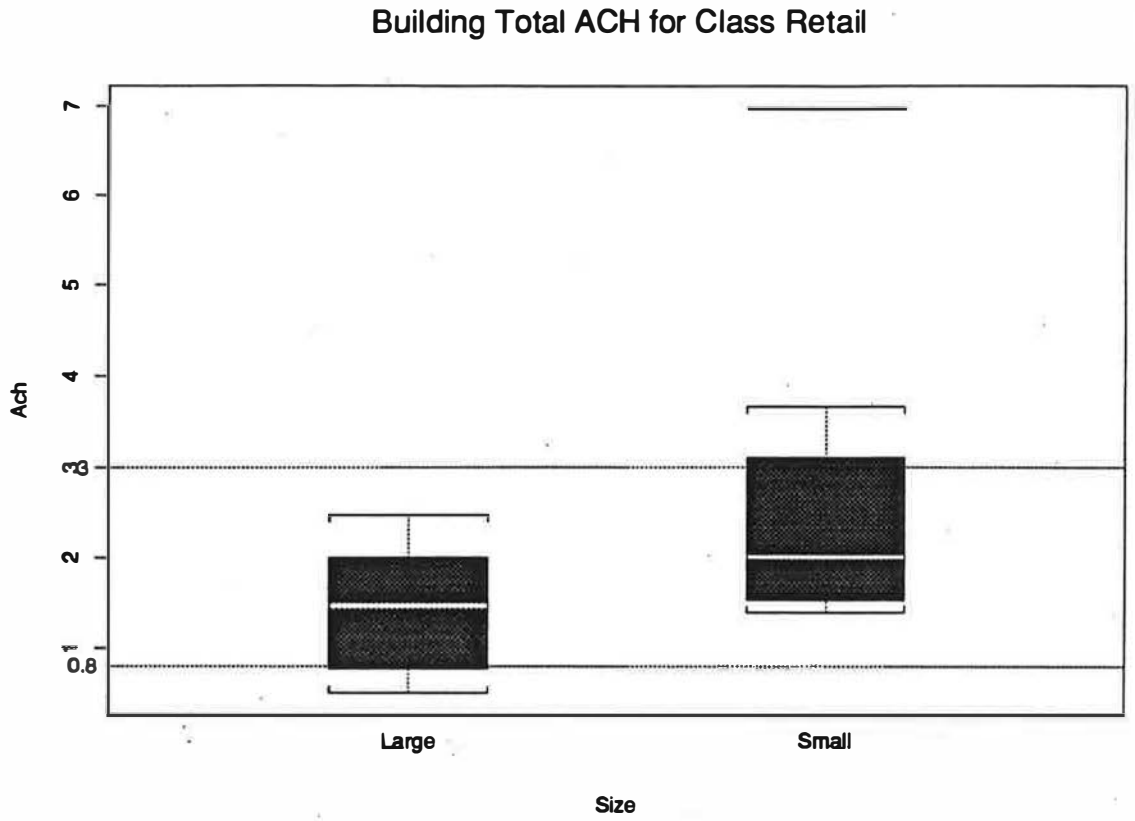


Figure 4-18. Retail Building Total Air Change Rate Distribution by Size

Table 4-18. Retail Building Total Air Change Rate by Size

	N	Median	Quartiles	Mean	Outliers
Large	5	1.47	0.77 2.00	1.44	
Small	8	2.01	1.54 3.11	3.11	6.97

Retail Buildings

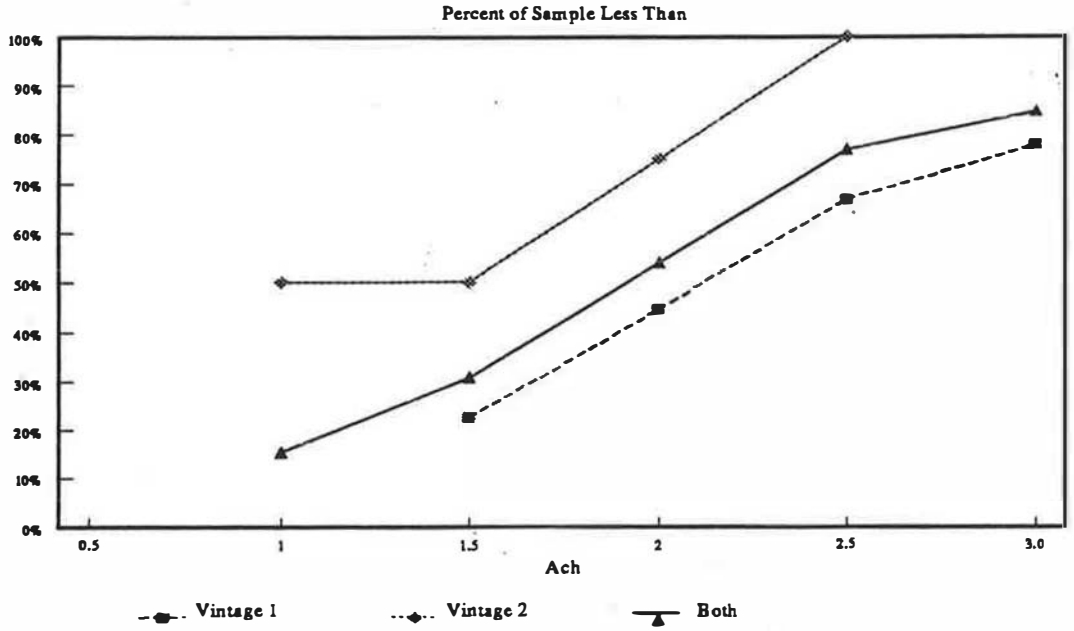


Figure 4-19. Percent of Retail Buildings Below a Certain Air Change Rate

Table 4-19. Number of Retail Number Below a Certain Air Change Rate

Retail Buildings			
Total Ach Less Than	**All**	**Vintage 1**	**Vintage 2**
< 0.5	0	0	0
< 1.0	2	0	2
< 1.5	4	2	2
< 2.0	7	4	3
Sample Number	13	9	4

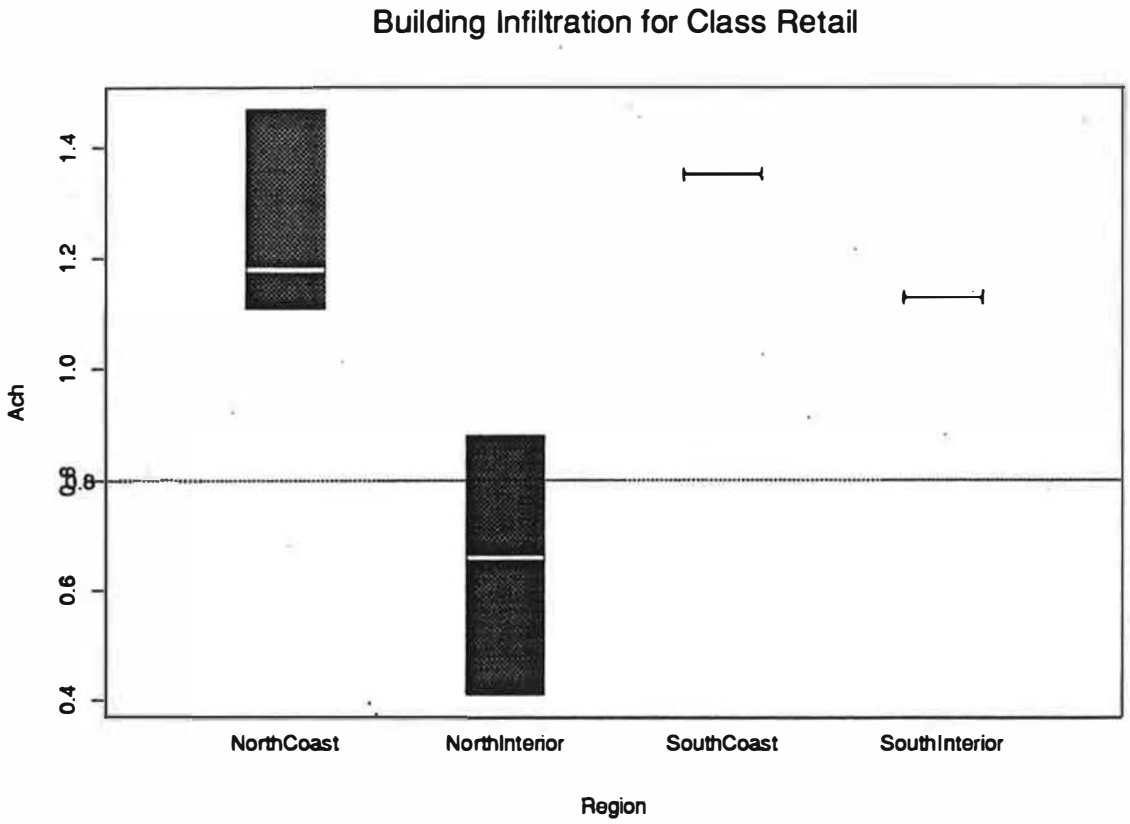


Figure 4-20. Retail Building Infiltration Rate Distribution by Climate Region

Table 4-20. Retail Building Infiltration Air Change Rate by Climate Region

	N	Median	Quartiles	Mean	Outliers
North Coast	3	1.18	1.11 1.47	1.25	
North Interior	3	0.66	0.41 0.88	0.65	
South Coast	1	1.35		1.35	
South Interior	1	1.13		1.13	

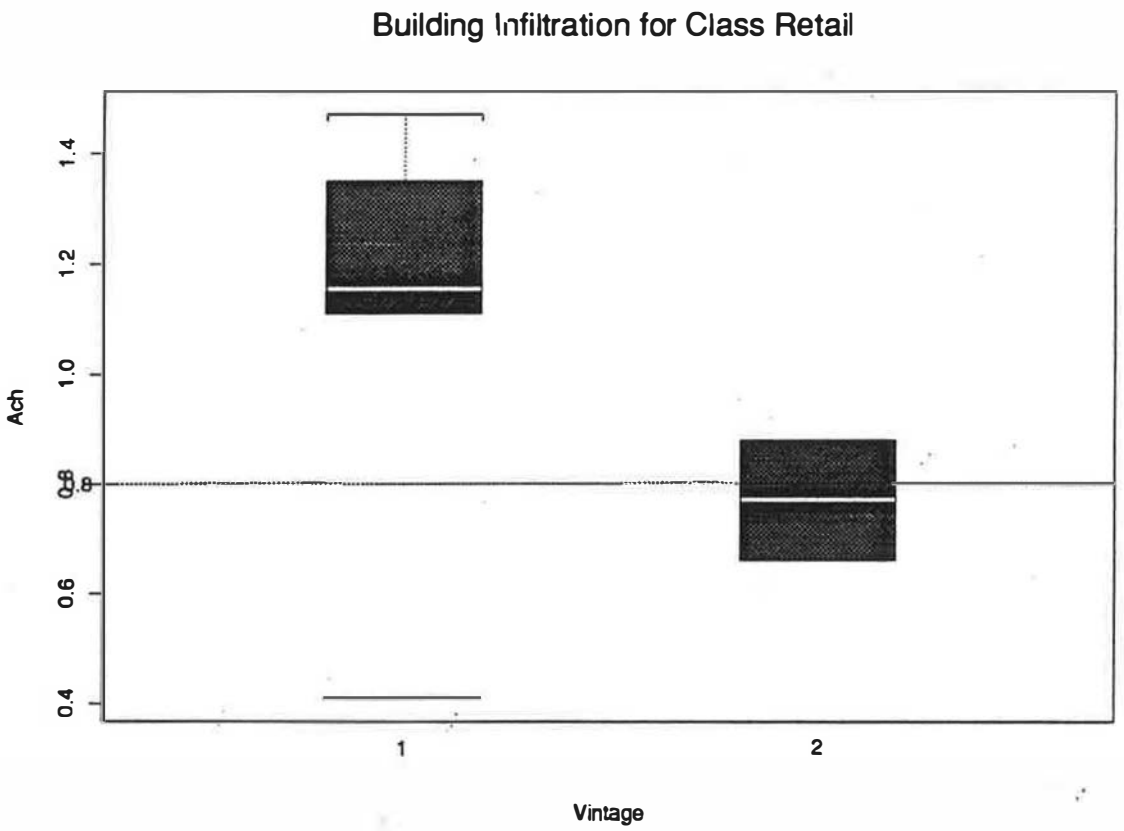


Figure 4-21. Retail Building Infiltration Rate Distribution by Vintage

Table 4-21. Retail Building Infiltration Rate Distribution by Vintage

	N	Median	Quartiles		Mean	Outliers
Vintage 1	6	1.16	1.11	1.35	1.11	0.41
Vintage 2	2	0.77	0.72	0.83	0.77	

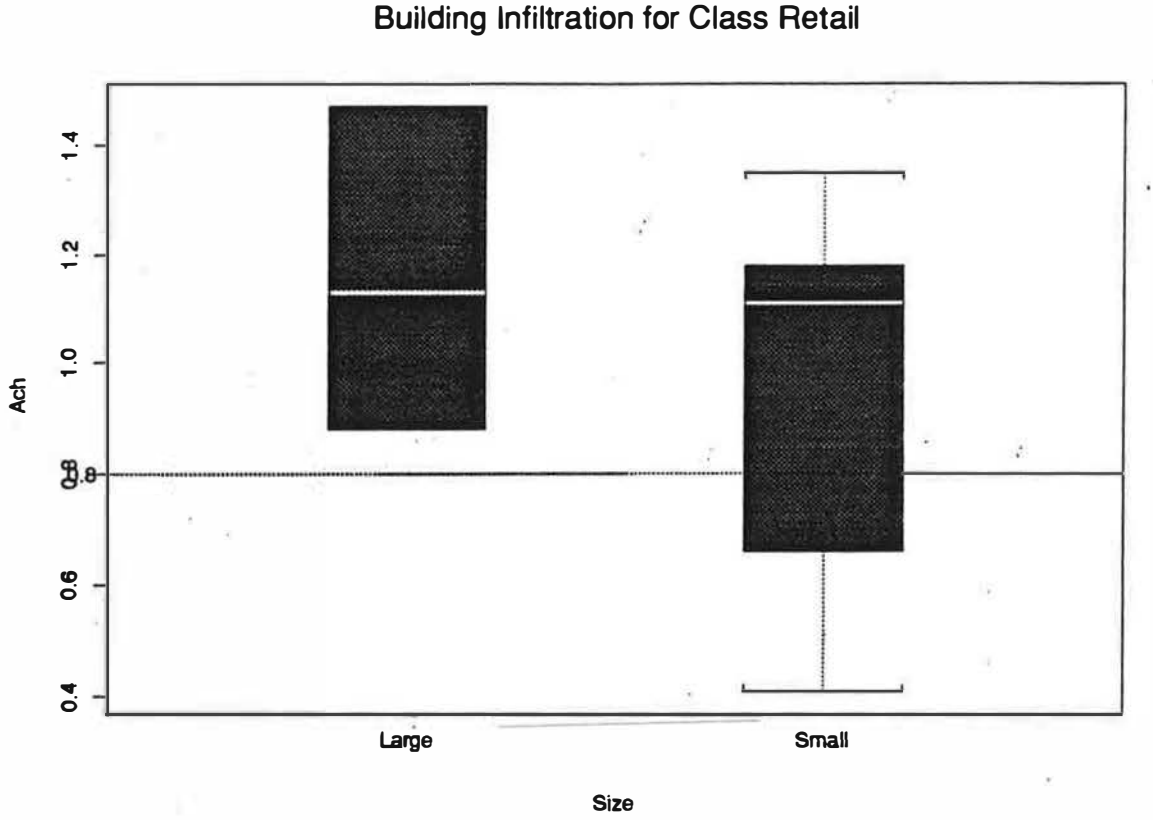


Figure 4-22 . Retail Building Infiltration Rate Distribution by Size

Table 4-22. Retail Building Infiltration Rate Distribution by Size

	N	Median	Quartiles	Mean	Outliers
Large	3	1.13	0.88 1.47	1.16	
Small	5	1.11	0.66 1.18	0.93	

4.5 Schools

This section discusses the air change rate data for the school buildings tested. The schools tested consisted of elementary schools, middle schools, high schools and community colleges. The typical elementary school, middle school or high school had individual roof-top packaged units serving a single class room. The teacher could control the operation of the HVAC selecting 1) a setting of "off" which some would do due to the noise of the system; 2) intermittent operation which only provided outside air when heating or cooling was required or 3) "fan on" which provide ventilation continuously. Many of these classrooms had no windows and had a door which opened to the outside which would be kept open.

The second most common HVAC system consisted of a similar larger packaged unit serving a module of 2 to 4 classrooms, the other characteristics being the same. Several systems required major repair which had not been done for financial reasons - one had a fan motor with a worn bearing which made such a noise that it was turned off; another had a collapsed return air duct and another had broken fan belts.

The community colleges tested had mostly several central HVAC system units serving a building and the door of the classroom or lecture halls opened to interior corridors.

Air Change Rates

Figure 4-23 and Table 4-23 show the distribution for the total building air change rates for schools. The median total building air change rate for schools is 2.24 ACH. The distribution is fairly symmetrical about the median with one very high outlier of 7.49 ACH and a low value of 0.6 ACH which explains why the low 1.5 quartile "whisker" is very low.

Figure 4-24 and Table 4-24 show the distribution of school total air change rates by climate zone. Small sample sizes make detailed comparisons impossible. Nonetheless, north coast results include the 7.49 outlier shown in Table 4-23. If this data point is eliminated, the four climate zone show no median differences or differences in distribution shape.

Figure 4-25 and Table 4-25 show the distribution of the school total air change rate by vintage. Vintage 1 schools have a median of 2.76 ACH compared to the Vintage 2 schools with a median of 1.85 ACH. The school with the lowest air change rate of 0.6 (an outlier in the box plot but not by the more stringent stem and leaf analysis) is a Vintage 2 school.

Figure 4-26 and Table 4-26 show the percent and building of school buildings with total air change rates below a certain value. About 20 percent of the school building have air change rates less than half the value required to provide current recommended ASHRAE ventilation rate of 15 cfm per person. About 60 percent of Vintage 2 school buildings and 20 percent of the Vintage 1 school buildings have air change rates less than two thirds the value required.

Air Infiltration Rates

Figure 4-27 and Table 4-27 show the distribution in the air infiltration change rate for school buildings. Only 12 of the 14 schools have infiltration measurements. The median air infiltration rate is 0.32 ACH with a lower quartile of 0.12 and a high quartile of 0.76.

Figure 4-28 and Table 4-28 show the distribution of air infiltration rates for schools by climate zone. Sample sizes are too small to make conclusions; although, except for the high infiltration rate of 1.45 in the north coast climate zone, the distributions look qualitatively similar.

Figure 4-29 and Table 4-29 show the distribution of school air infiltration rates by vintage. The median air infiltration rate for Vintage 1 schools is 0.53 compared to a median for Vintage 2 schools is 0.14. The Vintage 1 distribution appears more symmetric than the Vintage 2 distribution.

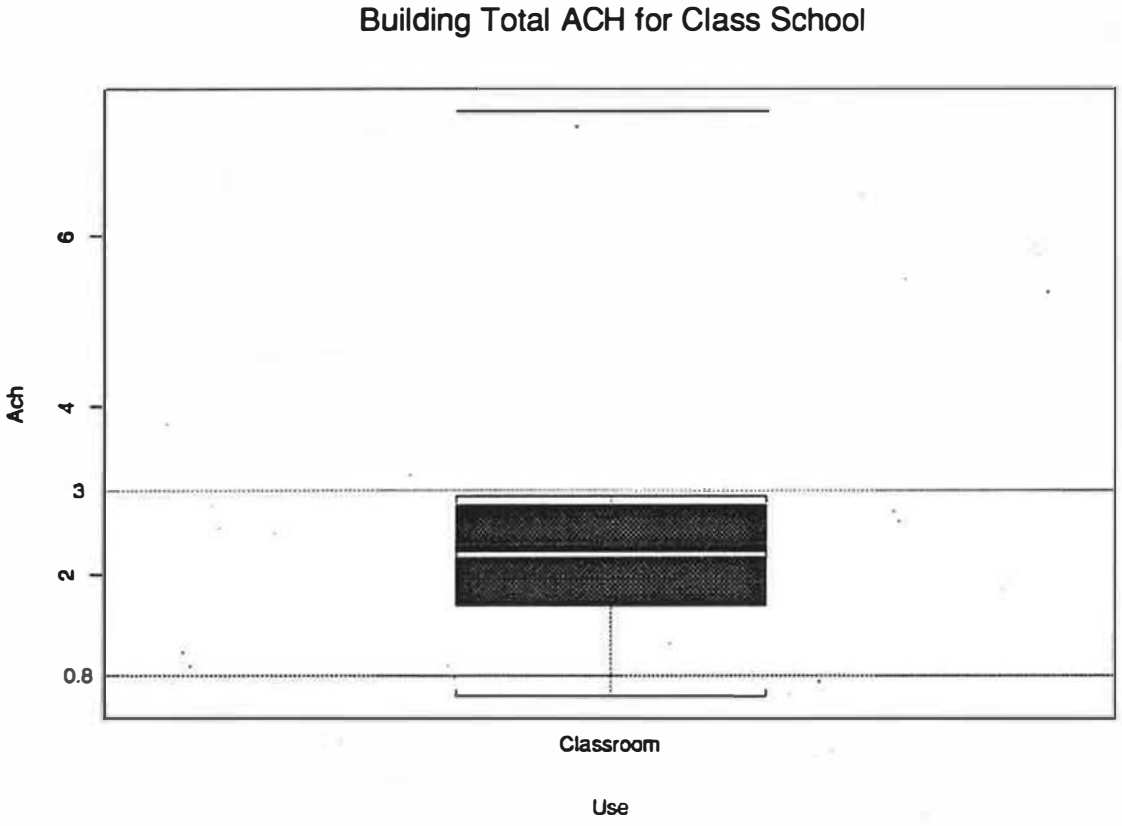


Figure 4-23. School Building Total Air Change Rate Distribution

Table 4-23. School Total Air Change Rate Distribution

	N	Median	Quartiles	Mean	Outliers
School	14	2.24	1.63 2.82	2.45	7.49

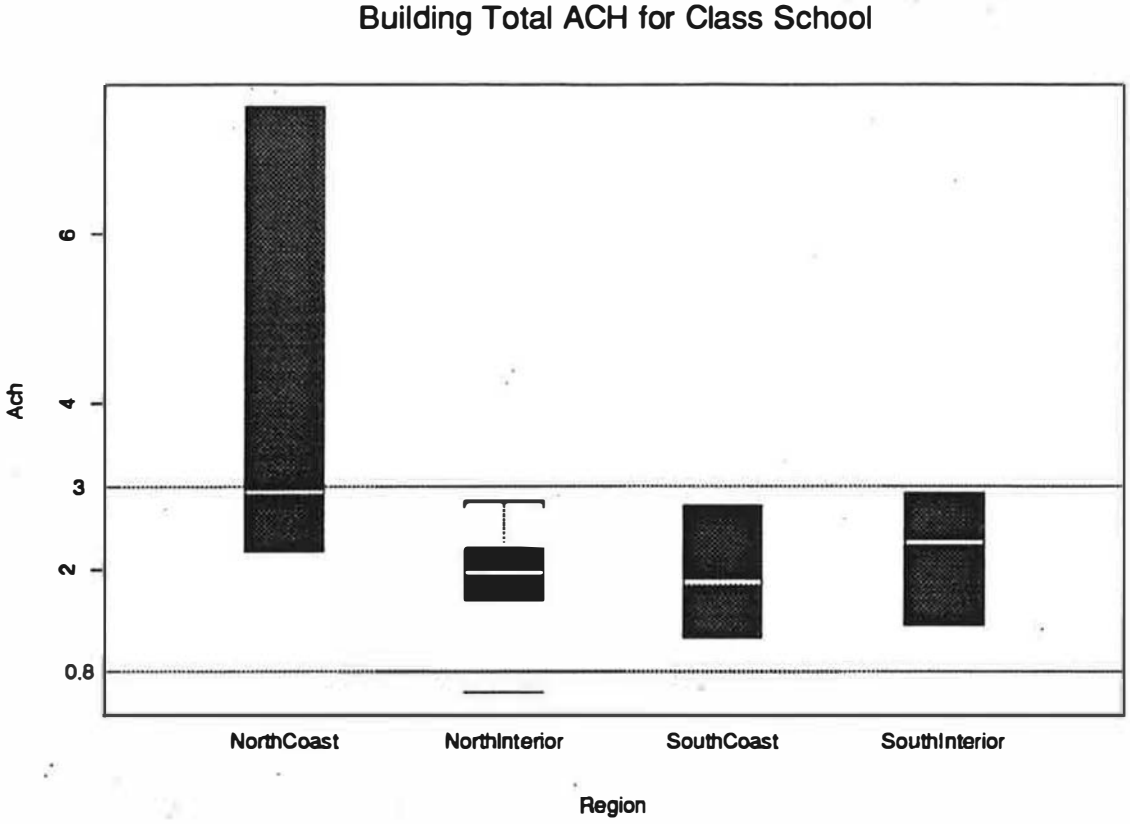


Figure 4-24. School Building Total Air Infiltration Rate Distribution by Climate Zone

Table 4-24. School Total Air Change Rate Distribution by Climate Region

	N	Median	Quartiles	Mean	Outliers
North Coast	3	2.93	2.22 7.49	4.21	
North Interior	5	1.96	1.63 2.25	1.84	
South Coast	3	1.85	1.20 2.76	1.94	
South Interior	3	2.32	1.34 2.92	2.19	

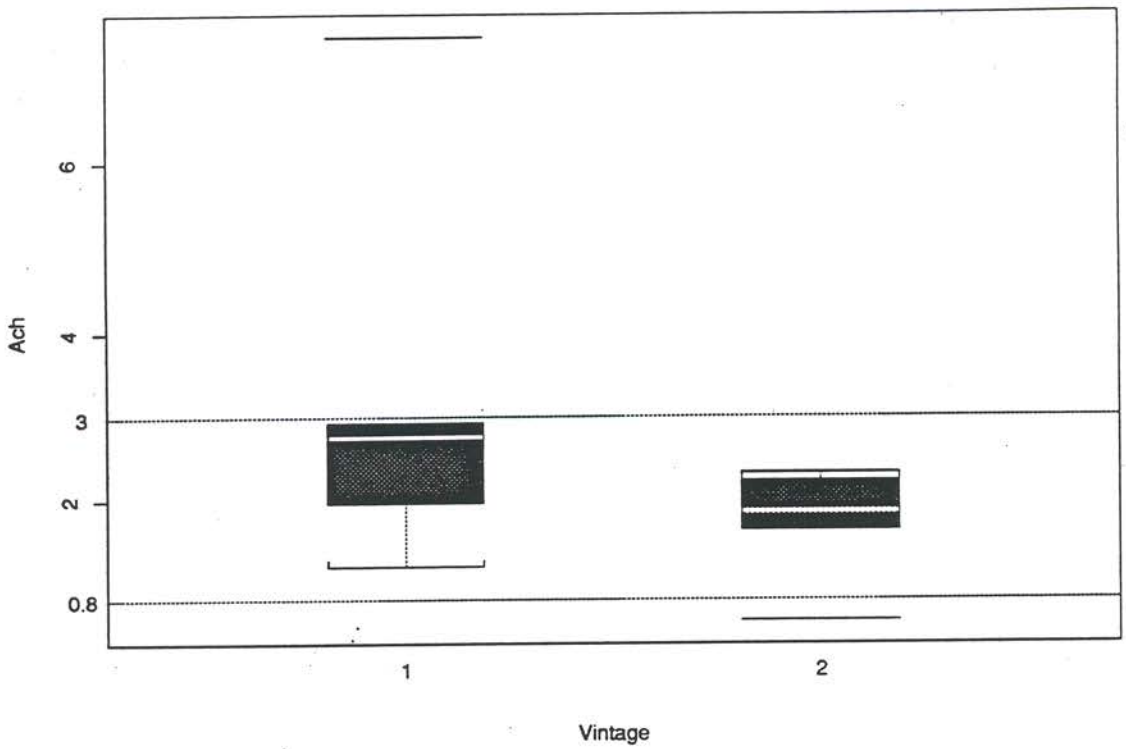


Figure 4-25. School Building Total Air Change Rate Distribution by Vintage

Table 4-25. School Total Air Change Rate Distribution by Vintage

	N	Median	Quartiles	Mean	Outliers
Vintage 1	9	2.76	1.96 2.92	2.85	7.49
Vintage 2	5	1.85	1.63 2.22	1.72	

Schools

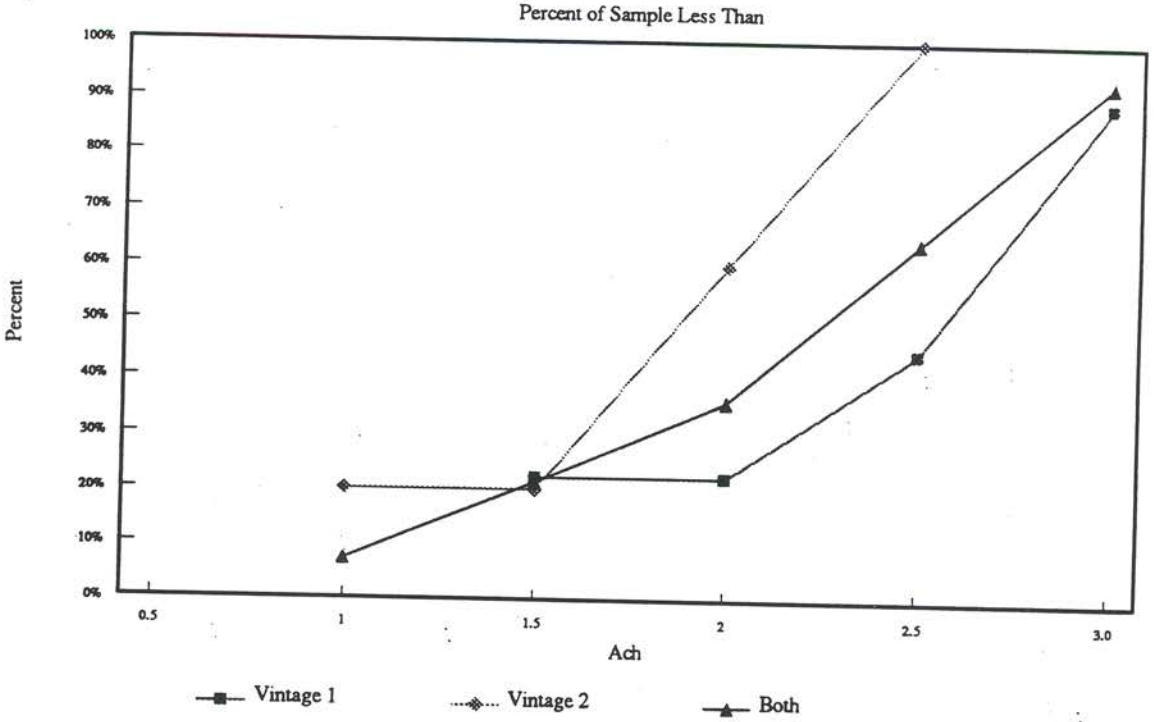


Figure 4-26. Percent of School Buildings Below a Certain Air Change Rate

Table 4-26. Number of Classrooms Below a Ceratin Air Change Rate

School Buildings			
Number of Buildings with Total Ach Less Than	**All**	**Vintage 1**	**Vintage 2**
< 0.5	0	0	0
< 1.0	1	0	1
< 1.5	3	2	1
< 2.0	5	2	3
< 2.5	9	4	5
Sample Number	14	9	5

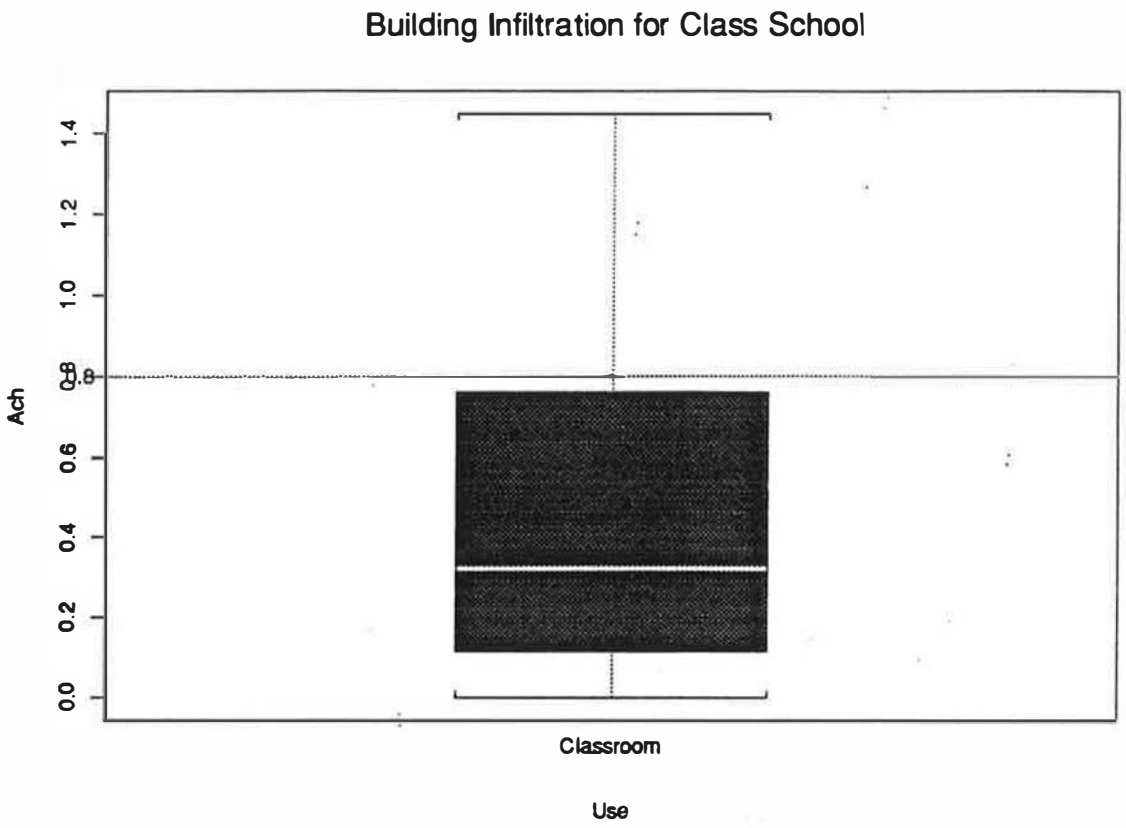


Figure 4-27. School Building Infiltration Rate Distribution

Table 4-27. School Infiltration Rate Distribution

	N	Median	Quartiles	Mean	Outliers
School	12	0.32	0.12 0.76	0.46	

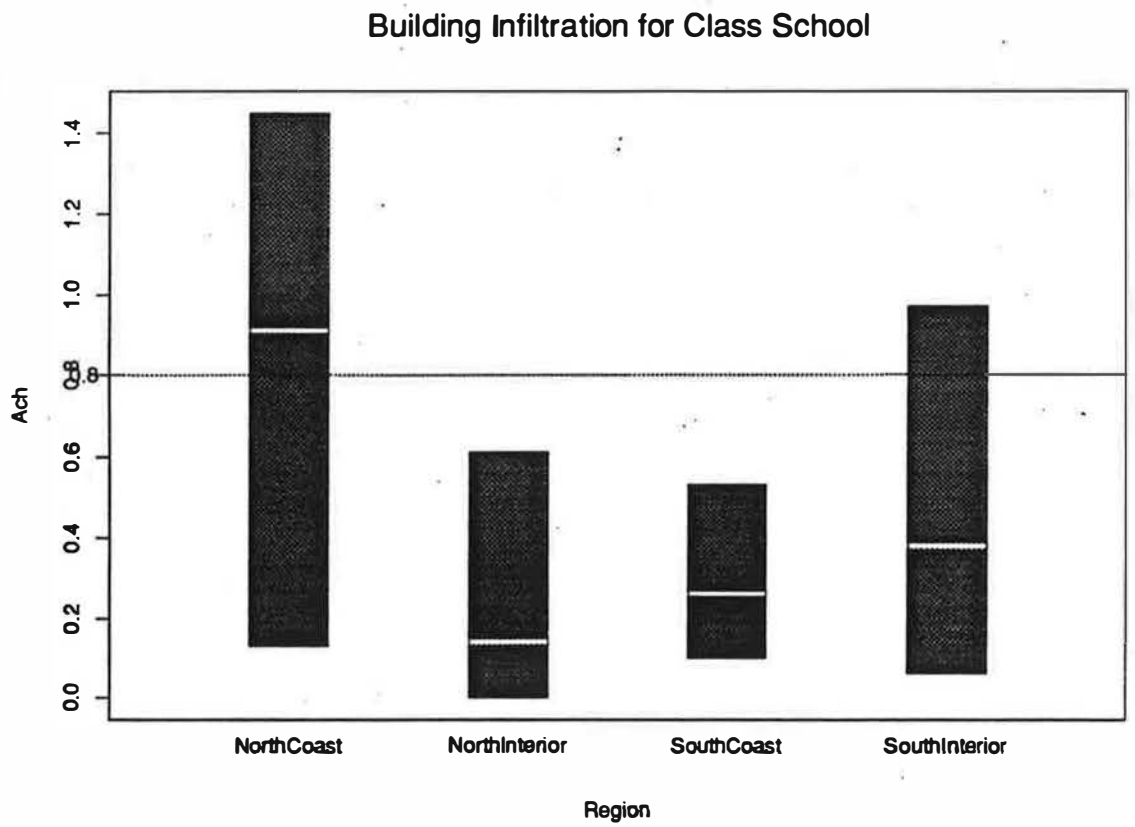


Figure 4-28. School Building Infiltration Rate Distribution by Climate Region

Table 4-28. School Infiltration Rate Distribution by Climate Region

	N	Median	Quartiles	Mean	Outliers
North Coast	3	0.91	0.13 1.45	0.83	
North Interior	3	0.14	0.06 0.61	0.25	
South Coast	3	0.26	0.10 0.53	0.30	
South Interior	3	0.38	0.06 0.97	0.46	

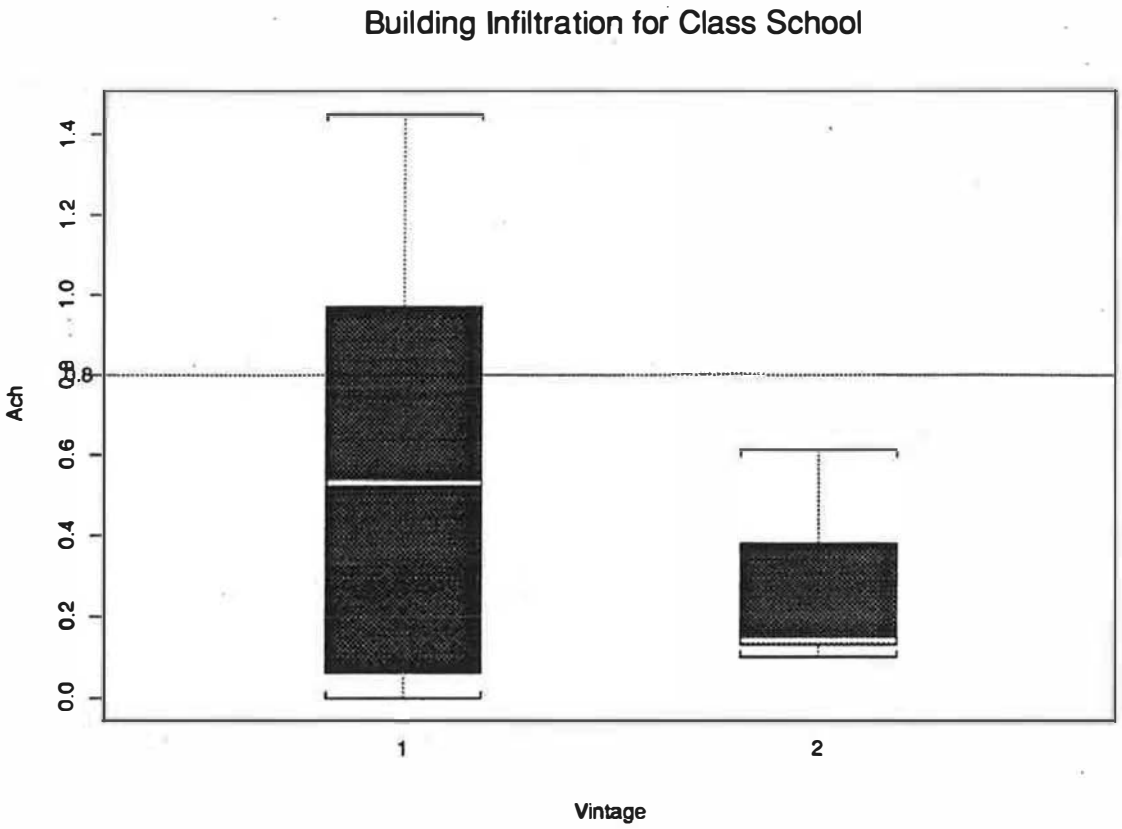


Figure 4-29. School Building Infiltration Rate Distribution by Vintage

Table 4-29. School Infiltration Rate Distribution by Vintage

	N	Median	Quartiles	Mean	Outliers
Vintage 1	7	0.53	0.06 0.97	0.60	
Vintage 2	5	0.14	0.13 0.38	0.27	

4.6 Measurement Air Change Rate Distributions

In each building tested, several air change rates were measured at several locations. In many buildings there was significant variation in the air change rates at different locations. For some buildings, the interior measurements were from different independent zones and for others from different locations in the same zone. The different locations in a zone were usually different rooms or different floors of the zone. For schools, the individual measurements were usually from different classrooms served by independent HVAC systems. These measurements were made in either the return air stream of the HVAC system serving the zone or at an interior space of the zone.

This section presents the statistical analysis of the individual measurements. In most cases the conclusions derived by location do not differ from those based on total building data. Location specific data sets are large so the influence of outliers on the results is less pronounced. Location observations are not independent however, so significance tests cannot be applied without adjustments for multiple comparisons and such adjustments require very large sample sizes.

Figure 4-30 and Table 4-30 show the percent and number of office locations with air change rates below specific values. Abount 19 percent of all office locations of either vintage, 12 percent of office locations in Vintage 1 buildings and 22 percent of office locations in Vintage 2 buildings had measured air change rates less than required to provide the ASHRAE required 20 cfm per persons for typical occupancy.

Figure 4-31 and Table 4-31 show the percent and number of retail locations below a certain air change rate. Note that 70 percent of Vintage 2 retail lacations had measured air change rates of 1.0 ACH while none of the Vintage 1 locations were below 1 ACH.

Figure 4-32 and Table 4-32 show the distribution for schools. Note that 30 percent of all classrooms, 23 percent of Vintage 1 classrooms and 42 percent of Vintage 2 classrooms had air change rates below the value required to provide half (7.5 cfm) the required 15 cfm by ASHRAE 62-1989 Ventilation for Acceptable Indoor Air Quality.

Figure 4-33 and Table 4-33 show the distribution of the local air change rates for each building class. The median for schools is 1.91 ACH with low and high quartiles of 1.46 and 2.71; for office locations the median is 1.15 with low and high quartiles of 0.93 and 1.51; for retail locations the median is 1.75 with low and high quartiles of 0.84 and 2.46. Each class has at least one outlier; office with seven having the most. These could all be from one building or for more than one building but comparisons across buildings must account for differences in the number and types of locations coded.

Figure 4-34 and Table 4-34 show the distribution of local air change rates by climate zone. Medians all approach the 0.8 limit although the north interior is pulled up by four high outliers.

Figure 4-35 and Table 4-35 show the distribution of local air change rates by building vintage. The median for Vintage 1 buildings was 1.73 with a low quartile point of 1.23 while the median for Vintage 2 buildings was 1.12 with a low quartile point of 0.74 . However, the Vintage 1 distribution may be biased upward by positive outliers possibly from one or more buildings.

Figure 4-36 and Table 4-36 show the distribution by class and size.

Figure 4-37 and Table 4-37 show the distribution of air change rate by measurement type:

BLDG - the building total air change rate,
I - an interior location measurement,
INFIL - an infiltration measurement
R - a measurement from a return air stream or zone average.

To determine the proportion of total air change attributable to infiltration, a separate variable was computed for the 40 buildings with complete information on both measures. The mean of this "fraction" is 0.35, with a 95 percent confidence interval ranging from 0.25 to 0.42. This suggests that 25 percent to 42 percent of the total building air change rate may be attributable to infiltration.

Office Spaces

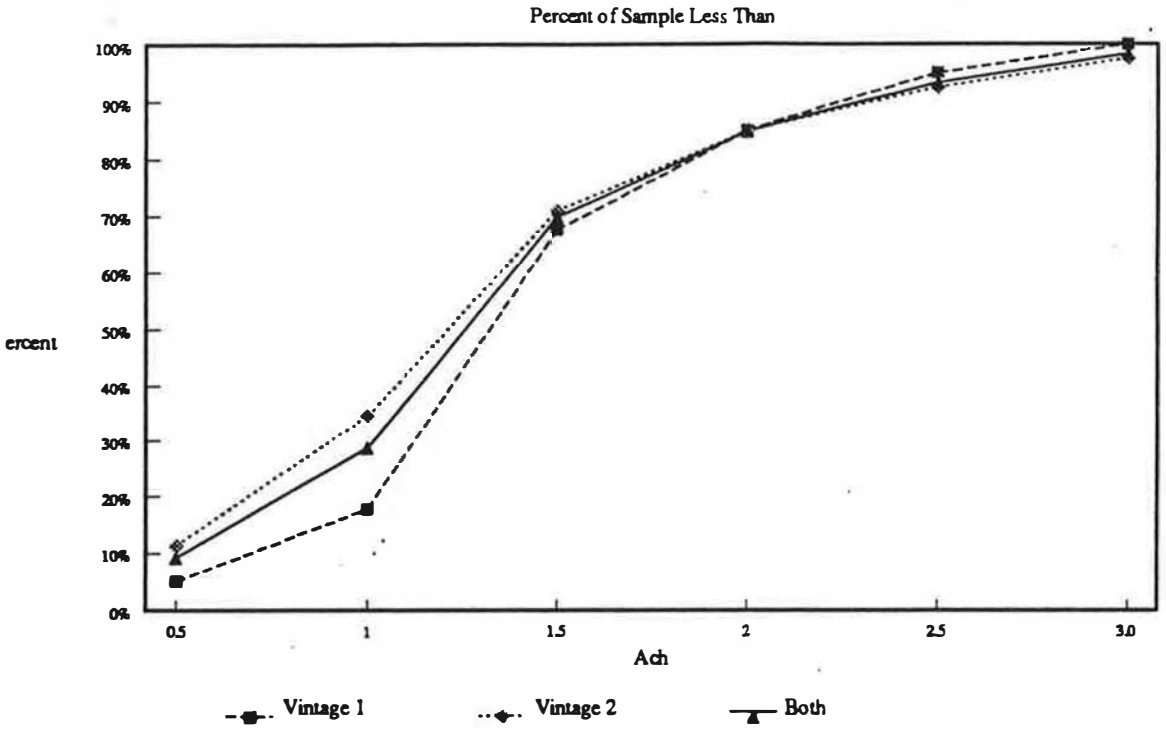


Figure 4-30 Percent of Office Locations Below a Certain Air Change Rate

Table 4-30 . Number of Office Locations with Low Air Change Rates

Office Buildings			
Number of Locations with ACH Less Than	**All**	**Vintage 1**	**Vintage 2**
< 0.5	11	2	9
< 0.8	23	5	18
<1.0	34	7	27
Sample Number	120	41	79

Retail Space

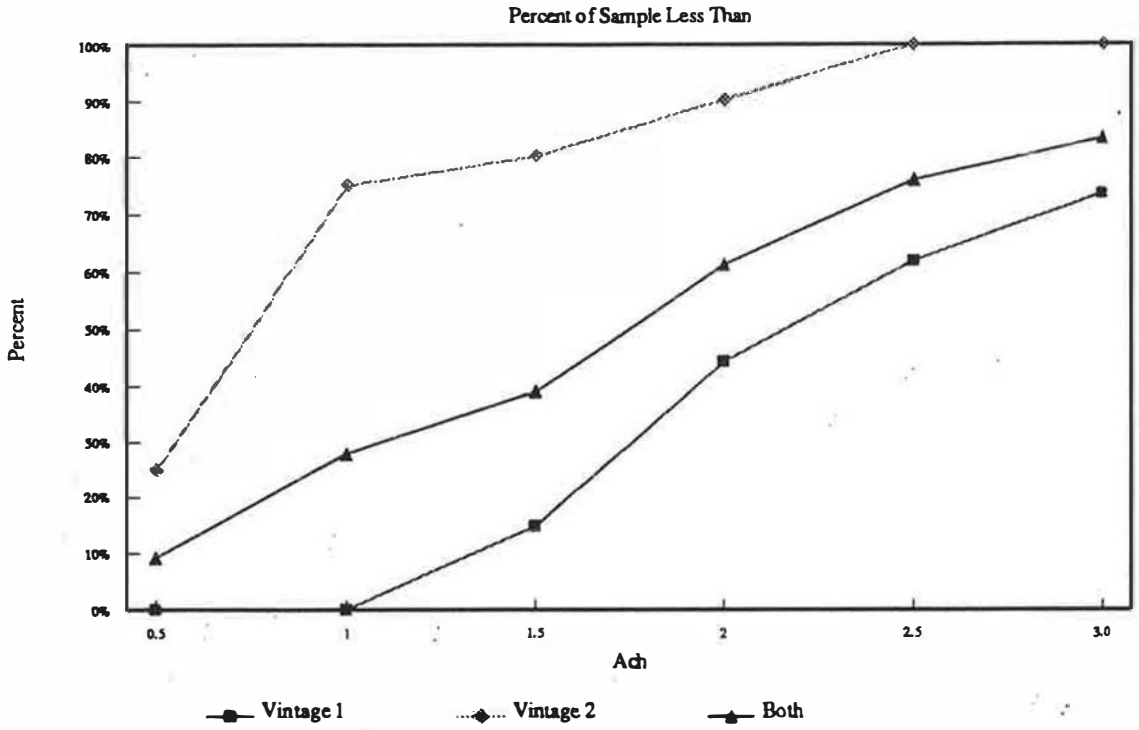


Figure 4-31 Percent of Retail Locations Below a Certain Air Change Rate

Table 4-31 Number of Retail Locations with Low Air Change Rates

Retail Buildings			
Number of Locations with Ach Less Than	**All**	**Vintage 1**	**Vintage 2**
< 0.5	5	0	5
< 1.0	16	0	16
< 1.5	21	4	17
< 2.0	28	11	17
Sample Number	43	26	17

Classrooms

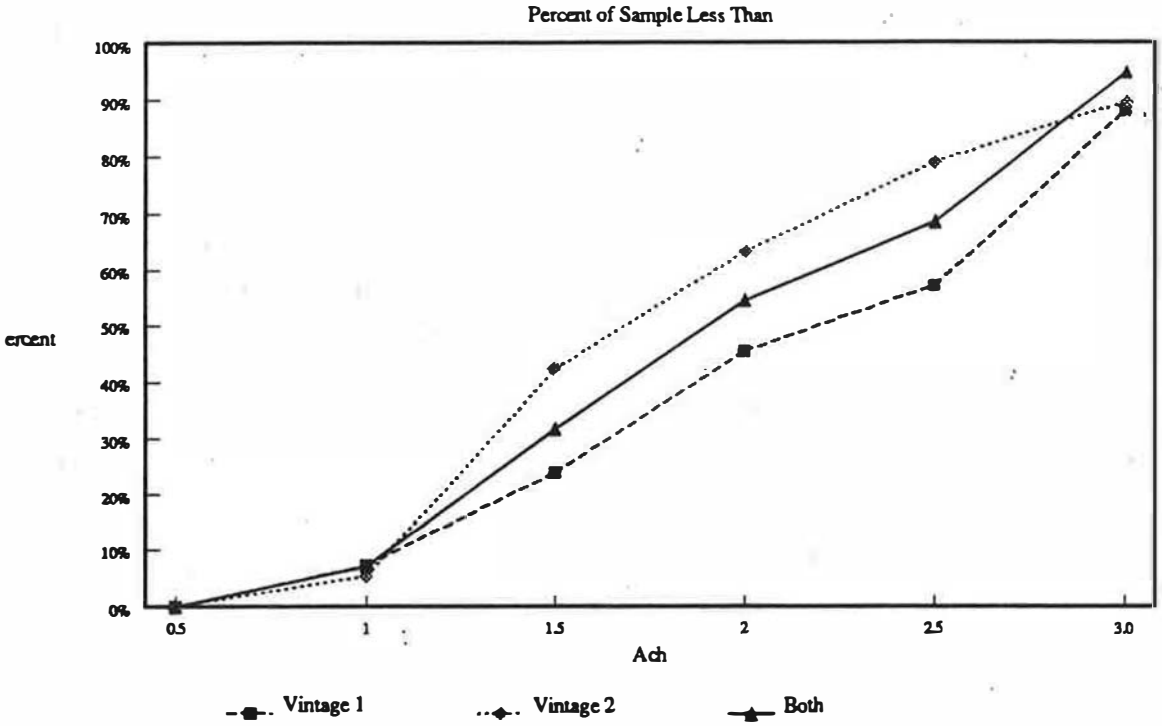


Figure 4-32 Percent of Classrooms Below a Certain Air Change Rate

Table 4-32 Number of Classroom Locations with Low Air Change Rates

School Buildings			
Number of Locations with Ach Less Than	**All**	**Vintage 1**	**Vintage 2**
< 0.5	0	0	0
< 1.0	4	3	1
< 1.5	18	10	8
< 2.0	31	19	12
< 2.5	39	24	15
Sample Number	61	42	19

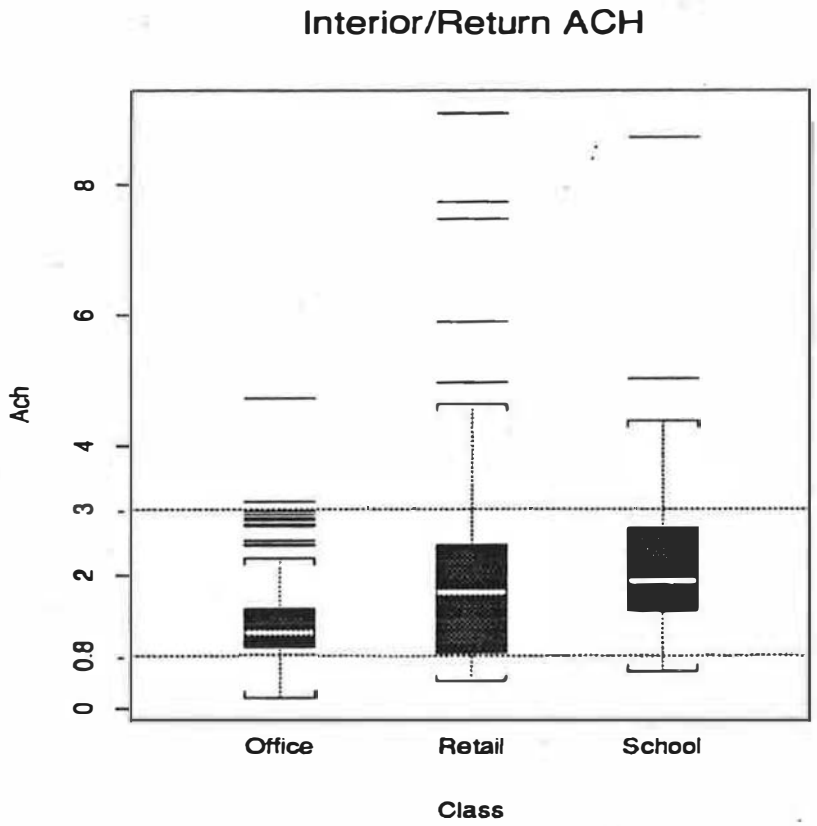


Figure 4-33. Meausred Air Changes Rates by Location Use

Table 4-33. Meaured Air Change Rates by Location Use

	N	Median	Quartiles	Mean	Outliers
Classroom	57	1.91	1.46 2.71	2.18	8.72
Office	113	1.15	0.93 1.51	1.31	2.75 2.77 2.84 2.93 2.97 3.12 4.73
Retail	54	1.75	0.84 2.46	2.14	5.90 7.48 7.74 9.09

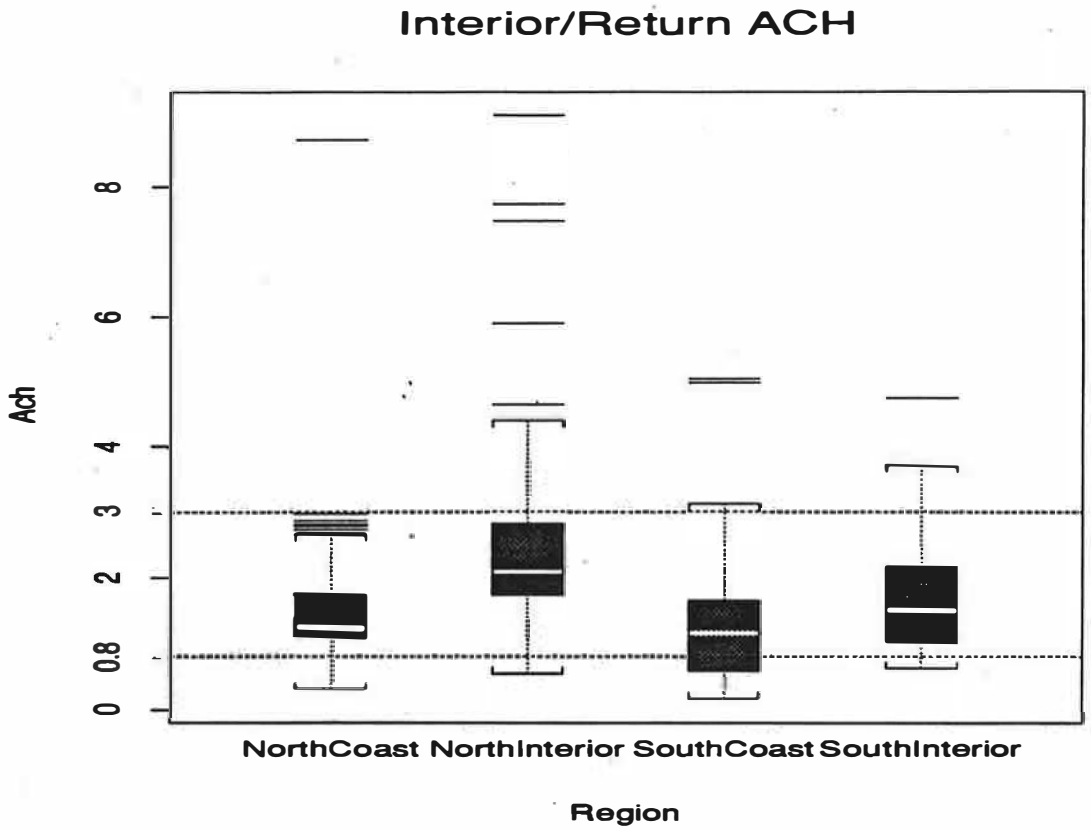


Figure 4-34 Measured Air Change Rate Distribution by Climate Region

Table 4-34 . Measured Air Change Rate Distribution by Climate Zone

	N	Median	Quartiles	Mean	Outliers
North Coast	51	1.22	1.08 1.74	1.59	8.72
North Interior	42	2.09	1.73 2.82	2.67	5.90 7.48 7.74 9.09
South Coast	71	1.15	0.59 1.63	1.32	4.97 5.03
South Interior	60	1.50	1.01 2.17	1.67	4.73

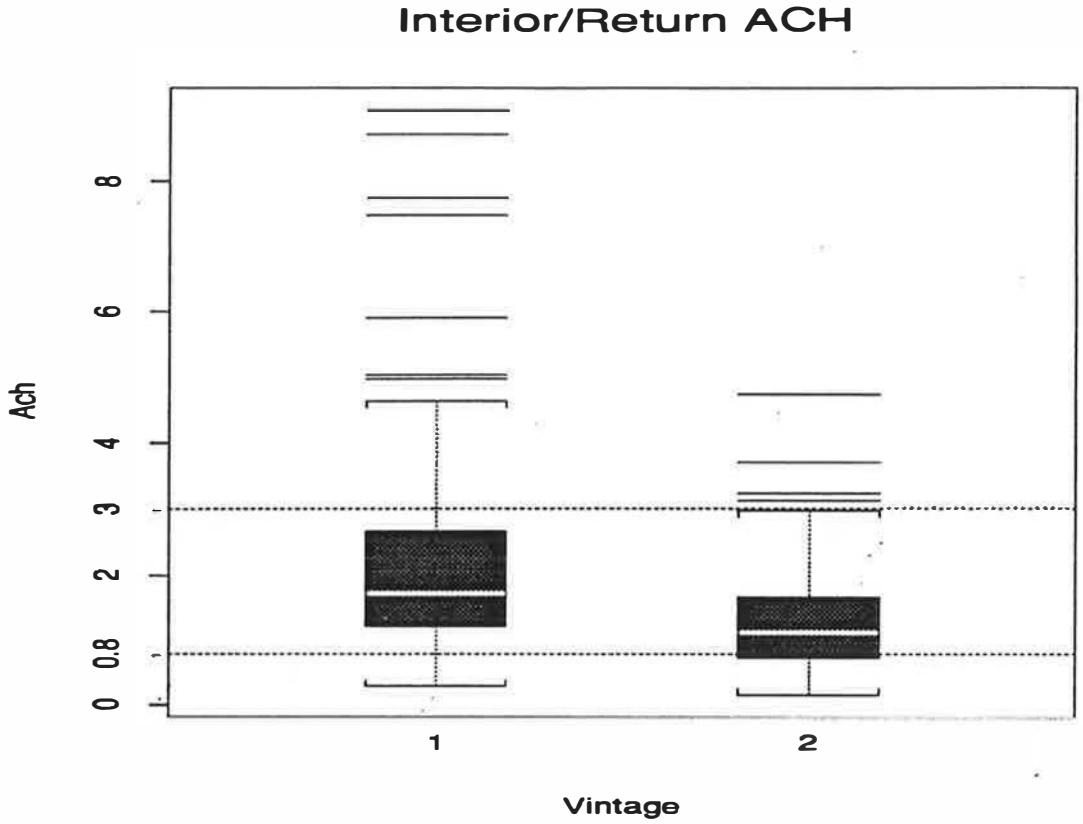


Figure 4-35 . Measured Air Change Rate Distribution by Vintage

Table 4-35. Measured Air Change rate Distribution by Vintage

	N	Median	Quartiles	Mean	Outliers
Vintage 1	109	1.73	1.23 2.66	2.15	5.90 7.48 7.74 8.72 9.09
Vintage 2	115	1.13	0.74 1.67	1.31	3.70 4.73

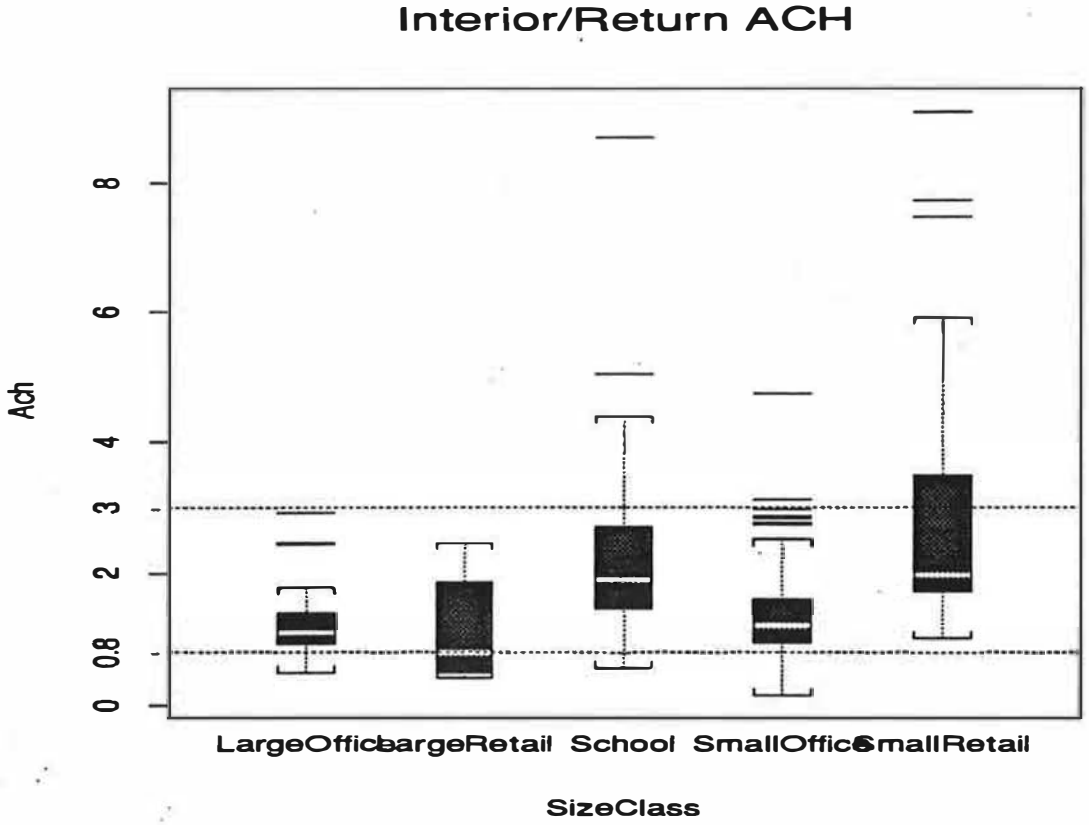


Figure 4-36. Measured Air Change Rate Distribution by Class and Size

Table 4-36. Measured Air Change Rate Distribution by Class and Size

	N	Median	Quartiles	Mean	Outliers
Large Office	33	1.10	0.92 1.38	1.20	2.45 2.47 2.93
Large Retail	23	0.80	0.50 1.87	1.08	
School	57	1.91	1.46 2.71	2.18	8.72
Small Office	80	1.20	0.94 1.61	1.35	2.97 3.12 4.73
Small Retail	47	1.98	1.72 3.49	2.93	7.48 7.74 9.09

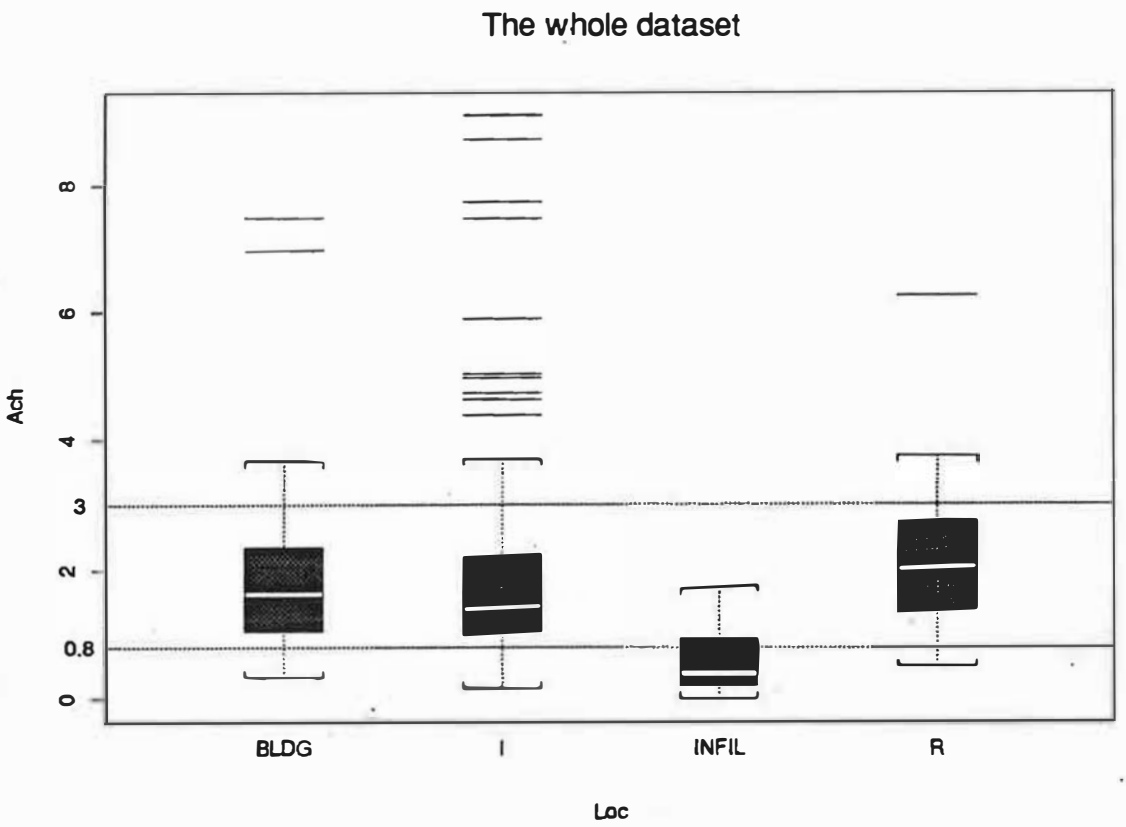


Figure 4-37. Measured Air Change Rates by Measurement Type

Table 4-37 . Measured Air Change Rates by Measurement Type

	N	Median	Quartiles	Mean	Outliers
Building	49	1.63	1.05 2.34	1.89	6.97 7.49
Interior	224	1.42	1.02 2.22	1.73.	4.73 4.97 5.03 5.90 7.48 7.74 8.72 9.04
Infiltration	40	0.40	0.21 0.94	0.56	
HVAC Return	28	2.02	1.36 2.74	2.17	6.25

5. Summary and Recommendations

This project developed a protocol for measuring the air change rate in non-residential buildings in the state of California and applied the protocol to 49 buildings in four climate zones in the state. The data gathered in the this stage indicates that:

- Vintage 2 buildings have lower total air changes rates than Vintage 1 buildings.
- Vintage 2 buildings have lower infiltration rates than Vintage 1 buildings but this difference in infiltration rates does not account for more than 30 percent of the difference in total air change rate between the two classes
- On the average, air infiltration is from 25 percent to 42 percent of the total building air change air.
- A large variation in air change rate exists within any class, the value of the high interquartile point being typically 1.5 times the value of the low interquartile point.
- The median air change rate of all office buildings tested is 1.09 air changes per hour, 36% more than the 0.8 air change rate required to provide the 20 cfm per occupant of the ASHRAE Standard 62-1989. Nevertheless, 23 percent of the office buildings tested have air change rates below the value required to satisfy ASHRAE Standard 62-1989 .
- A median total air change rate for retail buildings of 1.8 air changes per hour is 50 percent more than the 1.2 required by ASHRAE Standard 62-1989. About 50 percent of the Vintage 2 retail buildings had air change rates below what would be required by ASHRAE 62-1989; while all of the Vintage 1 satisfy the standard. The retail buildings tested probably are not representative of the population of California retail buildings.
- Schools consistently had air change rates lower than required to provide the 15 cfm per occupant required by ASHRAE Standard 62-1989. Thirty percent of all classrooms (21% of schools) were

found to have air change rates less than the 1.5 air changes per hour required to provide 7.5 cfm per occupant.

From a protocol and methodology point of view, the project shows that it is possible as envisioned in the protocol to measure and evaluate the amount of outside air being provided to non-residential buildings. Any changes to the measurement protocol are relatively minor:

- The mix sampling point required to determine the percent of outside air in the supply air was difficult to reliably measure due to the lack of mixing of the return air and supply air while tracer gas was being injected. It was better to make this measurement in the supply air stream after the injection was stopped. Also, the procedure can be simplified by making this measurement only once or twice instead of at every measurement interval.

- Small modular injection tracer units should be used and developed for buildings with packaged roof top units if other than the decay method is to be used. The time spent in installing tracer injection tubing from one or two gas cylinders can be significant and under several conditions the technicians had to spend several hours working on the roof with over a 100 degree temperature .

- The questionnaire for determining the characteristics of the building should be simplified to contain data only required for the test. Many of the technical questions about the HVAC system could not be answered by the building personnel or owners. If these data are to be obtained by the field team, more time will be needed.

- The data analysis clearly shows the limitations of deriving conclusions from small sample size and poor sample design. The number and "representativeness" of samples within each category of each class ("cell group") must be greatly expanded, to at least a minimum of 25.

- With regard to sample design: retail class should be more exactly defined and restricted.

- An effort should be made to obtain a more balanced sample of buildings representative of each "cell group." The overall number of buildings to be sampled depends on obtaining the minimum number of observations per "cell group".

6. Sample Stem Leaf Analysis

Stem and leaf analysis displays the distribution , N (number of observations), mean, median, quartiles, and outlliers of the data. A number that is precisely zero is identified by z. No stem and leaf display is provided if there is 0 or only one unique value in the data.

TERMS

- **fence** the multiple of the inter-quartile range used to determine outliers
- **outlier** any point further than 2 inter-quartile ranges from the nearest quartile is considered and outlier, and is printed separately from the body of the stem-and-leaf display
- **count** the number of data values on a line. It is shown on the second column of the display.
- **depth** is the cumulative sum of the counts to the nearer extreme. It is shown on the first column of the display

The stem and leaf diagram is a compact way to record the data. At the same time, it gives visual information, the length of each row shows the number of values in each row, so the display is essentially a histogram lying on its side. The stem and leaf diagram is particularly useful when it is important to convey both the numerical values themselves and the graphical information about the distribution. It enables seeing the batch as a whole and noticing such features as:

- How nearly symmetric the batch is.
- How spread out the numbers are.
- Whether a few values are far removed from the rest.
- Whether there are concentrations of data.
- Whether there are gaps in the data.

Stem & Leaf for Interior/Return ACH of Class Office

```
N = 113   Median = 1.15
Quartiles = 0.93, 1.51

Decimal point is 1 place to the left of the colon

    1     1     1 : 7
    1     0     2 :
    7     6     3 : 004667
   11     4     4 : 0146
   16     5     5 : 00557
   21     5     6 : 13459
   23     2     7 : 14
   25     2     8 : 46
   34     9     9 : 222334678
   48    14    10 : 24555777888889
         13    11 : 0111344556799
   52     7    12 : 0033479
   45     7    13 : 3667888
   38     8    14 : 22234479
   30     6    15 : 011235
   24     1    16 : 6
   23     5    17 : 00048
   18     1    18 : 8
   17     0    19 :
   17     2    20 : 99
   15     1    21 : 4
   14     3    22 : 666
   11     0    23 :
   11     2    24 : 57
    9     1    25 : 2

High: 2.75 2.77 2.84 2.87 2.93 2.97 3.12 4.73

Mean = 1.31
```

Stem & Leaf for Interior/Return ACH of Class Retail

```
N = 54   Median = 1.75
Quartiles = 0.84, 2.46

Decimal point is at the colon

    3     3    0 : 444
   15    12    0 : 555666788889
   22     7    1 : 0022334
         11    1 : 57777899999
   21     7    2 : 0001223
   14     5    2 : 55778
    9     1    3 : 1
    8     2    3 : 57
    6     0    4 :
    6     1    4 : 6
    5     1    5 : 0

High: 5.90 7.48 7.74 9.09

Mean = 2.14
```

Stem & Leaf for Interior/Return ACH of Class School

```
N = 57   Median = 1.91
Quartiles = 1.46, 2.71

Decimal point is at the colon

    4     4    0 : 6788
   14    10    1 : 0122222333
         16    1 : 5566666777788999
   27     8    2 : 13333344
   19    13    2 : 5567778888899
    6     2    3 : 02
    4     1    3 : 7
    3     1    4 : 4
    2     0    4 :
    2     1    5 : 0

High: 8.72

Mean = 2.18
```

Stem & Leaf for Interior/Return ACH of Vintage 1

```
N = 109   Median = 1.73
Quartiles = 1.23, 2.66

Decimal point is at the colon

    2     2    0 : 34
    9     7    0 : 5667889
   39    30    1 : 000111111112222222223334444444
         25    1 : 55556666677777777778999999
   45    14    2 : 00112233333444
   31    18    2 : 556777778888889999
   13     2    3 : 01
   11     2    3 : 57
    9     1    4 : 4
    8     1    4 : 6
    7     2    5 : 00

High: 5.90 7.48 7.74 8.72 9.09

Mean = 2.17
```

Stem & Leaf for Interior/Return ACH of Vintage 2

```
N = 115   Median = 1.13
Quartiles = 0.74, 1.67

Decimal point is at the colon

   11    11    0 : 23344444444
   41    30    0 : 55555556666666777778888889999999
         37    1 : 000000001111111111122222223333344444
   37    17    1 : 55555557777888999
   20     8    2 : 01113333
   12     7    2 : 5555788
    5     3    3 : 012

High: 3.70 4.73

Mean = 1.31
```

Stem & Leaf for Interior/Return ACH of Use Classroom

N = 61 Median = 1.92
Quartiles = 1.34, 2.71

Decimal point is at the colon

```
   4     4   0 : 6788
  18    14   1 : 01122222233344
        13   1 : 5566677788999
  30     8   2 : 33333344
  22    15   2 : 556777778888899
   7     2   3 : 02
   5     1   3 : 7
   4     1   4 : 4
   3     0   4 :
   3     2   5 : 00
```

High: 8.72

Mean = 2.21

Stem & Leaf for Interior/Return ACH of Use Office

N = 120 Median = 1.19
Quartiles = 0.935, 1.645

Decimal point is 1 place to the left of the colon

```
   1     1    1 : 7
   1     0    2 :
   7     6    3 : 004667
  11     4    4 : 0146
  16     5    5 : 00557
  21     5    6 : 13459
  23     2    7 : 14
  25     2    8 : 46
  34     9    9 : 222334678
  48    14   10 : 12455577788889
        13   11 : 0111344556799
  59     8   12 : 00334779
  51     6   13 : 367888
  45     8   14 : 22344479
  37     5   15 : 01123
  32     5   16 : 33699
  27     5   17 : 00048
  22     2   18 : 88
  20     1   19 : 2
  19     3   20 : 399
  16     2   21 : 45
  14     3   22 : 666
  11     0   23 :
  11     2   24 : 56
   9     1   25 : 2
   8     0   26 :
   8     2   27 : 57
   6     2   28 : 47
   4     2   29 : 37
```

High: 3.12 4.73

Mean = 1.34

Stem & Leaf for Interior/Return ACH of Use Retail

N = 43 Median = 1.73
Quartiles = 0.77, 2.47

Decimal point is at the colon

```
    3     3   0 : 444
   15    12   0 : 555666788889
   18     3   1 : 023
          9   1 : 557778999
   16     5   2 : 00122
   11     3   2 : 558
    8     1   3 : 1
    7     2   3 : 57
    5     0   4 :
    5     1   4 : 6
```

High: 5.90 7.48 7.74 9.09

Mean = 2.14

Stem & Leaf for Interior/Return ACH of SizeClass LargeOffice

N = 33 Median = 1.1
Quartiles = 0.92, 1.38

Decimal point is 1 place to the left of the colon

```
    3     3    5 : 005
    6     3    6 : 345
    8     2    7 : 14
    8     0    8 :
   10     2    9 : 23
   16     6   10 : 557889
          5   11 : 01356
   12     2   12 : 03
   10     2   13 : 38
    8     2   14 : 24
    6     2   15 : 11
    4     0   16 :
    4     1   17 : 8
```

High: 2.45 2.47 2.93

Mean = 1.2

Stem & Leaf for Interior/Return ACH of SizeClass LargeRetail

N = 23 Median = 0.8
Quartiles = 0.5, 1.87

Decimal point is 1 place to the left of the colon

```
    5    5    4 : 24479
    7    2    5 : 09
   10    3    6 : 139
   11    1    7 : 7
         4    8 : 0247
    8    0    9 :
    8    1   10 : 0
    7    0   11 :
    7    0   12 :
    7    0   13 :
    7    1   14 : 7
    6    0   15 :
    6    0   16 :
    6    0   17 :
    6    1   18 : 7
    5    0   19 :
    5    1   20 : 3
    4    1   21 : 1
    3    2   22 : 22
    1    0   23 :
    1    1   24 : 6
```

Mean = 1.08

Stem & Leaf for Interior/Return ACH of SizeClass SmallOffice

N = 80 Median = 1.195
Quartiles = 0.935, 1.605

Decimal point is 1 place to the left of the colon

```
    1    1    1 : 7
    1    0    2 :
    7    6    3 : 004667
   11    4    4 : 0146
   13    2    5 : 57
   15    2    6 : 19
   15    0    7 :
   17    2    8 : 46
   24    7    9 : 2234678
   32    8   10 : 24577888
   40    8   11 : 11445799
   40    5   12 : 03479
   35    5   13 : 66788
   30    6   14 : 223479
   24    4   15 : 0235
   20    1   16 : 6
   19    4   17 : 0004
   15    1   18 : 8
   14    0   19 :
   14    2   20 : 99
   12    1   21 : 4
   11    3   22 : 666
    8    0   23 :
    8    0   24 :
    8    1   25 : 2
    7    0   26 :
    7    2   27 : 57
    5    2   28 : 47
```

High: 2.97 3.12 4.73

Mean = 1.35

Stem & Leaf for Interior/Return ACH of SizeClass SmallRetail

N = 31 Median = 1.98
Quartiles = 1.72, 3.49

Decimal point is at the colon

```
   15   15   1 : 022334777789999
         7   2 : 0035778
    9    3   3 : 157
    6    1   4 : 6
    5    2   5 : 09
```

High: 7.48 7.74 9.09

Mean = 2.93

Stem & Leaf for Interior/Return ACH of Vintage 1 Class Office

N = 37 Median = 1.2
Quartiles = 1.08, 1.55

Decimal point is 1 place to the left of the colon

```
    2    2    3 : 07
    2    0    4 :
    4    2    5 : 57
    5    1    6 : 1
    5    0    7 :
    5    0    8 :
    7    2    9 : 27
   12    5   10 : 55889
   18    6   11 : 114457
         3   12 : 003
   16    3   13 : 688
   13    3   14 : 223
   10    1   15 : 5
    9    0   16 :
    9    3   17 : 004
    6    0   18 :
    6    0   19 :
    6    0   20 :
    6    0   21 :
    6    2   22 : 66
    4    0   23 :
    4    1   24 : 5
```

High: 2.84 2.87 2.93

Mean = 1.37

Stem & Leaf for Interior/Return ACH of Vintage 1 Class Retail

N = 34 Median = 2.07
Quartiles = 1.73, 3.06

Decimal point is at the colon

```
    5    5   1 : 22334
   15   10   1 : 5777789999
         6   2 : 001223
   13    4   2 : 5778
    9    1   3 : 1
    8    2   3 : 57
    6    0   4 :
    6    1   4 : 6
    5    1   5 : 0
```

High: 5.90 7.48 7.74 9.09

Mean = 2.87

Stem & Leaf for Interior/Return ACH of Vintage 1 Class School

N = 38 Median = 2.205
Quartiles = 1.58, 2.81

Decimal point is at the colon

```
    3     3   0 : 788
    7     4   1 : 2223
   18    11   1 : 55666667799
          5   2 : 13344
   15    11   2 : 56777888899
    4     1   3 : 0
    3     0   3 :
    3     1   4 : 4
    2     0   4 :
    2     1   5 : 0
```

High: 8.72

Mean = 2.33

Stem & Leaf for Interior/Return ACH of Vintage 2 Class Office

N = 76 Median = 1.12
Quartiles = 0.85, 1.505

Decimal point is 1 place to the left of the colon

```
    1     1    1 : 7
    1     0    2 :
    5     4    3 : 0466
    9     4    4 : 0146
   12     3    5 : 005
   16     4    6 : 3459
   18     2    7 : 14
   20     2    8 : 46
   27     7    9 : 2233468
   36     9   10 : 245777888
          7   11 : 0135699
   33     4   12 : 3479
   29     4   13 : 3678
   25     5   14 : 24479
   20     5   15 : 01123
   15     1   16 : 6
   14     2   17 : 08
   12     1   18 : 8
   11     0   19 :
   11     2   20 : 99
    9     1   21 : 4
    8     1   22 : 6
    7     0   23 :
    7     1   24 : 7
    6     1   25 : 2
    5     0   26 :
    5     2   27 : 57
```

High: 2.97 3.12 4.73

Mean = 1.28

Stem & Leaf for Interior/Return ACH of Vintage 2 Class Retail

```
N = 20   Median = 0.73
Quartiles = 0.495, 0.935

Decimal point is 1 place to the left of the colon

    5    5    4 : 24479
    7    2    5 : 09
   10    3    6 : 139
   10    1    7 : 7
    9    4    8 : 0247
    5    0    9 :
    5    2   10 : 01

High: 1.92 2.03 2.46

Mean = 0.89
```

Stem & Leaf for Interior/Return ACH of Vintage 2 Class School

```
N = 19   Median = 1.8
Quartiles = 1.22, 2.33

Decimal point is at the colon

    1    1   0 : 6
        11   1 : 01223377889
    7    5   2 : 33358
    2    2   3 : 27

Mean = 1.88
```

Stem & Leaf for Interior/Return ACH of Vintage 1 Region NorthCoast

```
N = 32    Median = 1.21
Quartiles = 1.1, 1.75

Decimal point is 1 place to the left of the colon

    2     2     3 : 07
    2     0     4 :
    2     0     5 :
    3     1     6 : 1
    3     0     7 :
    3     0     8 :
    4     1     9 : 2
    8     4    10 : 5589
   14     6    11 : 114457
          4    12 : 0023
   14     1    13 : 3
   13     2    14 : 27
   11     0    15 :
   11     0    16 :
   11     4    17 : 2346
    7     0    18 :
    7     0    19 :
    7     0    20 :
    7     0    21 :
    7     1    22 : 9
    6     0    23 :
    6     0    24 :
    6     0    25 :
    6     2    26 : 66
    4     0    27 :
    4     3    28 : 027

High: 8.72

Mean = 1.69
```

Stem & Leaf for Interior/Return ACH of Vintage 1 Region NorthInterior

```
N = 33    Median = 2.45
Quartiles = 1.88, 3.06

Decimal point is at the colon

    2     2    0 : 56
   12    10    1 : 0467799999
         12    2 : 013445677889
    9     3    3 : 157
    6     2    4 : 46

High: 5.90 7.48 7.74 9.09

Mean = 2.96
```

Stem & Leaf for Interior/Return ACH of Vintage 1 Region SouthCoast

```
N = 17    Median = 1.58
Quartiles = 1.23, 2.4

Decimal point is at the colon

    2     2    0 : 78
    7     5    1 : 22233
          4    1 : 5667
    6     2    2 : 34
    4     2    2 : 57

High: 4.97 5.03

Mean = 2.01
```

Stem & Leaf for Interior/Return ACH of Vintage 1 Region SouthInterior

```
N = 27    Median = 1.7
Quartiles = 1.42, 2.26

Decimal point is 1 place to the left of the colon

    1     1     7 : 6
    1     0     8 :
    1     0     9 :
    2     1    10 : 8
    2     0    11 :
    3     1    12 : 1
    6     3    13 : 688
    9     3    14 : 238
   10     1    15 : 5
   12     2    16 : 13
          3    17 : 004
   12     1    18 : 7
   11     0    19 :
   11     1    20 : 3
   10     1    21 : 1
    9     4    22 : 2266
    5     0    23 :
    5     0    24 :
    5     0    25 :
    5     0    26 :
    5     0    27 :
    5     3    28 : 347
    2     1    29 : 3
    1     1    30 : 3

Mean = 1.89
```

Stem & Leaf for Interior/Return ACH of Vintage 2 Region NorthCoast

N = 19 Median = 1.24
Quartiles = 1.05, 1.67

Decimal point is at the colon

```
    3     3   0 : 579
         11   1 : 00112223344
    5     2   1 : 79
    3     0   2 :
    3     2   2 : 57
```

High: 2.97

Mean = 1.42

Stem & Leaf for Interior/Return ACH of Vintage 2 Region NorthInterior

N = 9 Median = 1.8
Quartiles = 1.19, 1.92

Decimal point is at the colon

```
    1     1   0 : 6
    3     2   1 : 02
          4   1 : 7889
    2     1   2 : 0
    1     1   2 : 5
```

Mean = 1.61

Stem & Leaf for Interior/Return ACH of Vintage 2 Region SouthCoast

N = 54 Median = 1.075
Quartiles = 0.5, 1.42

Decimal point is 1 place to the left of the colon

```
    1    1    1 : 7
    1    0    2 :
    5    4    3 : 0466
   13    8    4 : 01244479
   18    5    5 : 00059
   22    4    6 : 1345
   24    2    7 : 14
   24    0    8 :
   26    2    9 : 23
         3   10 : 788
   25    6   11 : 013556
   19    2   12 : 37
   17    3   13 : 348
   14    2   14 : 24
   12    2   15 : 11
   10    0   16 :
   10    0   17 :
   10    1   18 : 8
    9    0   19 :
    9    2   20 : 99
    7    1   21 : 4
    6    2   22 : 67
    4    1   23 : 3
    3    0   24 :
    3    0   25 :
    3    0   26 :
    3    2   27 : 67
    1    0   28 :
    1    0   29 :
    1    0   30 :
    1    1   31 : 2
```

Mean = 1.11

Stem & Leaf for Interior/Return ACH of Vintage 2 Region SouthInterior

N = 33 Median = 1.07
Quartiles = 0.87, 1.66

Decimal point is 1 place to the left of the colon

```
    2    2    6 : 39
    3    1    7 : 7
    9    6    8 : 024467
   13    4    9 : 2368
         4   10 : 0247
   16    0   11 :
   16    1   12 : 2
   15    1   13 : 6
   14    2   14 : 79
   12    3   15 : 023
    9    1   16 : 6
    8    2   17 : 08
    6    0   18 :
    6    0   19 :
    6    0   20 :
    6    0   21 :
    6    1   22 : 6
    5    0   23 :
    5    1   24 : 7
    4    1   25 : 3
    3    0   26 :
    3    0   27 :
    3    0   28 :
    3    0   29 :
    3    0   30 :
    3    0   31 :
    3    1   32 : 3
```

High: 3.70 4.73

Mean = 1.49

Stem & Leaf for Interior/Return ACH of Vintage 1 Use Classroom

N = 42 Median = 2.29
Quartiles = 1.46, 2.8

Decimal point is at the colon

```
    3    3    0 : 788
   10    7    1 : 1222234
   19    9    1 : 556667799
         5    2 : 33344
   18   13    2 : 5677777888899
    5    1    3 : 0
    4    0    3 :
    4    1    4 : 4
    3    0    4 :
    3    2    5 : 00
```

High: 8.72

Mean = 2.37

Stem & Leaf for Interior/Return ACH of Vintage 1 Use Office

```
N = 41   Median = 1.27
Quartiles = 1.09, 1.7

Decimal point is 1 place to the left of the colon

    2    2    3 : 07
    2    0    4 :
    4    2    5 : 57
    5    1    6 : 1
    5    0    7 :
    5    0    8 :
    7    2    9 : 27
   11    4   10 : 5589
   17    6   11 : 114457
         4   12 : 0037
   20    3   13 : 688
   17    3   14 : 234
   14    0   15 :
   14    3   16 : 339
   11    3   17 : 004
    8    1   18 : 8
    7    0   19 :
    7    0   20 :
    7    1   21 : 5
    6    2   22 : 66
    4    0   23 :
    4    1   24 : 5
    3    0   25 :
    3    0   26 :
    3    0   27 :
    3    2   28 : 47

High: 2.93

Mean = 1.42
```

Stem & Leaf for Interior/Return ACH of Vintage 1 Use Retail

```
N = 26   Median = 2.07
Quartiles = 1.74, 3.49

Decimal point is at the colon

   11   11   1 : 23557778999
         7   2 : 0012258
    8    3   3 : 157
    5    1   4 : 6
    4    1   5 : 9

High: 7.48 7.74 9.09

Mean = 3.05
```

Stem & Leaf for Interior/Return ACH of Vintage 2 Use Classroom

```
N = 19   Median = 1.8
Quartiles = 1.22, 2.33

Decimal point is at the colon

    1    1   0 : 6
        11   1 : 01223347889
    7    5   2 : 33358
    2    2   3 : 27

Mean = 1.86
```

Stem & Leaf for Interior/Return ACH of Vintage 2 Use Office

N = 79 Median = 1.13
Quartiles = 0.86, 1.52

Decimal point is 1 place to the left of the colon

```
    1    1    1 : 7
    1    0    2 :
    5    4    3 : 0466
    9    4    4 : 0146
   12    3    5 : 005
   16    4    6 : 3459
   18    2    7 : 14
   20    2    8 : 46
   27    7    9 : 2233468
   37   10   10 : 1245777888
         7   11 : 0135699
   35    4   12 : 3479
   31    3   13 : 378
   28    5   14 : 24479
   23    5   15 : 01123
   18    2   16 : 69
   16    2   17 : 08
   14    1   18 : 8
   13    1   19 : 2
   12    3   20 : 399
    9    1   21 : 4
    8    1   22 : 6
    7    0   23 :
    7    1   24 : 6
    6    1   25 : 2
    5    0   26 :
    5    2   27 : 57
```

High: 2.97 3.12 4.73

Mean = 1.29

Stem & Leaf for Interior/Return ACH of Vintage 2 Use Retail

N = 17 Median = 0.63
Quartiles = 0.49, 0.82

Decimal point is 1 place to the left of the colon

```
    5    5    4 : 24479
    7    2    5 : 09
         3    6 : 139
    7    1    7 : 7
    6    4    8 : 0247
    2    0    9 :
    2    1   10 : 0
```

High: 2.47

Mean = 0.76

Stem & Leaf for Interior/Return ACH of Vintage 1 SizeClass LargeOffice

```
N = 6    Median = 1.145
Quartiles = 1.05, 2.45

Decimal point is at the colon

          4    1 : 0012
    2     2    2 : 49

Mean = 1.63
```

Stem & Leaf for Interior/Return ACH of Vintage 1 SizeClass LargeRetail

```
N = 6    Median = 2.07
Quartiles = 1.87, 2.22

Decimal point is 1 place to the left of the colon

    1     1    14 : 7
    1     0    15 :
    1     0    16 :
    1     0    17 :
    2     1    18 : 7
    2     0    19 :
    3     1    20 : 3
    3     1    21 : 1
    2     2    22 : 22

Mean = 1.99
```

Stem & Leaf for Interior/Return ACH of Vintage 1 SizeClass SmallOffice

```
N = 31    Median = 1.2
Quartiles = 1.08, 1.55

Decimal point is 1 place to the left of the colon

    2     2     3 : 07
    2     0     4 :
    4     2     5 : 57
    5     1     6 : 1
    5     0     7 :
    5     0     8 :
    7     2     9 : 27
    9     2    10 : 88
   15     6    11 : 114457
          2    12 : 03
   14     3    13 : 688
   11     3    14 : 223
    8     1    15 : 5
    7     0    16 :
    7     3    17 : 004
    4     0    18 :
    4     0    19 :
    4     0    20 :
    4     0    21 :
    4     2    22 : 66

High: 2.84 2.87

Mean = 1.32
```

Stem & Leaf for Interior/Return ACH of Vintage 1 SizeClass SmallRetail

```
N = 28   Median = 2.135
Quartiles = 1.725, 3.58

Decimal point is at the colon

   13    13    1 : 2233477778999
         6     2 : 035778
    9    3     3 : 157
    6    1     4 : 6
    5    2     5 : 09

High: 7.48 7.74 9.09

Mean = 3.06
```

Stem & Leaf for Interior/Return ACH of Vintage 2 SizeClass LargeOffice

```
N = 27   Median = 1.1
Quartiles = 0.71, 1.38

Decimal point is 1 place to the left of the colon

    3    3     5 : 005
    6    3     6 : 345
    8    2     7 : 14
    8    0     8 :
   10    2     9 : 23
   13    3    10 : 788
         5    11 : 01356
    9    1    12 : 3
    8    2    13 : 38
    6    2    14 : 24
    4    2    15 : 11
    2    0    16 :
    2    1    17 : 8
    1    0    18 :
    1    0    19 :
    1    0    20 :
    1    0    21 :
    1    0    22 :
    1    0    23 :
    1    1    24 : 7

Mean = 1.1
```

Stem & Leaf for Interior/Return ACH of Vintage 2 SizeClass LargeRetail

```
N = 17   Median = 0.63
Quartiles = 0.49, 0.82

Decimal point is 1 place to the left of the colon

    5    5     4 : 24479
    7    2     5 : 09
         3     6 : 139
    7    1     7 : 7
    6    4     8 : 0247
    2    0     9 :
    2    1    10 : 0

High: 2.46

Mean = 0.76
```

Stem & Leaf for Interior/Return ACH of Vintage 2 SizeClass School

N = 19 Median = 1.8
Quartiles = 1.22, 2.33

Decimal point is at the colon

```
    1     1    0 : 6
         11    1 : 01223377889
    7     5    2 : 33358
    2     2    3 : 27
```

Mean = 1.88

Stem & Leaf for Interior/Return ACH of Vintage 2 SizeClass SmallOffice

N = 49 Median = 1.19
Quartiles = 0.92, 1.66

Decimal point is 1 place to the left of the colon

```
    1     1     1 : 7
    1     0     2 :
    5     4     3 : 0466
    9     4     4 : 0146
    9     0     5 :
   10     1     6 : 9
   10     0     7 :
   12     2     8 : 46
   17     5     9 : 23468
   23     6    10 : 245778
          2    11 : 99
   24     3    12 : 479
   21     2    13 : 67
   19     3    14 : 479
   16     3    15 : 023
   13     1    16 : 6
   12     1    17 : 0
   11     1    18 : 8
   10     0    19 :
   10     2    20 : 99
    8     1    21 : 4
    7     1    22 : 6
    6     0    23 :
    6     0    24 :
    6     1    25 : 2
    5     0    26 :
    5     2    27 : 57
    3     0    28 :
    3     1    29 : 7
    2     0    30 :
    2     1    31 : 2
```

High: 4.73

Mean = 1.37

Stem & Leaf for Interior/Return ACH of Vintage 2 SizeClass SmallRetail

N = 3 Median = 1.92
Quartiles = 1.01, 2.03

Decimal point is at the colon

```
          2    1 : 09
    1     1    2 : 0
```

Mean = 1.65

Stem & Leaf for Interior/Return ACH of Region NorthCoast Class Office

```
N = 36   Median = 1.14
Quartiles = 1.05, 1.255

Decimal point is 1 place to the left of the colon

Low:  0.30 0.37 0.46 0.61

    5    1    6 : 9
    5    0    7 :
    5    0    8 :
    8    3    9 : 248
   15    7   10 : 5557889
         8   11 : 11445799
   13    6   12 : 003479
    7    1   13 : 7
    6    2   14 : 24

High: 2.52 2.75 2.87 2.97

Mean = 1.24
```

Stem & Leaf for Interior/Return ACH of Region NorthCoast Class Retail

```
N = 11   Median = 1.74
Quartiles = 1.47, 2.66

Decimal point is at the colon

    2    2   1 : 23
         5   1 : 57778
    4    1   2 : 3
    3    3   2 : 778

Mean = 1.94
```

Stem & Leaf for Interior/Return ACH of Region NorthCoast Class School

```
N = 4   Median = 2.36
Quartiles = 1.785, 5.77

Decimal point is at the colon

    2    2   1 : 79
    2    1   2 : 8
    1    0   3 :
    1    0   4 :
    1    0   5 :
    1    0   6 :
    1    0   7 :
    1    1   8 : 7

Mean = 3.78
```

Stem & Leaf for Interior/Return ACH of Region NorthInterior Class Office

```
N = 5   Median = 0.97
Quartiles = 0.57, 2.45

Decimal point is at the colon

    2     2   0 : 56
          1   1 : 0
    2     2   2 : 49

Mean = 1.49
```

Stem & Leaf for Interior/Return ACH of Region NorthInterior Class Retail

```
N = 18   Median = 2.505
Quartiles = 1.92, 4.63

Decimal point is at the colon

    6     6   1 : 049999
          4   2 : 0055
    8     3   3 : 157
    5     1   4 : 6
    4     1   5 : 9
    3     0   6 :
    3     2   7 : 57
    1     0   8 :
    1     1   9 : 1

Mean = 3.56
```

Stem & Leaf for Interior/Return ACH of Region NorthInterior Class School

```
N = 19   Median = 1.92
Quartiles = 1.69, 2.68

Decimal point is at the colon

    1     1   0 : 6
          9   1 : 267778899
    9     8   2 : 13467788
    1     0   3 :
    1     1   4 : 4

Mean = 2.14
```

Stem & Leaf for Interior/Return ACH of Region SouthCoast Class Office

N = 40 Median = 1.08
Quartiles = 0.525, 1.43

Decimal point is 1 place to the left of the colon

```
  1    1    1 : 7
  1    0    2 :
  5    4    3 : 0466
  8    3    4 : 014
 11    3    5 : 005
 14    3    6 : 345
 16    2    7 : 14
 16    0    8 :
 18    2    9 : 23
       3   10 : 788
 19    5   11 : 01356
 14    1   12 : 3
 13    2   13 : 38
 11    2   14 : 24
  9    2   15 : 11
  7    0   16 :
  7    0   17 :
  7    1   18 : 8
  6    0   19 :
  6    2   20 : 99
  4    1   21 : 4
  3    1   22 : 6
  2    0   23 :
  2    0   24 :
  2    0   25 :
  2    0   26 :
  2    1   27 : 7
  1    0   28 :
  1    0   29 :
  1    0   30 :
  1    1   31 : 2
```

Mean = 1.12

Stem & Leaf for Interior/Return ACH of Region SouthCoast Class Retail

N = 12 Median = 0.545
Quartiles = 0.455, 1.25

Decimal point is at the colon

```
  3    3   0 : 444
       5   0 : 55566
  4    2   1 : 23
  2    1   1 : 7
```

High: 4.97

Mean = 1.09

Stem & Leaf for Interior/Return ACH of Region SouthCoast Class School

```
N = 19   Median = 1.58
Quartiles = 1.23, 2.4

Decimal point is at the colon

    2     2    0 : 78
    8     6    1 : 122333
          3    1 : 566
    8     4    2 : 3334
    4     3    2 : 578

High: 5.03

Mean = 1.9
```

Stem & Leaf for Interior/Return ACH of Region SouthInterior Class Office

```
N = 32   Median = 1.48
Quartiles = 1.075, 1.7

Decimal point is 1 place to the left of the colon

    2     2     8 : 46
    5     3     9 : 236
    9     4    10 : 2478
    9     0    11 :
    9     0    12 :
   13     4    13 : 6688
          4    14 : 2379
   15     4    15 : 0235
   11     1    16 : 6
   10     5    17 : 00048
    5     0    18 :
    5     0    19 :
    5     0    20 :
    5     0    21 :
    5     2    22 : 66
    3     0    23 :
    3     1    24 : 7
    2     0    25 :
    2     0    26 :
    2     0    27 :
    2     1    28 : 4

High: 4.73

Mean = 1.59
```

Stem & Leaf for Interior/Return ACH of Region SouthInterior Class Retail

```
N = 13   Median = 0.87
Quartiles = 0.8, 2.03

Decimal point is at the colon

          7    0 : 6788889
    6     1    1 : 0
    5     1    1 : 9
    4     4    2 : 0122

Mean = 1.3
```

Stem & Leaf for Interior/Return ACH of Region SouthInterior Class School

```
N = 15   Median = 2.26
Quartiles = 1.22, 2.93

Decimal point is at the colon

    1    1   0 : 8
    4    3   1 : 022
    7    3   1 : 566
         1   2 : 3
    7    4   2 : 5899
    3    2   3 : 02
    1    1   3 : 7

Mean = 2.15
```

Stem & Leaf for Interior/Return ACH of Region NorthCoast Use Classroom

```
N = 10   Median = 2.475
Quartiles = 1.67, 2.8

Decimal point is at the colon

    2    2   1 : 14
    4    2   1 : 79
    5    1   2 : 3
    5    4   2 : 7788

High: 8.72

Mean = 2.8
```

Stem & Leaf for Interior/Return ACH of Region NorthCoast Use Office

```
N = 34   Median = 1.14
Quartiles = 1.05, 1.24

Decimal point is 1 place to the left of the colon

Low:  0.30 0.37 0.46 0.61

    5    1    6 : 9
    5    0    7 :
    5    0    8 :
    8    3    9 : 248
   14    6   10 : 555789
         8   11 : 11445799
   12    6   12 : 003479
    6    1   13 : 7
    5    1   14 : 4

High: 2.52 2.75 2.87 2.97

Mean = 1.24
```

Stem & Leaf for Interior/Return ACH of Region NorthCoast Use Retail

```
N = 7   Median = 1.72
Quartiles = 1.33, 1.74

Decimal point is 1 place to the left of the colon

    1     1    12 : 2
    2     1    13 : 3
    3     1    14 : 7
    3     0    15 :
    3     0    16 :
    4     4    17 : 2346

Mean = 1.57
```

Stem & Leaf for Interior/Return ACH of Region NorthInterior Use Classroom

```
N = 16   Median = 1.915
Quartiles = 1.7, 2.625

Decimal point is at the colon

    1     1    0 : 6
          8    1 : 26778899
    7     6    2 : 346778
    1     0    3 :
    1     1    4 : 4

Mean = 2.13
```

Stem & Leaf for Interior/Return ACH of Region NorthInterior Use Office

```
N = 13   Median = 1.88
Quartiles = 1.01, 2.15

Decimal point is at the colon

    2     2    0 : 56
          6    1 : 004799
    5     5    2 : 01459

Mean = 1.7
```

Stem & Leaf for Interior/Return ACH of Region NorthInterior Use Retail

```
N = 13   Median = 3.49
Quartiles = 2.55, 5.9

Decimal point is at the colon

    2     2    1 : 99
    5     3    2 : 058
          3    3 : 157
    5     1    4 : 6
    4     1    5 : 9
    3     0    6 :
    3     2    7 : 57
    1     0    8 :
    1     1    9 : 1

Mean = 4.32
```

Stem & Leaf for Interior/Return ACH of Region SouthCoast Use Classroom

N = 20 Median = 1.52
Quartiles = 1.23, 2.465

Decimal point is at the colon

```
    2     2    0 : 78
    9     7    1 : 1222333
          2    1 : 56
    9     4    2 : 3334
    5     3    2 : 578
```

High: 4.97 5.03

Mean = 2.03

Stem & Leaf for Interior/Return ACH of Region SouthCoast Use Office

N = 43 Median = 1.1
Quartiles = 0.55, 1.51

Decimal point is 1 place to the left of the colon

```
    1     1    1 : 7
    1     0    2 :
    5     4    3 : 0466
    8     3    4 : 014
   11     3    5 : 005
   14     3    6 : 345
   16     2    7 : 14
   16     0    8 :
   18     2    9 : 23
   21     3   10 : 788
          5   11 : 01356
   17     2   12 : 37
   15     2   13 : 38
   13     2   14 : 24
   11     2   15 : 11
    9     2   16 : 39
    7     0   17 :
    7     1   18 : 8
    6     0   19 :
    6     2   20 : 99
    4     1   21 : 4
    3     1   22 : 6
    2     0   23 :
    2     0   24 :
    2     0   25 :
    2     0   26 :
    2     1   27 : 7
    1     0   28 :
    1     0   29 :
    1     0   30 :
    1     1   31 : 2
```

Mean = 1.14

Stem & Leaf for Interior/Return ACH of Region SouthCoast Use Retail

N = 8 Median = 0.48
Quartiles = 0.44, 0.545

Decimal point is 1 place to the left of the colon

```
    3     3    4 : 244
          2    4 : 79
    3     1    5 : 0
    2     1    5 : 9
    1     1    6 : 1
```

Mean = 0.5

Stem & Leaf for Interior/Return ACH of Region SouthInterior Use Classroom

N = 15 Median = 2.26
Quartiles = 1.22, 2.93

Decimal point is at the colon

```
    1     1    0 : 8
    5     4    1 : 0224
    7     2    1 : 56
          1    2 : 3
    7     4    2 : 5899
    3     2    3 : 02
    1     1    3 : 7
```

Mean = 2.13

Stem & Leaf for Interior/Return ACH of Region SouthInterior Use Office

N = 30 Median = 1.48
Quartiles = 1.07, 1.7

Decimal point is 1 place to the left of the colon

```
    2     2     8 : 46
    5     3     9 : 236
    9     4    10 : 2478
    9     0    11 :
    9     0    12 :
   12     3    13 : 688
          4    14 : 2379
   14     3    15 : 023
   11     2    16 : 36
    9     5    17 : 00048
    4     0    18 :
    4     0    19 :
    4     0    20 :
    4     0    21 :
    4     2    22 : 66
    2     0    23 :
    2     0    24 :
    2     0    25 :
    2     0    26 :
    2     0    27 :
    2     1    28 : 4
```

High: 4.73

Mean = 1.57

Stem & Leaf for Interior/Return ACH of Region SouthInterior Use Retail

```
N = 15   Median = 1
Quartiles = 0.8, 2.11

Decimal point is at the colon

    7     7   0 : 6788889
          1   1 : 0
    7     2   1 : 59
    5     4   2 : 0122
    1     1   2 : 5

Mean = 1.39
```

Stem & Leaf for Interior/Return ACH of Region NorthCoast SizeClass SmallOffice

```
N = 32   Median = 1.145
Quartiles = 1.015, 1.28

Decimal point is 1 place to the left of the colon

Low:  0.30 0.37 0.46

    5     2    6 : 19
    5     0    7 :
    5     0    8 :
    8     3    9 : 248
   12     4   10 : 5788
          8   11 : 11445799
   12     5   12 : 03479
    7     1   13 : 7
    6     2   14 : 24

High: 2.52 2.75 2.87 2.97

Mean = 1.26
```

Stem & Leaf for Interior/Return ACH of Region NorthCoast SizeClass SmallRetail

```
N = 10   Median = 1.75
Quartiles = 1.72, 2.66

Decimal point is at the colon

    2     2   1 : 23
          4   1 : 7778
    4     1   2 : 3
    3     3   2 : 778

Mean = 1.99
```

Stem & Leaf for Interior/Return ACH of Region NorthInterior SizeClass School

N = 19 Median = 1.92
Quartiles = 1.69, 2.68

Decimal point is at the colon

```
    1     1   0 : 6
          9   1 : 267778899
    9     8   2 : 13467788
    1     0   3 :
    1     1   4 : 4
```

Mean = 2.14

Stem & Leaf for Interior/Return ACH of Region NorthInterior SizeClass SmallOffice

N = 3 Median = 0.57
Quartiles = 0.55, 0.97

Decimal point is 1 place to the left of the colon

```
          2   5 : 57
    1     0   6 :
    1     0   7 :
    1     0   8 :
    1     1   9 : 7
```

Mean = 0.7

Stem & Leaf for Interior/Return ACH of Region NorthInterior SizeClass SmallRetail

```
N = 17   Median = 2.55
Quartiles = 1.92, 4.63

Decimal point is at the colon

    6     6   1 : 049999
          3   2 : 005
    8     3   3 : 157
    5     1   4 : 6
    4     1   5 : 9
    3     0   6 :
    3     2   7 : 57
    1     0   8 :
    1     1   9 : 1

Mean = 3.63
```

Stem & Leaf for Interior/Return ACH of Region SouthCoast SizeClass LargeOffice

```
N = 25   Median = 1.08
Quartiles = 0.71, 1.23

Decimal point is 1 place to the left of the colon

    3     3    5 : 005
    6     3    6 : 345
    8     2    7 : 14
    8     0    8 :
   10     2    9 : 23
          3   10 : 788
   12     5   11 : 01356
    7     1   12 : 3
    6     2   13 : 38
    4     2   14 : 24
    2     2   15 : 11

Mean = 1.02
```

Stem & Leaf for Interior/Return ACH of Region SouthCoast SizeClass LargeRetail

```
N = 8   Median = 0.48
Quartiles = 0.44, 0.545

Decimal point is 1 place to the left of the colon

    3     3   4 : 244
          2   4 : 79
    3     1   5 : 0
    2     1   5 : 9
    1     1   6 : 1

Mean = 0.5
```

Stem & Leaf for Interior/Return ACH of Region SouthCoast SizeClass School

```
N = 19    Median = 1.58
Quartiles = 1.23, 2.4

Decimal point is at the colon

    2     2    0 : 78
    8     6    1 : 122333
          3    1 : 566
    8     4    2 : 3334
    4     3    2 : 578

High: 5.03

Mean = 1.9
```

Stem & Leaf for Interior/Return ACH of Region SouthCoast SizeClass SmallOffice

```
N = 15    Median = 0.44
Quartiles = 0.36, 2.14

Decimal point is at the colon

          8    0 : 23344444
    7     0    0 :
    7     0    1 :
    7     1    1 : 9
    6     4    2 : 1113
    2     1    2 : 8
    1     1    3 : 1

Mean = 1.28
```

Stem & Leaf for Interior/Return ACH of Region SouthCoast SizeClass SmallRetail

```
N = 4    Median = 1.48
Quartiles = 1.25, 3.33

Decimal point is at the colon

          3    1 : 237
    1     0    2 :
    1     0    3 :
    1     0    4 :
    1     1    5 : 0

Mean = 2.29
```

Stem & Leaf for Interior/Return ACH of Region SouthInterior SizeClass LargeOffice

```
N = 2   Median = 2.125
Quartiles = 1.78, 2.47

Decimal point is 1 place to the left of the colon

    1    1   17 : 8
    1    0   18 :
    1    0   19 :
    1    0   20 :
    1    0   21 :
    1    0   22 :
    1    0   23 :
    1    1   24 : 7

Mean = 2.12
```

Stem & Leaf for Interior/Return ACH of Region SouthInterior SizeClass LargeRetail

```
N = 13   Median = 0.87
Quartiles = 0.8, 2.03

Decimal point is at the colon

         7   0 : 6788889
    6    1   1 : 0
    5    1   1 : 9
    4    4   2 : 0122

Mean = 1.3
```

Stem & Leaf for Interior/Return ACH of Region SouthInterior SizeClass School

```
N = 15   Median = 2.26
Quartiles = 1.22, 2.93

Decimal point is at the colon

    1    1   0 : 8
    4    3   1 : 022
    7    3   1 : 566
         1   2 : 3
    7    4   2 : 5899
    3    2   3 : 02
    1    1   3 : 7

Mean = 2.15
```

Stem & Leaf for Interior/Return ACH of Region SouthInterior SizeClass SmallOffice

```
N = 30   Median = 1.45
Quartiles = 1.07, 1.7

Decimal point is 1 place to the left of the colon

    2    2    8 : 46
    5    3    9 : 236
    9    4   10 : 2478
    9    0   11 :
    9    0   12 :
   13    4   13 : 6688
         4   14 : 2379
   13    4   15 : 0235
    9    1   16 : 6
    8    4   17 : 0004
    4    0   18 :
    4    0   19 :
    4    0   20 :
    4    0   21 :
    4    2   22 : 66
    2    0   23 :
    2    0   24 :
    2    0   25 :
    2    0   26 :
    2    0   27 :
    2    1   28 : 4

High: 4.73

Mean = 1.56
```

Interior/Return ACH of Region SouthInterior SizeClass SmallRetail has no observation

Stem & Leaf for Building Total ACH of Size Large

```
N = 11   Median = 1.1
Quartiles = 0.77, 2.02

Decimal point is at the colon

    3    3   0 : 578
         4   1 : 0115
    4    4   2 : 0057

Mean = 1.44
```

Stem & Leaf for Building Total ACH of Size Small

```
N = 24   Median = 1.485
Quartiles = 1.01, 2.285

Decimal point is at the colon

    4    4   0 : 3456
        13   1 : 0000224456678
    7    5   2 : 23578
    2    1   3 : 7

High: 6.97

Mean = 1.78
```

Stem & Leaf for Building Total ACH of Region NorthCoast

```
N = 13    Median = 1.47
Quartiles = 1.16, 2.74

Decimal point is at the colon

    1     1    0 : 4
          6    1 : 012245
    6     5    2 : 22789

High: 7.49

Mean = 2.17
```

Stem & Leaf for Building Total ACH of Region NorthInterior

```
N = 15    Median = 1.96
Quartiles = 0.97, 2.67

Decimal point is at the colon

    3     3    0 : 566
    7     4    1 : 0668
          6    2 : 025578
    2     1    3 : 7

High: 6.97

Mean = 2.2
```

Stem & Leaf for Building Total ACH of Region SouthCoast

```
N = 10    Median = 1.14
Quartiles = 0.68, 1.85

Decimal point is at the colon

    3     3    0 : 357
          5    1 : 01248
    2     2    2 : 38

Mean = 1.32
```

Stem & Leaf for Building Total ACH of Region SouthInterior

```
N = 11    Median = 1.63
Quartiles = 1.05, 2.02

Decimal point is at the colon

    1     1    0 : 8
          6    1 : 003567
    4     4    2 : 0039

Mean = 1.67
```

Stem & Leaf for Building Total ACH of Vintage 1

```
N = 28   Median = 1.875
Quartiles = 1.27, 2.75

Decimal point is at the colon

    1     1    0 : 4
    3     2    0 : 56
   10     7    1 : 0122344
   14     4    1 : 5678
   14     4    2 : 0022
   10     7    2 : 5778899
    3     0    3 :
    3     1    3 : 7

High: 6.97 7.49

Mean = 2.24
```

Stem & Leaf for Building Total ACH of Vintage 2

```
N = 21   Median = 1.16
Quartiles = 0.98, 2.02

Decimal point is at the colon

    1     1    0 : 3
    5     4    0 : 5678
          6    1 : 000012
   10     4    1 : 5668
    6     4    2 : 0233
    2     2    2 : 58

Mean = 1.43
```

Stem & Leaf for Building Total ACH of Class Office

```
N = 22   Median = 1.09
Quartiles = 0.97, 1.74

Decimal point is at the colon

    2     2    0 : 34
    5     3    0 : 567
          9    1 : 000001122
    8     3    1 : 567
    5     2    2 : 03
    3     3    2 : 778

Mean = 1.35
```

Stem & Leaf for Building Total ACH of Class Retail

```
N = 13   Median = 1.79
Quartiles = 1.42, 2.47

Decimal point is at the colon

    2     2    0 : 58
          5    1 : 44568
    6     4    2 : 0255
    2     1    3 : 7

High: 6.97

Mean = 2.22
```

Stem & Leaf for Building Total ACH of Class School

```
N = 14   Median = 2.235
Quartiles = 1.63, 2.82

Decimal point is at the colon

    1     1    0 : 6
    3     2    1 : 23
    5     2    1 : 68
          4    2 : 0223
    5     4    2 : 8899

High: 7.49

Mean = 2.45
```

Stem & Leaf for Building Total ACH of SizeClass LargeOffice

```
N = 6   Median = 1.09
Quartiles = 1.04, 2.02

Decimal point is at the colon

    1     1    0 : 7
          3    1 : 011
    2     2    2 : 07

Mean = 1.43
```

Stem & Leaf for Building Total ACH of SizeClass LargeRetail

```
N = 5   Median = 1.47
Quartiles = 0.77, 2

Decimal point is at the colon

    2     2    0 : 58
          1    1 : 5
    2     2    2 : 05

Mean = 1.44
```

Stem & Leaf for Building Total ACH of SizeClass School

```
N = 14   Median = 2.235
Quartiles = 1.63, 2.82

Decimal point is at the colon

    1     1    0 : 6
    3     2    1 : 23
    5     2    1 : 68
          4    2 : 0223
    5     4    2 : 8899

High: 7.49

Mean = 2.45
```

Stem & Leaf for Building Total ACH of SizeClass SmallOffice

N = 16 Median = 1.105
Quartiles = 0.77, 1.685

Decimal point is at the colon

```
    2     2   0 : 34
    4     2   0 : 56
          6   1 : 000022
    6     3   1 : 567
    3     1   2 : 3
    2     2   2 : 78
```

Mean = 1.32

Stem & Leaf for Building Total ACH of SizeClass SmallRetail

N = 8 Median = 2.01
Quartiles = 1.535, 3.105

Decimal point is at the colon

```
    4     4   1 : 4468
    4     2   2 : 25
    2     1   3 : 7
```

High: 6.97

Mean = 2.71

Stem & Leaf for Building Infiltration of Size Large

N = 8 Median = 0.54
Quartiles = 0.315, 1.005

Decimal point is at the colon

```
    4     4   0 : 1334
    4     2   0 : 69
    2     1   1 : 1
    1     1   1 : 5
```

Mean = 0.66

Stem & Leaf for Building Infiltration of Size NA

N = 12 Median = 0.32
Quartiles = 0.115, 0.76

Decimal point is at the colon

```
          7   0 : z111134
    5     3   0 : 569
    2     2   1 : 04
```

Mean = 0.46

Stem & Leaf for Building Infiltration of Size Small

N = 20 Median = 0.36
Quartiles = 0.215, 1.055

Decimal point is 1 place to the left of the colon

```
    2    2    0 : 79
    3    1    1 : 2
    7    4    2 : 1127
   10    3    3 : 011
   10    2    4 : 11
    8    1    5 : 2
    7    1    6 : 6
    6    0    7 :
    6    0    8 :
    6    0    9 :
    6    2   10 : 47
    4    2   11 : 18
    2    0   12 :
    2    1   13 : 5
    1    0   14 :
    1    0   15 :
    1    0   16 :
    1    1   17 : 2
```

Mean = 0.58

Stem & Leaf for Building Infiltration of Region NorthCoast

N = 13 Median = 0.91
Quartiles = 0.31, 1.18

Decimal point is at the colon

```
    6    6    0 : 112344
         1    0 : 9
    6    4    1 : 1124
    2    2    1 : 57
```

Mean = 0.81

Stem & Leaf for Building Infiltration of Region NorthInterior

N = 9 Median = 0.41
Quartiles = 0.27, 0.61

Decimal point is 1 place to the left of the colon

```
    1    1    0 : z
    2    1    1 : 4
    3    1    2 : 7
    4    1    3 : 1
         1    4 : 1
    4    1    5 : 2
    3    2    6 : 16
    1    0    7 :
    1    1    8 : 8
```

Mean = 0.42

Stem & Leaf for Building Infiltration of Region SouthCoast

N = 8 Median = 0.29
Quartiles = 0.18, 0.585

Decimal point is at the colon

```
        5   0 : 11333
    3   2   0 : 56
    1   1   1 : 3
```

Mean = 0.44

Stem & Leaf for Building Infiltration of Region SouthInterior

N = 10 Median = 0.285
Quartiles = 0.12, 0.97

Decimal point is at the colon

```
        7   0 : 1112234
    3   0   0 :
    3   3   1 : 001
```

Mean = 0.45

Stem & Leaf for Building Infiltration of Vintage 1

N = 22 Median = 0.525
Quartiles = 0.26, 1.11

Decimal point is 1 place to the left of the colon

```
    3   3    0 : z69
    3   0    1 :
    7   4    2 : 1167
    8   1    3 : 1
   10   2    4 : 14
        2    5 : 23
   10   0    6 :
   10   0    7 :
   10   0    8 :
   10   2    9 : 17
    8   2   10 : 47
    6   3   11 : 138
    3   0   12 :
    3   1   13 : 5
    2   2   14 : 57
```

Mean = 0.68

Stem & Leaf for Building Infiltration of Vintage 2

N = 18 Median = 0.305
Quartiles = 0.13, 0.61

Decimal point is 1 place to the left of the colon

```
    2   2   0 : 79
    6   4   1 : 0234
    8   2   2 : 28
        4   3 : 0158
    6   1   4 : 1
    5   0   5 :
    5   3   6 : 146
    2   0   7 :
    2   1   8 : 8
```

High: 1.72

Mean = 0.41

Stem & Leaf for Building Infiltration of Class Office

```
N = 20    Median = 0.305
Quartiles = 0.21, 0.48

Decimal point is 1 place to the left of the colon

    3     3    0 : 799
    4     1    1 : 2
    9     5    2 : 11278
          4    3 : 0115
    7     2    4 : 14
    5     1    5 : 2
    4     1    6 : 4

High: 1.04 1.07 1.72

Mean = 0.43
```

Stem & Leaf for Building Infiltration of Class Retail

```
N = 8    Median = 1.12
Quartiles = 0.77, 1.265

Decimal point is at the colon

    1     1    0 : 4
    3     2    0 : 79
          4    1 : 1123
    1     1    1 : 5

Mean = 1.02
```

Stem & Leaf for Building Infiltration of Class School

```
N = 12    Median = 0.32
Quartiles = 0.115, 0.76

Decimal point is at the colon

          7    0 : z111134
    5     3    0 : 569
    2     2    1 : 04

Mean = 0.46
```

Stem & Leaf for Building Infiltration of SizeClass LargeOffice

```
N = 5    Median = 0.35
Quartiles = 0.28, 0.44

Decimal point is 1 place to the left of the colon

    1     1    0 : 9
    1     0    1 :
    2     1    2 : 8
          1    3 : 5
    2     1    4 : 4
    1     0    5 :
    1     1    6 : 4

Mean = 0.36
```

Stem & Leaf for Building Infiltration of SizeClass LargeRetail

N = 3 Median = 1.13
Quartiles = 0.88, 1.47

Decimal point is 1 place to the left of the colon

```
    1    1    8 : 8
    1    0    9 :
    1    0   10 :
         1   11 : 3
    1    0   12 :
    1    0   13 :
    1    1   14 : 7
```

Mean = 1.16

Stem & Leaf for Building Infiltration of SizeClass SmallOffice

N = 15 Median = 0.3
Quartiles = 0.21, 0.52

Decimal point is 1 place to the left of the colon

```
    2    2    0 : 79
    3    1    1 : 2
    7    4    2 : 1127
         3    3 : 011
    5    1    4 : 1
    4    1    5 : 2
    3    0    6 :
    3    0    7 :
    3    0    8 :
    3    0    9 :
    3    2   10 : 47
```

High: 1.72

Mean = 0.46

Stem & Leaf for Building Infiltration of SizeClass SmallRetail

N = 5 Median = 1.11
Quartiles = 0.66, 1.18

Decimal point is 1 place to the left of the colon

```
    1    1    4 : 1
    1    0    5 :
    2    1    6 : 6
    2    0    7 :
    2    0    8 :
    2    0    9 :
    2    0   10 :
         2   11 : 18
    1    0   12 :
    1    1   13 : 5
```

Mean = 0.94

Stem & Leaf for Building Total ACH of Class Office Size Large

```
N = 6   Median = 1.09
Quartiles = 1.04, 2.02

Decimal point is at the colon

    1     1    0 : 7
          3    1 : 011
    2     2    2 : 07

Mean = 1.43
```

Stem & Leaf for Building Total ACH of Class Office Size Small

```
N = 16   Median = 1.105
Quartiles = 0.77, 1.685

Decimal point is at the colon

    2     2    0 : 34
    4     2    0 : 56
          6    1 : 000022
    6     3    1 : 567
    3     1    2 : 3
    2     2    2 : 78

Mean = 1.32
```

Stem & Leaf for Building Total ACH of Class Office Region NorthCoast

```
N = 7   Median = 1.16
Quartiles = 1.04, 2.74

Decimal point is at the colon

    1     1    0 : 4
          4    1 : 0122
    2     2    2 : 78

Mean = 1.49
```

Stem & Leaf for Building Total ACH of Class Office Region NorthInterior

```
N = 4   Median = 0.77
Quartiles = 0.56, 1.82

Decimal point is at the colon

    2     2    0 : 56
    2     1    1 : 0
    1     1    2 : 7

Mean = 1.19
```

Stem & Leaf for Building Total ACH of Class Office Region SouthCoast

```
N = 5    Median = 1.04
Quartiles = 0.68, 1.08

Decimal point is 1 place to the left of the colon

    1     1     3 : 4
    1     0     4 :
    1     0     5 :
    2     1     6 : 8
    2     0     7 :
    2     0     8 :
    2     0     9 :
    3     2    10 : 48

High: 2.34

Mean = 1.1
```

Stem & Leaf for Building Total ACH of Class Office Region SouthInterior

```
N = 6    Median = 1.59
Quartiles = 1.05, 1.74

Decimal point is at the colon

          5    1 : 00567
    1     1    2 : 0

Mean = 1.5
```

Stem & Leaf for Building Total ACH of Class Office Vintage 1

```
N = 10    Median = 1.13
Quartiles = 0.57, 1.74

Decimal point is at the colon

    3     3    0 : 456
          5    1 : 01267
    2     2    2 : 77

Mean = 1.36
```

Stem & Leaf for Building Total ACH of Class Office Vintage 2

```
N = 12    Median = 1.065
Quartiles = 1.01, 1.785

Decimal point is at the colon

    2     2    0 : 37
          7    1 : 0000125
    3     3    2 : 038

Mean = 1.34
```

Stem & Leaf for Building Infiltration of Class Office Size Large

N = 5 Median = 0.35
Quartiles = 0.28, 0.44

Decimal point is 1 place to the left of the colon

```
    1     1    0 : 9
    1     0    1 :
    2     1    2 : 8
          1    3 : 5
    2     1    4 : 4
    1     0    5 :
    1     1    6 : 4
```

Mean = 0.36

Stem & Leaf for Building Infiltration of Class Office Size Small

N = 15 Median = 0.3
Quartiles = 0.21, 0.52

Decimal point is 1 place to the left of the colon

```
    2     2    0 : 79
    3     1    1 : 2
    7     4    2 : 1127
          3    3 : 011
    5     1    4 : 1
    4     1    5 : 2
    3     0    6 :
    3     0    7 :
    3     0    8 :
    3     0    9 :
    3     2   10 : 47
```

High: 1.72

Mean = 0.46

Stem & Leaf for Building Infiltration of Class Office Region NorthCoast

N = 7 Median = 0.41
Quartiles = 0.21, 1.07

Decimal point is at the colon

```
          5    0 : 12344
    2     0    0 :
    2     1    1 : 1
    1     1    1 : 7
```

Mean = 0.61

Stem & Leaf for Building Infiltration of Class Office Region NorthInterior

N = 3 Median = 0.31
Quartiles = 0.27, 0.52

Decimal point is 1 place to the left of the colon

```
    1     1   2 : 7
          1   3 : 1
    1     0   4 :
    1     1   5 : 2
```

Mean = 0.37

Stem & Leaf for Building Infiltration of Class Office Region SouthCoast

N = 4 Median = 0.29
Quartiles = 0.185, 0.47

Decimal point is 1 place to the left of the colon

```
    1     1   0 : 9
    1     0   1 :
    2     1   2 : 8
    2     1   3 : 0
    1     0   4 :
    1     0   5 :
    1     1   6 : 4
```

Mean = 0.33

Stem & Leaf for Building Infiltration of Class Office Region SouthInterior

N = 6 Median = 0.215
Quartiles = 0.12, 0.35

Decimal point is 1 place to the left of the colon

```
    1     1   0 : 7
    2     1   1 : 2
          2   2 : 12
    2     1   3 : 5
```

High: 1.04

Mean = 0.34

Stem & Leaf for Building Infiltration of Class Office Vintage 1

N = 9 Median = 0.31
Quartiles = 0.21, 0.52

Decimal point is 1 place to the left of the colon

```
    1     1     0 : 9
    1     0     1 :
    4     3     2 : 117
          1     3 : 1
    4     1     4 : 4
    3     1     5 : 2
    2     0     6 :
    2     0     7 :
    2     0     8 :
    2     0     9 :
    2     2    10 : 47
```

Mean = 0.46

Stem & Leaf for Building Infiltration of Class Office Vintage 2

N = 11 Median = 0.3
Quartiles = 0.12, 0.41

Decimal point is 1 place to the left of the colon

```
    2     2     0 : 79
    3     1     1 : 2
    5     2     2 : 28
          3     3 : 015
    3     1     4 : 1
    2     0     5 :
    2     1     6 : 4
```

High: 1.72

Mean = 0.41

Stem & Leaf for Building Total ACH of Class Retail Size Large

N = 5 Median = 1.47
Quartiles = 0.77, 2

Decimal point is at the colon

```
    2     2     0 : 58
          1     1 : 5
    2     2     2 : 05
```

Mean = 1.44

Stem & Leaf for Building Total ACH of Class Retail Size Small

```
N = 8   Median = 2.01
Quartiles = 1.535, 3.105

Decimal point is at the colon

    4     4   1 : 4468
    4     2   2 : 25
    2     1   3 : 7

High: 6.97

Mean = 2.71
```

Stem & Leaf for Building Total ACH of Class Retail Use Office

```
N = 3   Median = 1.65
Quartiles = 1.4, 2.47

Decimal point is at the colon

          2   1 : 46
    1     1   2 : 5

Mean = 1.84
```

Stem & Leaf for Building Total ACH of Class Retail Use Retail

```
N = 10   Median = 1.895
Quartiles = 1.42, 2.54

Decimal point is at the colon

    2     2   0 : 58
    5     3   1 : 458
    5     3   2 : 025
    2     1   3 : 7

High: 6.97

Mean = 2.34
```

Stem & Leaf for Building Total ACH of Class Retail Region NorthCoast

```
N = 3   Median = 1.47
Quartiles = 1.42, 2.23

Decimal point is 1 place to the left of the colon

          2   14 : 27
    1     0   15 :
    1     0   16 :
    1     0   17 :
    1     0   18 :
    1     0   19 :
    1     0   20 :
    1     0   21 :
    1     1   22 : 3

Mean = 1.71
```

Stem & Leaf for Building Total ACH of Class Retail Region NorthInterior

N = 6 Median = 2.505
Quartiles = 1.79, 3.67

Decimal point is at the colon

```
    2     2   1 : 68
          2   2 : 55
    2     1   3 : 7
    1     0   4 :
    1     0   5 :
    1     0   6 :
    1     1   7 : 0
```

Mean = 3.18

Stem & Leaf for Building Total ACH of Class Retail Region SouthCoast

N = 2 Median = 0.95
Quartiles = 0.5, 1.4

Decimal point is 1 place to the left of the colon

```
    1     1    5 : 0
    1     0    6 :
    1     0    7 :
    1     0    8 :
    1     0    9 :
    1     0   10 :
    1     0   11 :
    1     0   12 :
    1     0   13 :
    1     1   14 : 0
```

Mean = 0.95

Stem & Leaf for Building Total ACH of Class Retail Region SouthInterior

N = 2 Median = 1.385
Quartiles = 0.77, 2

Decimal point is at the colon

```
    1     1   0 : 8
    1     0   1 :
    1     1   2 : 0
```

Mean = 1.38

Stem & Leaf for Building Total ACH of Class Retail Vintage 1

N = 9 Median = 2
Quartiles = 1.47, 2.54

Decimal point is at the colon

```
    4     4   1 : 4458
          3   2 : 025
    2     1   3 : 7
```

High: 6.97

Mean = 2.61

Stem & Lea f for Building Total ACH of Class Retail Vintage 2

```
N = 4    Median = 1.21
Quartiles = 0.635, 2.06

Decimal point is at the colon

    2     2    0 : 58
    2     1    1 : 6
    1     1    2 : 5

Mean = 1.35
```

Stem & Leaf for Building Infiltration of Class Retail Size Large

```
N = 3    Median = 1.13
Quartiles = 0.88, 1.47

Decimal point is 1 place to the left of the colon

    1     1     8 : 8
    1     0     9 :
    1     0    10 :
          1    11 : 3
    1     0    12 :
    1     0    13 :
    1     1    14 : 7

Mean = 1.16
```

Stem & Leaf for Building Infiltration of Class Retail Size Small

```
N = 5    Median = 1.11
Quartiles = 0.66, 1.18

Decimal point is 1 place to the left of the colon

    1     1     4 : 1
    1     0     5 :
    2     1     6 : 6
    2     0     7 :
    2     0     8 :
    2     0     9 :
    2     0    10 :
          2    11 : 18
    1     0    12 :
    1     1    13 : 5

Mean = 0. 94
```

Stem & Leaf for Building Infiltration of Class Retail Region NorthCoast

```
N = 3    Median = 1.18
Quartiles = 1.11, 1.47

Decimal point is 1 place to the left of the colon

          2    11 : 18
    1     0    12 :
    1     0    13 :
    1     1    14 : 7

Mean = 1.25
```

Stem & Leaf for Building Infiltration of Class Retail Region NorthInterior

```
N = 3    Median = 0.66
Quartiles = 0.41, 0.88

Decimal point is 1 place to the left of the colon

    1     1    4 : 1
    1     0    5 :
          1    6 : 6
    1     0    7 :
    1     1    8 : 8

Mean = 0.65
```

Stem & Leaf for Building Infiltration of Class Retail Vintage 1

```
N = 6    Median = 1.155
Quartiles = 1.11, 1.35

Decimal point is 1 place to the left of the colon

Low:  0.41

          3    11 : 138
    2     0    12 :
    2     1    13 : 5
    1     1    14 : 7

Mean = 1.11
```

Stem & Leaf for Building Infiltration of Class Retail Vintage 2

```
N = 2    Median = 0.77
Quartiles = 0.66, 0.88

Decimal point is 1 place to the left of the colon

    1     1    6 : 6
    1     0    7 :
    1     1    8 : 8

Mean = 0.77
```

Stem & Leaf for Building Total ACH of Class School Use Classroom

```
N = 14    Median = 2.235
Quartiles = 1.63, 2.82

Decimal point is at the colon

    1     1    0 : 6
    3     2    1 : 23
    5     2    1 : 68
          4    2 : 0223
    5     4    2 : 8899

High: 7.49

Mean = 2.45
```

Stem & Leaf for Building Total ACH of Class School Region NorthCoast

```
N = 3   Median = 2.93
Quartiles = 2.22, 7.49

Decimal point is at the colon

          2   2 : 29
    1     0   3 :
    1     0   4 :
    1     0   5 :
    1     0   6 :
    1     1   7 : 5

Mean = 4.21
```

Stem & Leaf for Building Total ACH of Class School Region NorthInterior

```
N = 5   Median = 1.96
Quartiles = 1.63, 2.25

Decimal point is at the colon

    1     1   0 : 6
    2     1   1 : 6
    3     3   2 : 028

Mean = 1.84
```

Stem & Leaf for Building Total ACH of Class School Region SouthCoast

```
N = 3   Median = 1.85
Quartiles = 1.2, 2.76

Decimal point is at the colon

          2   1 : 28
    1     1   2 : 8

Mean = 1.94
```

Stem & Leaf for Building Total ACH of Class School Region SouthInterior

```
N = 3   Median = 2.32
Quartiles = 1.34, 2.92

Decimal point is at the colon

    1     1   1 : 3
    2     2   2 : 39

Mean = 2.19
```

Stem & Leaf for Building Total ACH of Class School Vintage 1

```
N = 9   Median = 2.76
Quartiles = 1.96, 2.92

Decimal point is at the colon

    2     2   1 : 23
    2     0   1 :
    4     2   2 : 02
    5     4   2 : 8899

High: 7.49

Mean = 2.85
```

Stem & Leaf for Building Total ACH of Class School Vintage 2

```
N = 5    Median = 1.85
Quartiles = 1.63, 2.22

Decimal point is at the colon

    1     1    0 : 6
          2    1 : 68
    2     2    2 : 23

Mean = 1.72
```

Stem & Leaf for Building Infiltration of Class School Region NorthCoast

```
N = 3    Median = 0.91
Quartiles = 0.13, 1.45

Decimal point is at the colon

          2    0 : 19
    1     1    1 : 4

Mean = 0.83
```

Stem & Leaf for Building Infiltration of Class School Region NorthInterior

```
N = 3    Median = 0.14
Quartiles =  0, 0.61

Decimal point is 1 place to the left of the colon

    1     1    0 : 2
          1    1 : 4
    1     0    2 :
    1     0    3 :
    1     0    4 :
    1     0    5 :
    1     1    6 : 1

Mean = 0.25
```

Stem & Leaf for Building Infiltration of Class School Region SouthCoast

```
N = 3    Median = 0.26
Quartiles = 0.1, 0.53

Decimal point is 1 place to the left of the colon

    1     1    1 : 0
          1    2 : 6
    1     0    3 :
    1     0    4 :
    1     1    5 : 3

Mean = 0.3
```

Stem & Leaf for Building Infiltration of Class School Region SouthInterior

```
N = 3   Median = 0.38
Quartiles = 0.06, 0.97

Decimal point is 1 place to the left of the colon

    1     1    0 : 6
    1     0    1 :
    1     0    2 :
          1    3 : 8
    1     0    4 :
    1     0    5 :
    1     0    6 :
    1     0    7 :
    1     0    8 :
    1     1    9 : 7

Mean = 0.47
```

Stem & Leaf for Building Infiltration of Class School Vintage 1

```
N = 7   Median = 0.53
Quartiles = 0.06, 0.97

Decimal point is at the colon

    3     3    0 : z13
          2    0 : 59
    2     2    1 : 04

Mean = 0.6
```

Stem & Leaf for Building Infiltration of Class School Vintage 2

```
N = 5   Median = 0.14
Quartiles = 0.13, 0.38

Decimal point is 1 place to the left of the colon

          3    1 : 034
    2     0    2 :
    2     1    3 : 8
    1     0    4 :
    1     0    5 :
    1     1    6 : 1

Mean = 0.27
```

7. Air Change Rate Data

This section contains a listing of the summary data file containing air change rate data used for the analysis presented in this report. The data in this file were extracted from individual building data files producted from the field measurements. The individual data files contain a complete anlaysis of the tracer data as explained in the protocol report prepared iunder Task I of the project.

CEC Zone Air Change Rates
HVAC System On

Building	Class	Size	Region	Vintage	Zone	Location	Use	Ach
CEC003	Office	Small	North Coast	1	Z1	R1	Office	1.22
CEC003	Office	Small	North Coast	1	Z1	I1	Office	1.23
CEC003	Office	Small	North Coast	1	Z1	I2	Office	1.11
CEC003	Office	Small	North Coast	1	Z1	I3	Office	1.14
CEC003	Office	Small	North Coast	1	Z1	I4	Office	1.15
CEC003	Office	Small	North Coast	1	Z1	I5	Office	1.14
CEC003	Office	Small	North Coast	1	Z1	I6	Office	1.11
CEC003	Office	Small	North Coast	1	Z1	I7	Classroom	1.08
CEC003	Office	Small	North Coast	1	Z1	I8	Classroom	1.42
CEC003	Office	Small	North Coast	1	Z1	I9	Office	1.20
CEC003	Office	Small	North Coast	1	Z1	I10	Office	1.17
CEC003	Office	Small	North Coast	1	Z1	I11	Office	0.92
CEC003	Office	Small	North Coast	1	BLDG	BLDG	Office	1.16
CEC003	Office	Small	North Coast	1	BLDG	INFIL	Office	0.09
CEC005A	School		North Coast	1	Z1	R1	Classroom	3.03
CEC005A	School		North Coast	1	Z1	I1	Classroom	2.82
CEC005A	School		North Coast	1	BLDG	BLDG	Classroom	2.93
CEC005A	School		North Coast	1	BLDG	INFIL	Classroom	1.45
CEC005B	School		North Coast	1	Z1	R1	Classroom	6.25
CEC005B	School		North Coast	1	Z1	I1	Classroom	8.72
CEC005B	School		North Coast	1	BLDG	BLDG	Classroom	7.49
CEC005B	School		North Coast	1	BLDG	INFIL	Classroom	0.91
CEC005C	Office	Small	North Coast	1	Z1	R1	Office	2.61
CEC005C	Office	Small	North Coast	1	Z1	I1	Office	2.87
CEC005C	Office	Small	North Coast	1	BLDG	BLDG	Office	2.74
CEC005C	Office	Small	North Coast	1	BLDG	INFIL	Office	1.07

CEC Zone Air Change Rates
HVAC System On

Building	Class	Size	Region	Vintage	Zone	Location	Use	Ach
CEC007	School		North Coast	2	Z1	R1	Classroom	1.87
CEC007	School		North Coast	2	Z2	R2	Classroom	2.57
CEC007	School		North Coast	2	Z3	R4	Classroom	1.54
CEC007	School		North Coast	2	Z4	R4	Classroom	3.75
CEC007	School		North Coast	2	Z1	I1	Classroom	1.90
CEC007	School		North Coast	2	Z3	I2	Classroom	1.67
CEC007	School		North Coast	2	BLDG	BLDG	Classroom	2.22
CEC007	School		North Coast	2	BLDG	INFIL	Classroom	0.13
CEC008A	Office	Small	North Coast	2	Z1	I1	Office	0.46
CEC008A	Office	Small	North Coast	2	Z1	I2	Office	0.69
CEC008A	Office	Small	North Coast	2	Z1	I3	Office	1.19
CEC008A	Office	Small	North Coast	2	Z1	I4	Office	0.98
CEC008A	Office	Small	North Coast	2	Z1	I5	Office	1.08
CEC008A	Office	Small	North Coast	2	Z1	I6	Office	1.24
CEC008A	Office	Small	North Coast	2	Z1	I7	Office	1.37
CEC008A	Office	Small	North Coast	2	Z1	I8	Office	1.27
CEC008A	Office	Small	North Coast	2	BLDG	BLDG	Office	1.04
CEC008A	Office	Small	North Coast	2	BLDG	INFIL	Office	0.31
CEC008B	Office	Small	North Coast	1	Z1	I1	Office	0.37
CEC008B	Office	Small	North Coast	1	Z1	I2	Office	0.61
CEC008B	Office	Small	North Coast	1	Z1	I3	Office	0.30
CEC008B	Office	Small	North Coast	1	BLDG	BLDG	Office	0.43
CEC008B	Office	Small	North Coast	1	BLDG	INFIL	Office	0.21

CEC Zone Air Change Rates
HVAC System On

Building	Class	Size	Region	Vintage	Zone	Location	Use	Ach
CEC013	Retail	Small	North Coast	1	Z1	I1	Retail	1.33
CEC013	Retail	Small	North Coast	1	Z1	I2	Retail	1.72
CEC013	Retail	Small	North Coast	1	Z1	I3	Retail	1.22
CEC013	Retail	Small	North Coast	1	BLDG	BLDG	Retail	1.42
CEC013	Retail	Small	North Coast	1	BLDG	INFIL	Retail	1.11
CEC015	Office	Small	North Coast	2	Z1	I1	Office	1.29
CEC015	Office	Small	North Coast	2	Z2	I2	Office	1.19
CEC015	Office	Small	North Coast	2	Z3	I3	Office	0.94
CEC015	Office	Small	North Coast	2	Z4	I4	Office	1.44
CEC015	Office	Small	North Coast	2	Z5	I5	Office	1.07
CEC015	Office	Small	North Coast	2	Z5	I6	Office	1.05
CEC015	Office	Small	North Coast	2	BLDG	BLDG	Office	1.16
CEC015	Office	Small	North Coast	2	BLDG	INFIL	Office	0.41
CEC016	Office	Large	North Coast	1	Z1	R1	Office	1.08
CEC016	Office	Large	North Coast	1	Z1	R2	Office	1.10
CEC016	Office	Large	North Coast	1	Z1	I1	Office	1.20
CEC016	Office	Large	North Coast	1	Z1	I2	Office	1.05
CEC016	Office	Large	North Coast	1	Z1	I3	Office	1.09
CEC016	Office	Large	North Coast	1	Z1	I4	Office	1.05
CEC016	Office	Large	North Coast	1	BLDG	BLDG	Office	1.10
CEC016	Office	Large	North Coast	1	BLDG	INFIL	Office	0.44

CEC Zone Air Change Rates
HVAC System On

Building	Class	Size	Region	Vintage	Zone	Location	Use	Ach
CEC017	Retail	Small	North Coast	1	Z1	I1	Retail	1.76
CEC017	Retail	Small	North Coast	1	Z1	I2	Retail	1.74
CEC017	Retail	Small	North Coast	1	Z1	I3	Retail	1.73
CEC017	Retail	Small	North Coast	1	Z2	I4	Classroom	2.29
CEC017	Retail	Small	North Coast	1	Z2	I5	Classroom	2.80
CEC017	Retail	Small	North Coast	1	Z2	I6	Classroom	2.66
CEC017	Retail	Small	North Coast	1	Z2	I7	Classroom	2.66
CEC017	Retail	Small	North Coast	1	BLDG	BLDG	Retail	2.23
CEC017	Retail	Small	North Coast	1	BLDG	INFIL	Retail	1.18
CEC020	Retail	Large	North Coast	1	Z1	I1	Retail	1.47
CEC020	Retail	Large	North Coast	1	BLDG	BLDG	Retail	1.47
CEC020	Retail	Large	North Coast	1	BLDG	INFIL	Retail	1.47
CEC028A	Retail	Small	North Interior	1	Z1	I1	Retail	3.67
CEC028A	Retail	Small	North Interior	1	BLDG	BLDG	Retail	3.67
CEC028A	Retail	Small	North Interior	1	BLDG	INFIL	Retail	NA
CEC028B	School		North Interior	1	Z1	R1	Classroom	2.80
CEC028B	School		North Interior	1	Z2	R2	Classroom	2.68
CEC028B	School		North Interior	1	Z1	I1	Retail	2.82
CEC028B	School		North Interior	1	Z2	I2	Classroom	2.26
CEC028B	School		North Interior	1	Z2	I3	Classroom	2.68
CEC028B	School		North Interior	1	Z2	I4	Office	2.15
CEC028B	School		North Interior	1	Z2	I5	Classroom	4.38
CEC028B	School		North Interior	1	BLDG	BLDG	Classroom	2.82
CEC028B	School		North Interior	1	BLDG	INFIL	Classroom	NA

CEC Zone Air Change Rates
HVAC System On

Building	Class	Size	Region	Vintage	Zone	Location	Use	Ach
CEC028C	School		North Interior	1	Z1	R1	Classroom	2.85
CEC028C	School		North Interior	1	Z2	R2	Classroom	1.50
CEC028C	School		North Interior	1	Z1	I1	Classroom	2.71
CEC028C	School		North Interior	1	Z1	I2	Classroom	2.81
CEC028C	School		North Interior	1	Z2	I3	Classroom	1.91
CEC028C	School		North Interior	1	Z2	I4	Classroom	2.38
CEC028C	School		North Interior	1	Z2	I5	Classroom	1.61
CEC028C	School		North Interior	1	BLDG	BLDG	Classroom	2.25
CEC028C	School		North Interior	1	BLDG	INFIL	Classroom	NA
CEC0032	School		North Interior	2	Z1	I1	Office	1.69
CEC0032	School		North Interior	2	Z2	I2	Classroom	1.19
CEC0032	School		North Interior	2	Z3	I3	Classroom	1.80
CEC0032	School		North Interior	2	Z4	I4	Classroom	1.84
CEC0032	School		North Interior	2	BLDG	BLDG	Classroom	1.63
CEC0032	School		North Interior	2	BLDG	INFIL	Classroom	0.61
CEC034	School		North Interior	2	Z1	I1	Classroom	0.56
CEC034	School		North Interior	2	BLDG	BLDG	Classroom	0.56
CEC034	School		North Interior	2	BLDG	INFIL	Classroom	0.14
CEC035A	School		North Interior	1	Z1	R1	Classroom	1.71
CEC035A	School		North Interior	1	Z2	R2	Classroom	2.17
CEC035A	School		North Interior	1	Z1	I1	Classroom	1.92
CEC035A	School		North Interior	1	Z2	I2	Classroom	2.57
CEC035A	School		North Interior	1	Z1	I3	Classroom	1.73
CEC035A	School		North Interior	1	Z1	I4	Classroom	1.67
CEC035A	School		North Interior	1	BLDG	BLDG	Classroom	1.96
CEC035A	School		North Interior	1	BLDG	INFIL	Classroom	NA

CEC Zone Air Change Rates
HVAC System On

Building	Class	Size	Region	Vintage	Zone	Location	Use	Ach
CEC035B	Retail	Small	North Interior	1	Z1	R1	Retail	2.83
CEC035B	Retail	Small	North Interior	1	Z2	R2	Retail	2.35
CEC035B	Retail	Small	North Interior	1	Z3	R3	Retail	1.59
CEC035B	Retail	Small	North Interior	1	Z3	I1	Retail	1.94
CEC035B	Retail	Small	North Interior	1	Z2	I2	Retail	2.55
CEC035B	Retail	Small	North Interior	1	Z1	I3	Retail	3.06
CEC035B	Retail	Small	North Interior	1	Z1	I4	Retail	3.49
CEC035B	Retail	Small	North Interior	1	BLDG	BLDG	Retail	2.54
CEC035B	Retail	Small	North Interior	1	BLDG	INFIL	Retail	NA
CEC037A	Retail	Small	North Interior	1	Z1	I1	Office	1.44
CEC037A	Retail	Small	North Interior	1	Z1	I2	Retail	1.86
CEC037A	Retail	Small	North Interior	1	Z1	I3	Office	1.88
CEC037A	Retail	Small	North Interior	1	Z2	I4	Retail	1.98
CEC037A	Retail	Small	North Interior	1	BLDG	BLDG	Retail	1.79
CEC037A	Retail	Small	North Interior	1	BLDG	INFIL	Retail	0.41
CEC037B	Retail	Small	North Interior	2	Z1	I1	Office	2.03
CEC037B	Retail	Small	North Interior	2	Z1	I2	Office	1.92
CEC037B	Retail	Small	North Interior	2	Z2	I3	Office	1.01
CEC037B	Retail	Small	North Interior	2	BLDG	BLDG	Office	1.65
CEC037B	Retail	Small	North Interior	2	BLDG	INFIL	Office	0.66
CEC038A	Office	Small	North Interior	1	Z1	I1	Office	0.57
CEC038A	Office	Small	North Interior	1	BLDG	BLDG	Office	0.57
CEC038A	Office	Small	North Interior	1	BLDG	INFIL	Office	0.27
CEC038B	Office	Small	North Interior	1	Z1	I1	Office	0.55
CEC038B	Office	Small	North Interior	1	BLDG	BLDG	Office	0.55
CEC038B	Office	Small	North Interior	1	BLDG	INFIL	Office	0.31

CEC Zone Air Change Rates
HVAC System On

Building	Class	Size	Region	Vintage	Zone	Location	Use	Ach
CEC038C	Office	Small	North Interior	1	Z1	I1	Office	0.97
CEC038C	Office	Small	North Interior	1	BLDG	BLDG	Office	0.97
CEC038C	Office	Small	North Interior	1	BLDG	INFIL	Office	0.52
CEC043	Retail	Large	North Interior	2	Z1	R1	Office	2.48
CEC043	Retail	Large	North Interior	2	Z1	I1	Office	2.46
CEC043	Retail	Large	North Interior	2	BLDG	BLDG	Office	2.47
CEC043	Retail	Large	North Interior	2	BLDG	INFIL	Office	0.88
CEC045	Retail	Small	North Interior	1	Z1	I1	Retail	5.90
CEC045	Retail	Small	North Interior	1	Z2	I2	Retail	7.48
CEC045	Retail	Small	North Interior	1	Z3	I3	Retail	9.09
CEC045	Retail	Small	North Interior	1	Z4	I4	Retail	7.74
CEC045	Retail	Small	North Interior	1	Z5	I5	Retail	4.63
CEC045	Retail	Small	North Interior	1	BLDG	BLDG	Retail	6.97
CEC045	Retail	Small	North Interior	1	BLDG	INFIL	Retail	NA
CEC050	Retail	Large	South Interior	1	Z1	R1	Retail	1.81
CEC050	Retail	Large	South Interior	1	Z1	R2	Retail	1.73
CEC050	Retail	Large	South Interior	1	Z1	I1	Retail	2.22
CEC050	Retail	Large	South Interior	1	Z1	I2	Retail	2.11
CEC050	Retail	Large	South Interior	1	Z2	I3	Retail	2.03
CEC050	Retail	Large	South Interior	1	Z2	I4	Retail	2.22
CEC050	Retail	Large	South Interior	1	Z3	I5	Retail	1.87
CEC050	Retail	Large	South Interior	1	BLDG	BLDG	Retail	2.00
CEC050	Retail	Large	South Interior	1	BLDG	INFIL	Retail	1.13

CEC Zone Air Change Rates
HVAC System On

Building	Class	Size	Region	Vintage	Zone	Location	Use	Ach
CEC052	Office	Large	South Coast	2	Z1	R1	Office	0.96
CEC052	Office	Large	South Coast	2	Z2	R2	Office	1.11
CEC052	Office	Large	South Coast	2	Z3	R3	Office	0.98
CEC052	Office	Large	South Coast	2	Z4	R4	Office	0.51
CEC052	Office	Large	South Coast	2	Z1	I1	Office	1.23
CEC052	Office	Large	South Coast	2	Z1	I2	Office	1.38
CEC052	Office	Large	South Coast	2	Z2	I3	Office	1.51
CEC052	Office	Large	South Coast	2	Z2	I4	Office	1.13
CEC052	Office	Large	South Coast	2	Z2	I5	Office	1.08
CEC052	Office	Large	South Coast	2	Z2	I6	Office	1.16
CEC052	Office	Large	South Coast	2	Z3	I7	Office	1.44
CEC052	Office	Large	South Coast	2	Z3	I8	Office	1.51
CEC052	Office	Large	South Coast	2	Z3	I9	Office	1.15
CEC052	Office	Large	South Coast	2	Z3	I10	Office	1.42
CEC052	Office	Large	South Coast	2	Z4	I11	Office	0.50
CEC052	Office	Large	South Coast	2	Z4	I12	Office	0.50
CEC052	Office	Large	South Coast	2	Z4	I13	Office	0.55
CEC052	Office	Large	South Coast	2	Z4	I14	Office	0.64
CEC052	Office	Large	South Coast	2	BLDG	BLDG	Office	1.04
CEC052	Office	Large	South Coast	2	BLDG	INFIL	Office	0.64

CEC Zone Air Change Rates
HVAC System On

Building	Class	Size	Region	Vintage	Zone	Location	Use	Ach
CEC056	Office	Small	South Interior	2	Z1	I1	Office	1.04
CEC056	Office	Small	South Interior	2	Z2	I2	Office	1.07
CEC056	Office	Small	South Interior	2	Z3	I3	Office	1.02
CEC056	Office	Small	South Interior	2	Z4	I4	Office	0.92
CEC056	Office	Small	South Interior	2	Z5	I5	Office	0.84
CEC056	Office	Small	South Interior	2	Z6	I6	Office	0.96
CEC056	Office	Small	South Interior	2	BLDG	BLDG	Office	0.98
CEC056	Office	Small	South Interior	2	BLDG	INFIL	Office	0.07
CEC057A	School		South Interior	1	Z1	I1	Classroom	1.21
CEC057A	School		South Interior	1	Z2	I2	Classroom	0.76
CEC057A	School		South Interior	1	Z3	I3	Classroom	1.48
CEC057A	School		South Interior	1	Z4	I4	Classroom	1.61
CEC057A	School		South Interior	1	Z5	I5	Office	1.63
CEC057A	School		South Interior	1	BLDG	BLDG	Classroom	1.34
CEC057A	School		South Interior	1	BLDG	INFIL	Classroom	0.06
CEC057B	Office	Small	South Interior	2	Z1	I1	Office	0.86
CEC057B	Office	Small	South Interior	2	Z2	I2	Office	0.93
CEC057B	Office	Small	South Interior	2	Z3	I3	Classroom	1.36
CEC057B	Office	Small	South Interior	2	BLDG	BLDG	Office	1.05
CEC057B	Office	Small	South Interior	2	BLDG	INFIL	Office	0.22

CEC Zone Air Change Rates
HVAC System On

Building	Class	Size	Region	Vintage	Zone	Location	Use	Ach
CEC064	School		South Coast	1	Z1	I1	Classroom	1.23
CEC064	School		South Coast	1	Z2	I2	Classroom	1.23
CEC064	School		South Coast	1	Z3	I3	Classroom	1.46
CEC064	School		South Coast	1	Z4	I4	Classroom	1.33
CEC064	School		South Coast	1	Z5	I5	Classroom	0.80
CEC064	School		South Coast	1	Z6	I6	Classroom	0.74
CEC064	School		South Coast	1	Z7	I7	Office	1.63
CEC064	School		South Coast	1	BLDG	BLDG	Classroom	1.20
CEC064	School		South Coast	1	BLDG	INFIL	Classroom	0.26
CEC065A	Office	Small	South Coast	2	Z1	I1	Office	2.14
CEC065A	Office	Small	South Coast	2	Z2	I2	Office	2.09
CEC065A	Office	Small	South Coast	2	Z3	I3	Office	2.26
CEC065A	Office	Small	South Coast	2	Z4	I4	Office	1.88
CEC065A	Office	Small	South Coast	2	Z5	I5	Office	3.12
CEC065A	Office	Small	South Coast	2	Z6	I6	Office	2.77
CEC065A	Office	Small	South Coast	2	Z7	I7	Office	2.09
CEC065A	Office	Small	South Coast	2	BLDG	BLDG	Office	2.34
CEC065A	Office	Small	South Coast	2	BLDG	INFIL	Office	0.30
CEC065B	School		South Coast	1	Z1	I1	Classroom	5.03
CEC065B	School		South Coast	1	Z2	I2	Classroom	1.58
CEC065B	School		South Coast	1	Z3	I3	Classroom	2.29
CEC065B	School		South Coast	1	Z4	I4	Classroom	2.53
CEC065B	School		South Coast	1	Z5	I5	Classroom	2.40
CEC065B	School		South Coast	1	Z6	I6	Classroom	2.71
CEC065B	School		South Coast	1	BLDG	BLDG	Classroom	2.76
CEC065B	School		South Coast	1	BLDG	INFIL	Classroom	0.53

CEC Zone Air Change Rates
HVAC System On

Building	Class	Size	Region	Vintage	Zone	Location	Use	Ach
CEC070	Retail	Small	South Coast	1	Z1	I1	Classroom	4.97
CEC070	Retail	Small	South Coast	1	Z1	I2	Classroom	1.23
CEC070	Retail	Small	South Coast	1	Z1	I3	Office	1.27
CEC070	Retail	Small	South Coast	1	Z1	I4	Office	1.69
CEC070	Retail	Small	South Coast	1	BLDG	BLDG	Office	1.40
CEC070	Retail	Small	South Coast	1	BLDG	INFIL	Office	1.35
CEC078A	Office	Small	South Coast	2	Z1	I1	Office	0.36
CEC078A	Office	Small	South Coast	2	Z1	I2	Office	0.40
CEC078A	Office	Small	South Coast	2	Z1	I3	Office	0.17
CEC078A	Office	Small	South Coast	2	Z1	I4	Office	0.34
CEC078A	Office	Small	South Coast	2	Z1	I5	Office	0.36
CEC078A	Office	Small	South Coast	2	Z1	I6	Office	0.41
CEC078A	Office	Small	South Coast	2	Z1	I7	Office	0.44
CEC078A	Office	Small	South Coast	2	Z2	I8	Office	0.30
CEC078A	Office	Small	South Coast	2	BLDG	BLDG	Office	0.34
CEC078A	Office	Small	South Coast	2	BLDG	INFIL	Office	NA
CEC078B	School		South Coast	2	Z1	I1	Classroom	1.15
CEC078B	School		South Coast	2	Z2	I2	Classroom	1.34
CEC078B	School		South Coast	2	Z3	I3	Classroom	1.27
CEC078B	School		South Coast	2	Z4	I4	Classroom	2.33
CEC078B	School		South Coast	2	Z5	I5	Classroom	2.27
CEC078B	School		South Coast	2	Z6	I6	Classroom	2.76
CEC078B	School		South Coast	2	BLDG	BLDG	Classroom	1.85
CEC078B	School		South Coast	2	BLDG	INFIL	Classroom	0.10

CEC Zone Air Change Rates
HVAC System On

Building	Class	Size	Region	Vintage	Zone	Location	Use	Ach
CEC079A	School		South Interior	2	Z1	I1	Classroom	0.98
CEC079A	School		South Interior	2	Z2	I2	Classroom	1.22
CEC079A	School		South Interior	2	Z3	I3	Classroom	3.70
CEC079A	School		South Interior	2	Z4	I4	Classroom	3.23
CEC079A	School		South Interior	2	Z5	I5	Classroom	2.26
CEC079A	School		South Interior	2	Z6	I6	Classroom	2.53
CEC079A	School		South Interior	2	BLDG	BLDG	Classroom	2.32
CEC079A	School		South Interior	2	BLDG	INFIL	Classroom	0.38
CEC079B	Office	Small	South Interior	2	Z1	I1	Office	1.52
CEC079B	Office	Small	South Interior	2	Z2	I2	Office	1.47
CEC079B	Office	Small	South Interior	2	Z3	I3	Office	1.53
CEC079B	Office	Small	South Interior	2	Z4	I4	Office	1.70
CEC079B	Office	Small	South Interior	2	Z5	I5	Office	1.50
CEC079B	Office	Small	South Interior	2	Z6	I6	Office	1.49
CEC079B	Office	Small	South Interior	2	Z7	I7	Office	1.66
CEC079B	Office	Small	South Interior	2	Z8	I8	Office	4.73
CEC079B	Office	Small	South Interior	2	BLDG	BLDG	Office	1.55
CEC079B	Office	Small	South Interior	2	BLDG	INFIL	Office	0.12
CEC079C	Office	Small	South Interior	1	Z1	I1	Office	1.38
CEC079C	Office	Small	South Interior	1	Z1	I2	Office	1.43
CEC079C	Office	Small	South Interior	1	Z1	I3	Office	1.42
CEC079C	Office	Small	South Interior	1	Z2	I4	Office	1.08
CEC079C	Office	Small	South Interior	1	Z3	I5	Office	2.84
CEC079C	Office	Small	South Interior	1	BLDG	BLDG	Office	1.63
CEC079C	Office	Small	South Interior	1	BLDG	INFIL	Office	0.21

CEC Zone Air Change Rates
HVAC System On

Building	Class	Size	Region	Vintage	Zone	Location	Use	Ach
CEC079D	School		South Interior	1	Z1	I1	Classroom	2.87
CEC079D	School		South Interior	1	Z1	I2	Classroom	2.83
CEC079D	School		South Interior	1	Z1	I3	Classroom	2.93
CEC079D	School		South Interior	1	Z1	I4	Classroom	3.03
CEC079D	School		South Interior	1	BLDG	BLDG	Classroom	2.92
CEC079D	School		South Interior	1	BLDG	INFIL	Classroom	0.97
CEC089	Office	Small	North Coast	2	Z1	R1	Office	2.93
CEC089	Office	Small	North Coast	2	Z1	I1	Office	2.97
CEC089	Office	Small	North Coast	2	Z1	I2	Office	2.75
CEC089	Office	Small	North Coast	2	Z1	I3	Office	2.52
CEC089	Office	Small	North Coast	2	BLDG	BLDG	Office	2.79
CEC089	Office	Small	North Coast	2	BLDG	INFIL	Office	1.72
CEC090	Office	Large	North Interior	1	Z1	R1	Office	2.64
CEC090	Office	Large	North Interior	1	Z1	I1	Office	2.93
CEC090	Office	Large	North Interior	1	Z1	I2	Office	2.45
CEC090	Office	Large	North Interior	1	BLDG	BLDG	Office	2.67
CEC090	Office	Large	North Interior	1	BLDG	INFIL	Office	NA

CEC Zone Air Change Rates
HVAC System On

Building	Class	Size	Region	Vintage	Zone	Location	Use	Ach
CEC097	Retail	Large	South Interior	2	Z1	I1	Retail	1.00
CEC097	Retail	Large	South Interior	2	Z2	I2	Retail	0.82
CEC097	Retail	Large	South Interior	2	Z3	I3	Retail	0.87
CEC097	Retail	Large	South Interior	2	Z4	I4	Retail	0.80
CEC097	Retail	Large	South Interior	2	Z5	I5	Retail	0.63
CEC097	Retail	Large	South Interior	2	Z6	I6	Retail	0.69
CEC097	Retail	Large	South Interior	2	Z7	I7	Retail	0.77
CEC097	Retail	Large	South Interior	2	Z8	I8	Retail	0.84
CEC097	Retail	Large	South Interior	2	BLDG	BLDG	Retail	0.77
CEC097	Retail	Large	South Interior	2	BLDG	INFIL	Retail	NA
CEC098	Retail	Large	South Coast	2	Z1	I1	Retail	0.61
CEC098	Retail	Large	South Coast	2	Z2	I2	Retail	0.49
CEC098	Retail	Large	South Coast	2	Z3	I3	Retail	0.42
CEC098	Retail	Large	South Coast	2	Z4	I4	Retail	0.44
CEC098	Retail	Large	South Coast	2	Z5	I5	Retail	0.59
CEC098	Retail	Large	South Coast	2	Z6	I6	Retail	0.50
CEC098	Retail	Large	South Coast	2	Z7	I7	Retail	0.44
CEC098	Retail	Large	South Coast	2	Z8	I8	Retail	0.47
CEC098	Retail	Large	South Coast	2	BLDG	BLDG	Retail	0.50
CEC098	Retail	Large	South Coast	2	BLDG	INFIL	Retail	NA

CEC Zone Air Change Rates
HVAC System On

Building	Class	Size	Region	Vintage	Zone	Location	Use	Ach
CEC100	Office	Small	South Interior	1	Z1	I1	Office	1.36
CEC100	Office	Small	South Interior	1	Z2	I2	Office	1.70
CEC100	Office	Small	South Interior	1	Z3	I3	Office	1.74
CEC100	Office	Small	South Interior	1	Z4	I4	Office	1.38
CEC100	Office	Small	South Interior	1	Z5	I5	Office	2.26
CEC100	Office	Small	South Interior	1	Z6	I6	Office	2.26
CEC100	Office	Small	South Interior	1	Z7	I7	Office	1.70
CEC100	Office	Small	South Interior	1	Z8	I8	Retail	1.55
CEC100	Office	Small	South Interior	1	BLDG	BLDG	Retail	1.74
CEC100	Office	Small	South Interior	1	BLDG	INFIL	Retail	1.04
CEC101	Office	Large	South Interior	2	Z1	I1	Retail	2.47
CEC101	Office	Large	South Interior	2	Z2	I2	Office	1.78
CEC101	Office	Large	South Interior	2	BLDG	BLDG	Office	2.02
CEC101	Office	Large	South Interior	2	BLDG	INFIL	Office	0.35
CEC102	Office	Large	South Coast	2	Z1	R1	Office	0.65
CEC102	Office	Large	South Coast	2	Z2	R2	Office	0.74
CEC102	Office	Large	South Coast	2	Z3	R3	Office	0.71
CEC102	Office	Large	South Coast	2	Z4	R4	Office	0.63
CEC102	Office	Large	South Coast	2	BLDG	BLDG	Office	0.68
CEC102	Office	Large	South Coast	2	BLDG	INFIL	Office	0.28

CEC Zone Air Change Rates
HVAC System On

Building	Class	Size	Region	Vintage	Zone	Location	Use	Ach
CEC103	Office	Large	South Coast	2	Z1	I2	Office	1.33
CEC103	Office	Large	South Coast	2	Z2	I3	Office	1.10
CEC103	Office	Large	South Coast	2	Z2	I4	Office	1.08
CEC103	Office	Large	South Coast	2	Z3	I5	Office	0.93
CEC103	Office	Large	South Coast	2	Z3	I6	Office	0.92
CEC103	Office	Large	South Coast	2	Z4	I7	Office	1.11
CEC103	Office	Large	South Coast	2	Z4	I8	Office	1.07
CEC103	Office	Large	South Coast	2	BLDG	BLDG	Office	1.08
CEC103	Office	Large	South Coast	2	BLDG	INFIL	Office	0.09