

Technical Report 1

ASHRAE Standards 62.1
& 90.1 Evaluations

Glen Burnie High School: Buildings D, E & F Glen Burnie, MD



Wade Myers; BAE Mechanical Option

Thesis Advisor: William Bahnfleth

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Table of Contents

Executive Summary.....	3
ASHRAE Standard 62.1 Section 5 Evaluation	4
Section 5.1: Natural Ventilation.....	4
Section 5.2: Ventilation Air Distribution	4
Section 5.3: Exhaust Duct Location	4
Section 5.4: Ventilation System Controls.....	4
Section 5.5: Airstream Surfaces	4
Section 5.6: Outdoor Air Intakes.....	4
Section 5.7: Local Capture of Contaminants.....	4
Section 5.8: Combustion Air.....	4
Section 5.9: Particulate Matter Removal.....	4
Section 5.10: Dehumidification Systems.....	5
Section 5.11: Drain Pans	5
Section 5.12: Finned-Tube Coils and Heat Exchangers	5
Section 5.13: Humidifiers and Water-Spray Systems	5
Section 5.14: Access for Inspection, Cleaning, and Maintenance	5
Section 5.15: Building Envelope and Interior Surfaces	5
Section 5.16: Buildings with Attached Parking Garages	5
Section 5.17: Air Classification and Recirculation	5
Section 5.18: Requirements for Buildings Containing ETS Areas and ETS-Free Areas.....	5
ASHRAE Standard 62.1 Section 6 Evaluation	6
Section 6: Ventilation Rate Calculation Procedure	6
Section 6 Conclusion:	7
ASHRAE Standard 90.1 Evaluation	8
Section 5: Building Envelope	8
Section 5.1.4: Climate	8
Section 5.2: Compliance Paths.....	8
Section 5.4: Mandatory Provisions	9
Section 5.5: Prescriptive Building Envelope Option.....	9

Section 6: Heating, Ventilating, and Air Conditioning.....	10
Section 6.2: Compliance Paths.....	10
Section 6.4: Mandatory Provisions	10
Section 6.5: Prescriptive Path	10
Section 6.7: Submittals.....	11
Section 6.8: Minimum Equipment Efficiency Tables.....	11
Section 7: Service Water Heating.....	12
Section 7.4: Mandatory Provisions	12
Section 7.8: Performance Requirements for Water Heating Equipment	12
Section 8: Power	13
Section 9: Lighting.....	13
Standard 90.1 Conclusion:	13
References:	14
Appendix:	15

Executive Summary

Glen Burnie High School is a campus style high school located in Glen Burnie, MD. The campus is comprised of 6 buildings, but for the purposes of this report, only Buildings D, E & F will be evaluated. Each building was checked for compliance with sections 5 and 6 of ASHRAE Standard 62.1; Ventilation for Acceptable Indoor Air Quality, as well as ASHRAE Standard 90.1; Energy Standard for Buildings Except Low-Rise Residential Buildings.

Section 5 of Standard 62.1 focuses on the basics of mechanical systems and equipment found in buildings. It touches on such topics as ventilation requirements, air classification and filtration, dehumidification and condensate removal, and the building envelope, among others. All three buildings were found to be completely compliant with section 5.

The next section evaluated was section 6. This section states the requirements for the minimum amount of outdoor air that must be supplied to buildings based on occupancy, occupancy type, and square footage. After performing the calculations it was found that the majority of the systems within Glen Burnie High School are compliant. There were only four systems that fell slightly short of the baseline, but this was found to be caused by the assumptions made during the calculations. The systems in Building D were combined into a single larger system for the calculations, causing the critical system in the spreadsheets to affect the results of all the systems. This does not actually occur because the systems are independent. Two other systems were under due to changes in taking place in the occupancy type of some of the rooms. The third system, which serves the gymnasium and locker rooms of Building F, has higher required outdoor air rates than are actually needed because of overlapping occupancy times which would not occur during normal building operation. It is assumed that once the changes to the floor plans are completed and the occupancy overlap is taken into consideration, more accurate assumptions will be able to be made and the systems should correct themselves.

Standard 90.1 discusses the required performance and energy efficiencies for buildings. The multiple sections contain information about the climate, a more detailed look at the building envelope, HVAC equipment efficiencies, power, and lighting. The three buildings had their highest rate of non-compliance in this section. The areas that failed were building construction U-Values, and lighting power densities. These failures occurred because the buildings were originally built well before this standard went into effect. Ultimately, this makes the building exempt from many of the sections of the standard, but there were still areas that Glen Burnie High School managed to comply with. Because the buildings are in the process of a mechanical renovation, the new HVAC equipment is completely compliant with the standards. Another point to note is that the recently installed glazing units meet the specifications of the standard as well. Based on these observations, it is safe to assume that as more renovations take place, the buildings will become more compliant to the standard.

ASHRAE Standard 62.1 Section 5 Evaluation

Section 5.1: Natural Ventilation

Glen Burnie High School does not utilize natural ventilation. All ventilation is provided by the cooling/heating system.

Section 5.2: Ventilation Air Distribution

The systems in place are all installed with adjustable outdoor air intakes to modulate the amount of ventilation air supplied to the spaces. The plenums are not used to distribute ventilation air, so the system itself is responsible for distributing the ventilation air evenly to the spaces.

Section 5.3: Exhaust Duct Location

Exhaust ducts are only run through the areas that they are exhausting, and the specs require that all ducts must comply with SMACNA construction standards.

Section 5.4: Ventilation System Controls

All unit ventilators, air handling units, fan coil units, and other ventilating equipment in all three buildings are set to be energized and running when in occupied mode by the Building Automation System (BAS). In unoccupied mode, the systems are set to maintain the unoccupied heating/cooling setpoints only.

Section 5.5: Airstream Surfaces

All air-stream surfaces are made of sheet metal making them exempt to this section.

Section 5.6: Outdoor Air Intakes

All outdoor air intakes are installed with bird screens and rain hoods or louvers to prevent unwanted rain infiltration. Minimum clearances from contaminant sources as stated in table 5-1 are also maintained for all intakes.

Section 5.7: Local Capture of Contaminants

There are no contaminants created by non-combustion equipment in Glen Burnie High School, so this section does not apply.

Section 5.8: Combustion Air

The combustion exhaust created by the boilers in Building F is vented directly outdoors by way of their corresponding flues and up through a shared chimney.

Section 5.9: Particulate Matter Removal

Section 5.9 requires all filters to meet the MERV rating called for in ASHRAE Standard 52.2. The building specs call for the same requirement, so this section is met.

Section 5.10: Dehumidification Systems

The systems are designed to maintain relative humidity at 50% which meets the requirement of 65% or less.

Section 5.11: Drain Pans

All drain pans are sized and sloped to meet manufacturer recommendations which adhere to this standard. Fan coil units located in the locker rooms in Building F had a need for the condensate to rise above the units in order to enter the existing drain pipes, so condensate pumps were added that do not interfere with the condensate removal from the drain pans.

Section 5.12: Finned-Tube Coils and Heat Exchangers

Drain pans are provided for condensate producing coils in the same fashion as for section 5.11. There are no coils used in series in the equipment used for Glen Burnie High School, so access to the coils and the resulting pressure drops are not a factor.

Section 5.13: Humidifiers and Water-Spray Systems

Glen Burnie High School does not utilize humidifiers or water-spray systems. This section does not apply.

Section 5.14: Access for Inspection, Cleaning, and Maintenance

All equipment is placed as to provide unobstructed admittance to access doors and other maintenance areas.

Section 5.15: Building Envelope and Interior Surfaces

Sections 15080 and 15083 of the specs state all requirements for the insulation of ducts, pipes, and other interior surfaces as well as the building envelope in order to prevent any unwanted moisture accumulation. These requirements provide compliance to this section.

Section 5.16: Buildings with Attached Parking Garages

This section does not apply as Glen Burnie High School does not have any attached parking garages.

Section 5.17: Air Classification and Recirculation

The majority of air in the buildings of Glen Burnie High School is class 1 air. The only exceptions are from the gymnasium areas, art classrooms and restrooms, which are class 2 air zones, and the janitor's closets and mechanical rooms, which are class 3 air zones. All of this air is exhausted directly out of the building.

Section 5.18: Requirements for Buildings Containing ETS Areas and ETS-Free Areas

Glen Burnie High School is a non-smoking campus so this section does not apply.

ASHRAE Standard 62.1 Section 6 Evaluation

Section 6: Ventilation Rate Calculation Procedure

Section 6 of Standard 62.1 is used to determine the minimum amount of outdoor air that must be supplied to the building. This is calculated based on occupancy, occupancy type, and square footage. Each system in all three buildings was examined, including the individual unit ventilators for Building D and the air handling units in Buildings E and F. The amount of outdoor air was calculated using the following equations:

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

Where,

V_{bz} = Breathing Zone Outdoor Airflow

R_p = Outdoor Airflow Rate per Person (CFM/person)

P_z = Zone Population

R_a = Outdoor Airflow Rate per Unit Area (CFM/SF)

A_z = Zone Floor Area (SF)

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

Where,

V_{oz} = Zone Outdoor Airflow

E_z = Zone Air Distribution Effectiveness

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

Where,

Z_p = Zone Primary Outdoor Air Fraction

V_{pz} = Zone Primary Airflow

$$V_{ou} = D * \sum (R_p * P_z) + \sum (R_a * A_z)$$

Where,

D = Occupant Diversity

$$D = P_s / \sum P_z$$

Where,

P_s = System Population

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

Where,

V_{ot} = Outdoor Air Intake Flow

All of the spreadsheets showing the calculations for these systems can be found in the appendix at the end of this report.

Section 6 Conclusion:

Outdoor Airflow Rates			
Building/System	Design OA	Minimum Required OA	Compliance
Building D/UVs	9700	10483	NO
Building E/AHU-1	2000	480	YES
Building E/AHU-2	2800	1344	YES
Building E/AHU-3	2000	510	YES
Building E/AHU-4 & 5	6000	2765	YES
Building E/AHU-6	2500	28	YES
Building E/AHU-7	350	137	YES
Building E/AHU-8	100	110	NO
Building E/AHU-9	1300	518	YES
Building F/AHU-1	5600	5799	NO
Building F/AHU-2	5850	5608	YES
Building F/AHU-3 & 4	2140	2261	NO
Building F/AHU-5	950	391	YES

Table 1

There are only four zones/systems that do not comply with Standard 62.1. Because the variance between the design and required airflows is minimal, it can be reasonably determined that the cause is due to the assumptions that were made during the calculations. All assumptions for occupancy were made based on the type of room, instead of the actual occupancies that occur in the building as these are not known.

The likely reason for the shortage of outdoor air supplied to Building D stems from combining all of the systems into one large system in the spreadsheets. This would cause the critical system to effect the required OA of all of the systems, when in fact, each system is critical only to itself since they are all independent from one another.

AHU-8 in Building E was designed to serve a space that is being converted and has not been fully laid out yet. This led to an assumption for the occupancy of the space, which will change when the actual design conditions are known. Building F/AHU-1 is also non-compliant by a small margin. Like in Building E, there are spaces in Building F that have not yet been fully identified as to their occupancy. Once again, when these assumptions are made more accurate, the difference in OA supply should correct itself.

The gym in Building F is served by AHU-3 and AHU-4 which also supply air to the locker rooms on either side of the gym. The slight difference in outdoor air can be attributed to the occupancy estimates used. For the purpose of the calculation, it is assumed that each space has occupants in it at the same time. However this is not true, as the locker rooms are only occupied right before and right after the gym becomes occupied during normal operating hours for the building.

ASHRAE Standard 90.1 Evaluation

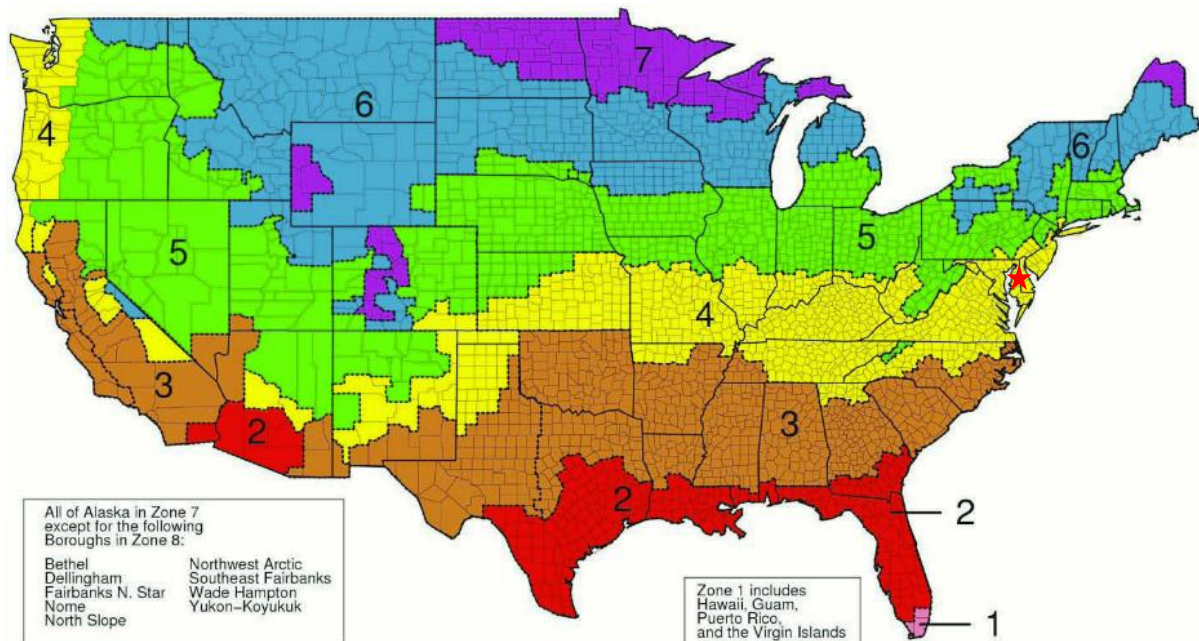
Standard 90.1 provides requirements for the energy-efficient design of buildings, except low-rise residential buildings. In this evaluation, the compliance of Buildings D, E & F will be checked and analyzed to determine why compliance does or does not occur.

Section 5: Building Envelope

Section 5 specifies requirements for the building envelope.

Section 5.1.4: Climate

Glen Burnie High School is located in Glen Burnie, MD, marked on the map below, and falls into climate zone 4a.



Section 5.2: Compliance Paths

Glen Burnie High School's fenestration percentages are as follows:

Fenestration Percentages		
Building	Vertical Fenestration %	Skylight Fenestration %
Building D	6	0
Building E	12	0
Building F	12	0

Table 2

Because these are less than the maximum allowable 40% for vertical and 5% for skylight, all three buildings can be evaluated using the Prescriptive Building Envelope Option.

Section 5.4: Mandatory Provisions

According to section 5.4, air leakage must be controlled, using various means, in the following areas:

- Joints around fenestration and door frames
- Junctions between walls and foundations, building corners, floors, and roofs
- Openings at utility service penetrations
- Building assemblies used as ducts or plenums
- Joints, seams, and penetrations of vapor retarders
- All other openings in the building envelope

The mandatory provisions also call for vestibules at building entrances to separate the exterior from the conditioned spaces of the building. Buildings D, E & F all comply with this provision by supplying vestibules with self-closing doors at the intended building entrances. The entrances have also been constructed with the required 7 feet of separation between the door sets so it is not required to have both sets of doors open at the same time.

Section 5.5: Prescriptive Building Envelope Option

Section 5.5 details the requirements for the building envelope U-Values. Table 3 shows the compliance of the different construction components used in the buildings.

Building Construction U-Values			
Building Component	Actual U-Value	Maximum Allowable U-Value	Compliance
Roof	0.21	0.048	NO
Walls	0.11	0.104	NO
Floors	0.21	0.087	NO
Slab-On-Grade Floors	0.21	0.86	YES
Vertical Glazing	1.04/.5	0.5	NO

Table 3

The buildings only meet the requirements for the slab-on-grade floors. However, the regular floor slabs should also be acceptable because they separate conditioned spaces. As for the roof and walls, these components are allowed to not meet the requirements because the buildings were originally built before this standard came into effect. The recently installed glazing units that were installed during a partial window replacement do meet the standard, but the remaining original windows do not. Again, this is because they were installed before this standard came into effect.

Section 6: Heating, Ventilating, and Air Conditioning

This section of the standard states requirements for the HVAC system of the building, including efficiency and controls.

Section 6.2: Compliance Paths

Glen Burnie High School must follow Section 6.4: Mandatory Provisions, and Section 6.5: Prescriptive Path. This is because the total size of the buildings exceeds the maximum limit of 25,000 square feet allowed to use the Simplified Approach Option for HVAC Systems.

Section 6.4: Mandatory Provisions

The buildings of Glen Burnie High School are controlled by a BAS which puts the systems into a setback mode during unoccupied times. These unoccupied times occur after school hours and during the weekend. There is also a varied schedule for summer operation. In addition, it is required that all equipment that is not covered by the U.S. NAECA of 1987 must have manufacturer labels stating that the equipment is compliant with Standard 90.1.

Section 6.5: Prescriptive Path

Section 6.5 states that buildings in climate zone 4a are required to have an air-side economizer regardless of system size. Each of the buildings have air-side economizers in place acting to reduce the load on the systems, so this requirement is met.

Standard 90.1 also has limits for the maximum allowable fan motor HP based on CFM. For a constant volume system, the allowable HP is determined by the equation: $HP < CFM * .0011$. Variable volume systems are based on the equation: $HP < CFM * .0015$.

Building D uses several unit ventilators, but there are only 5 different airflow levels. Because the UV's are all constant volume, the first equation is used to calculate maximum HP. Table 4 provides the compliance with 90.1's limits for each of the airflows.

Building D Fan Motor Compliance			
Supply CFM	Fan Motor HP	Maximum Allowable HP	Compliance
1500	1/4	1.65	YES
1250	1/4	1.375	YES
1160	1/4	1.28	YES
1000	1/4	1.1	YES
750	1/4	0.83	YES

Table 4

Building E is served by another constant volume system consisting of AHU's and a single unit ventilator. The first equation is used again to calculate compliance and the results can be seen in Table 5.

Building E Fan Motor Compliance			
Supply CFM	Fan Motor HP	Maximum Allowable HP	Compliance
7200	10	7.92	YES*
2800	5	3.08	YES*
2500	3	2.75	YES*
2000 - AHU	3	2.2	YES*
2000 - UV	1/3	2.2	YES
1300	1	1.43	YES
900	3/4	0.99	YES

Table 5

Building F utilizes AHU's, an RTU, and 2 FCU's in the only variable volume system of the three buildings. This means that its compliance is calculated using the second equation. The results of these calculations can be found in Table 6.

Building F Fan Motor Compliance			
Supply CFM	Fan Motor HP	Maximum Allowable HP	Compliance
17300	15	25.95	YES
15300	15	22.95	YES
5250	5	7.88	YES
3800	2	5.7	YES
2360	1	3.54	YES

Table 6

Based on these calculations, all three buildings have compliant fan motors. Building E is able to pass based on the exceptions that for fans less than 6 HP, the next available motor size may be used if it is within 50% of the allowable; and fans greater than 6 HP can use the next available if it is within 30% of the allowable.

Section 6.7: Submittals

This section calls for the submission of record drawings and operation manuals within 90 days of construction completion. System balancing and commissioning is also required to be completed. This is satisfied because balancing reports and record drawings are due upon project completion.

Section 6.8: Minimum Equipment Efficiency Tables

According to the equipment submittal, the chiller that is being installed for Building E has a COP of 2.8, this meets the requirement of standard 90.1 exactly since the minimum allowable COP is also 2.8.

The boiler being installed in Building F also meets the efficiency requirements of Standard 90.1. Its product submittal states an efficiency of 81% which exceeds the required minimum efficiency of at least 80%.

Section 7: Service Water Heating

Section 7 states the requirements of service water heating systems in buildings.

Section 7.4: Mandatory Provisions

According to this section, all equipment must comply with the criteria set forth in section 7.8. The system must also be controlled to allow the temperature of the water in storage to be adjusted from 120 degrees F or lower to the desired level. This section also sets limits on the maximum temperature allowed to be delivered from lavatory sinks. As stated earlier, the buildings are all controlled by a BAS which controls the domestic water heaters and expansion tanks.

Section 7.8: Performance Requirements for Water Heating Equipment

Table 7.8 of the standard contains the equations used to calculate the minimum required performance of water heating equipment. Electric water heaters with an input greater than 12kW must use the following equation:

$$20+35*(V)^{.5}$$

Where:

V = Water Heater Capacity

If the electric water heater has an input less than 12kW, the following equation is used:

$$.93-.00132*V$$

Where:

V = Water Heater Capacity

A 225 gallon and 50 gallon water heater will be installed to provide domestic hot water. The 225 gallon water heater has an input of 27 kW so the first equation is used to calculate its minimum required performance while the 50 gallon water heater uses the second equation because its input is only 10 kW. Table 7 provides the required performances for the water heaters.

Water Heater Performance		
Capacity (gal)	Minimum Required Performance	Compliance
225	545 SL	YES
50	.86 EF	YES

Table 7

The 225 gallon water heater is designed for a 100°F temperature rise and the 50 gallon water heater provides a 60°F temperature rise. This is the only information stated in the schedules, but the equipment submittals state that both water heaters are 90.1 compliant.

Section 8: Power

Section 8 states that feeders are allowed a maximum voltage drop of 2% at design load and branch circuits are allowed a maximum voltage drop of 3% at design load. According to the spec, the maximum allowable voltage drop is 5% total which meets the requirements of this section. Section 8 also requires the same submittal requirements as mentioned earlier in this report, so these are already satisfied.

Section 9: Lighting

Using the Building Area Method Compliance Path, the lighting power densities were calculated for the buildings of Glen Burnie High School. Table 8 shows the calculated compliances.

Lighting Power Densities			
Building	Actual W/SF	Maximum Allowed W/SF	Compliance
Building D	1.5	1.2	NO
Building E	1.5	1.2	NO
Building F	1.5	1.2	NO

Table 8

Once again, there is a problem with compliance, but this is due to the buildings being originally constructed before the standard took effect. This results in exemption from the standard for the buildings lighting power densities.

Standard 90.1 Conclusion:

Glen Burnie High School does have problems with compliance to the construction aspects of the 2007 standard, but this is because the building was constructed well before these codes took effect. The new mechanical system that is being installed has a 100% rate of success in meeting the current standards. Also, while the original building construction materials failed, the recently installed windows did not. Based on these findings, it is safe to assume that as more renovations take place to the buildings, the construction materials will have higher compliance rates with the standard.

References:

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

ASHRAE. 2007, ANSI/ASHRAE, Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings. American Society of Heating Refrigeration and Air-Conditioning Engineers, Inc., Atlanta, GA.

Bid Documents and Project Specifications for Glen Burnie High School Buildings D, E & F

Appendix:

The following appendix contains the spreadsheets used to calculate the minimum required outdoor airflows for each building's system. In order to calculate this, the square footage, occupancy, and supply airflow of each room had to be entered into the table. In this appendix you will also find the individual Z_p values as well as the max Z_p for each system.

Building:	GBHS Building D
System Tag/Name:	Unit Ventilators
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	20,748
Population of area served by system (including diversity)	Ps	P	597
Design primary supply fan airflow rate	Vpsd	cfm	43,070
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.14
OA req'd per person for system area (Weighted average)	Rps	cfm/p	10.0

Inputs for Potentially Critical zones				Kiln	Crafts	Art	Sculpture	General Art	Acting Arts	Speech
Zone Name	<i>Zone title turns purple italic for critical zone(s)</i>			100	104	121	127	130	203	204
Zone Tag				Wood/metal shop	Art Classroom	Art Classroom	Art Classroom	Art classroom	Classrooms (age 9 plus)	Classrooms (age 9 plus)
Space type	Select from pull-down list									
Floor Area of zone	Az	sf		115	1320	3030	1575	1500	744	800
Design population of zone	Pz	P	(default value listed; may be overridden)	0	40	40	43	35	30	30
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm		750	3000	4500	2000	3000	2000	2000
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	Select from pull-down list or leave blank if N/A									
Local recirc. air % representative of ave system return air	Er									

Inputs for Operating Condition Analyzed										
Percent of total design airflow rate at conditioned analyzed	Ds	%		100%	100%	100%	100%	100%	100%	100%
Air distribution type at conditioned analyzed	Select from pull-down list			CS	CS	CS	CS	CS	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez			1.00	1.00	1.00	1.00	1.00	1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep									

Results				
Ventilation System Efficiency	Ev			0.85
Outdoor air intake required for system	Vot	cfm		10483
Outdoor air per unit floor area	Vot/As	cfm/sf		0.51
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p		17.6
Outdoor air as a % of design primary supply air	Ypd	cfm		24%

Detailed Calculations												
Initial Calculations for the System as a whole												
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	43070						
Uncorrected OA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	8912						
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	=	0.21						
Initial Calculations for individual zones												
OA rate per unit area for zone	Raz	cfm/sf				0.18	0.18	0.18	0.18	0.18	0.12	0.12
OA rate per person	Rpz	cfm/p				10.00	10.00	10.00	10.00	10.00	10.00	10.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm				750	3000	4500	2000	3000	2000	2000
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=	20.7	637.6	945.4	713.5	620.0	389.3	396.0
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=	21	638	945	714	620	389	396
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	=	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	=	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	=	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	=	0.03	0.21	0.21	0.36	0.21	0.19	0.20
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=	0.03	0.21	0.21	0.36	0.21	0.19	0.20
System Ventilation Efficiency												
Zone Ventilation Efficiency (App A Method)	Evz		=	(Fa + FbXs - FcZ) / Fa	=	1.18	0.99	1.00	0.85	1.00	1.01	1.01
System Ventilation Efficiency (App A Method)	Ev		=	min (Evz)	=	0.85						
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	0.79						
Minimum outdoor air intake airflow												
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	10483						
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	0.24						
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	11235						
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	0.26						
OA Temp at which Min OA provides all cooling												
OAT below which OA Intake flow is @ minimum	Deg F		=	((Tp-dTsf)-(1-Y))*(Tr+dTr	=	2						

Building:	GBHS Building D
System Tag/Name:	Unit Ventilators
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	20,748
Population of area served by system (including diversity)	Ps	P	597
Design primary supply fan airflow rate	Vpsd	cfm	43,070
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.14
OA req'd per person for system area (Weighted average)	Rps	cfm/p	10.0

Inputs for Potentially Critical Zones		Potentially Critical Zones						
Zone Name	Zone title turns purple italic for critical zone(s)	Speech	Acting Arts	Acting Arts	Com & GPX Arts	Finishing	English	English
Zone Tag		205	206	219	223	224	300	301
Space type	Select from pull-down list	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)
Floor Area of zone	Az sf	675	2745	936	1320	170	384	720
Design population of zone	Pz P (default value listed; may be overridden)	25	60	35	40	5	20	35
Design total supply to zone (primary plus local recirculated)	Vdzd cfm	2320	3750	2000	3000	750	1250	1500
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	Er Select from pull-down list or leave blank if N/A							
Local recirc. air % representative of ave system return air	Er							

Inputs for Operating Condition Analyzed	Ds	%	100%	100%	100%	100%	100%	100%	100%
Percent of total design airflow rate at conditioned analyzed	Ds	%	100%	100%	100%	100%	100%	100%	100%
Air distribution type at conditioned analyzed	Ez	Select from pull-down list	CS	CS	CS	CS	CS	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ep		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Primary air fraction of supply air at conditioned analyzed									

Results	Ev	0.85
Ventilation System Efficiency	Ev	0.85
Outdoor air intake required for system	Vot cfm	10483
Outdoor air per unit floor area	Vot/As cfm/sf	0.51
Outdoor air per person served by system (including diversity)	Vot/Ps cfm/p	17.6
Outdoor air as a % of design primary supply air	Ypd cfm	24%

Detailed Calculations										
Initial Calculations for the System as a whole										
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	43070				
Uncorrected OA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	8912				
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	=	0.21				
Initial Calculations for individual zones										
OA rate per unit area for zone	Raz	cfm/sf				0.12	0.12	0.12	0.12	0.12
OA rate per person	Rpz	cfm/p				10.00	10.00	10.00	10.00	10.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm				2320	3750	2000	3000	750
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=	331.0	929.4	462.3	558.4	70.4
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=	331	929	462	558	70
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	=	1.00	1.00	1.00	1.00	1.00
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	=	1.00	1.00	1.00	1.00	1.00
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	=	1.00	1.00	1.00	1.00	1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	=	0.14	0.25	0.23	0.19	0.09
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=	0.14	0.25	0.23	0.19	0.09
System Ventilation Efficiency										
Zone Ventilation Efficiency (App A Method)	Evz		=	(Fa + FbXs - FcZ) / Fa	=	1.06	0.96	0.98	1.02	1.11
System Ventilation Efficiency (App A Method)	Ev		=	min (Evz)	=	0.85				
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	0.79				
Minimum outdoor air intake airflow										
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	10483				
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	0.24				
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	11235				
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	0.26				
OA Temp at which Min OA provides all cooling										
OAT below which OA Intake flow is @ minimum	Deg F		=	((Tp-dTsf)-(1-Y))*(Tr+dTr	=	2				

Building:	GBHS Building D
System Tag/Name:	Unit Ventilators
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	20,748
Population of area served by system (including diversity)	Ps	P	597
Design primary supply fan airflow rate	Vpsd	cfm	43,070
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.14
OA req'd per person for system area (Weighted average)	Rps	cfm/p	10.0

Inputs for Potentially Critical zones				Spanish	Foreign Lang	Foreign Lang Lab	Foreign Lang 1 & 2	Foreign Lang Plan	English Faculty
Zone Name	Zone Tag	Space type		302	303	305	306	309	318
Floor Area of zone	Design population of zone	Design total supply to zone (primary plus local recirculated)	Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)
		Select from pull-down list							
Az	Pz	Pz	Er	672	720	1176	1368	208	570
Pz	Pz	P (default value listed; may be overridden)	Er	25	25	40	55	4	10
Vdzd	Vdzd	cfm	Er	1500	1500	3000	3000	1000	1250
Local recirc. air % representative of ave system return air		Select from pull-down list or leave blank if N/A							

Inputs for Operating Condition Analyzed				100%	100%	100%	100%	100%	100%
Percent of total design airflow rate at conditioned analyzed	Air distribution type at conditioned analyzed	Zone air distribution effectiveness at conditioned analyzed	Primary air fraction of supply air at conditioned analyzed	Ds	Ez	Ep			
Ds	Ez	Ep		%	1.00				
				Select from pull-down list	CS				CS
					1.00				1.00

Results			
Ventilation System Efficiency	Ev		0.85
Outdoor air intake required for system	Vot	cfm	10483
Outdoor air per unit floor area	Vot/As	cfm/sf	0.51
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p	17.6
Outdoor air as a % of design primary supply air	Ypd	cfm	24%

Detailed Calculations									
Initial Calculations for the System as a whole									
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	43070			
Uncorrected OA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	8912			
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	=	0.21			
Initial Calculations for individual zones									
OA rate per unit area for zone	Raz	cfm/sf				0.12	0.12	0.12	0.12
OA rate per person	Rpz	cfm/p				10.00	10.00	10.00	10.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm				1500	1500	3000	1000
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=	330.6	336.4	541.1	714.2
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=	331	336	541	714
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	=	1.00	1.00	1.00	1.00
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	=	1.00	1.00	1.00	1.00
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	=	1.00	1.00	1.00	1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	=	0.22	0.22	0.18	0.24
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=	0.22	0.22	0.18	0.24
System Ventilation Efficiency									
Zone Ventilation Efficiency (App A Method)	Evz		=	(Fa + FbXs - FcZ) / Fa	=	0.99	0.98	1.03	0.97
System Ventilation Efficiency (App A Method)	Ev		=	min (Evz)	=	0.85			
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	0.79			
Minimum outdoor air intake airflow									
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	10483			
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	0.24			
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	11235			
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	0.26			
OA Temp at which Min OA provides all cooling									
OAT below which OA Intake flow is @ minimum	Deg F		=	((Tp-dTsf)-(1-Y))*(Tr+dTr	=	2			

Building:	GBHS Building E
System Tag/Name:	AHU-1
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	1599
Population of area served by system (including diversity)	Ps	P	22
Design primary supply fan airflow rate	Vpsd	cfm	1,900
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.19
OA req'd per person for system area (Weighted average)	Rps	cfm/p	5.6

Inputs for Potentially Critical zones	Name	Units	Potentially Critical Zones		
Zone Name	<i>Zone title turns purple italic for critical zone(s)</i>		Shower Rm	Locker Rm	Office
Zone Tag			16	21	26
Space type	Select from pull-down list		Swimming (pool & deck)	Spectator areas	Office space
Floor Area of zone	Az	sf	492	967	140
Design population of zone	Pz	P (default value listed; may be overridden)	5	15	2
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm	700	1000	200
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	Select from pull-down list or leave blank if N/A				
Local recirc. air % representative of ave system return air	Er		75%	75%	75%

Inputs for Operating Condition Analyzed	Name	Units	Value	Shower Rm	Locker Rm	Office
Percent of total design airflow rate at conditioned analyzed	Ds	%	100%	100%	100%	100%
Air distribution type at conditioned analyzed	Select from pull-down list			CS	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez		1.00	1.00	1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep					

Results	Name	Units	Value
Ventilation System Efficiency	Ev		0.89
Outdoor air intake required for system	Vot	cfm	480
Outdoor air per unit floor area	Vot/As	cfm/sf	0.30
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p	21.8
Outdoor air as a % of design primary supply air	Ypd	cfm	25%

Detailed Calculations						
Initial Calculations for the System as a whole						
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	1900
UncorrectedOA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	425
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	=	0.22
Initial Calculations for individual zones						
OA rate per unit area for zone	Raz	cfm/sf				0.48
OA rate per person	Rpz	cfm/p				0.06
Total supply air to zone (at condition being analyzed)	Vdz	cfm				700
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=	236.2
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=	170.5
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	=	236
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	=	171
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	=	1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	=	1.00
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=	0.34
						0.17
						0.09
System Ventilation Efficiency						
Zone Ventilation Efficiency (App A Method)	Evz		=	(Fa + FbXs - FcZ) / Fa	=	0.89
System Ventilation Efficiency (App A Method)	Ev		=	min (Evz)	=	1.05
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	1.13
						0.81
Minimum outdoor air intake airflow						
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	480
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	0.25
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	523
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	0.28
OA Temp at which Min OA provides all cooling						
OAT below which OA Intake flow is @ minimum	Deg F		=	{(Tp-dTsf)-(1-Y)}*(Tr+dTr	=	5

Building:	GBHS Building E
System Tag/Name:	AHU-2
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	2610
Population of area served by system (including diversity)	Ps	P	137
Design primary supply fan airflow rate	Vpsd	cfm	2,800
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.06
OA req'd per person for system area (Weighted average)	Rps	cfm/p	7.4

Inputs for Potentially Critical Zones	Name	Units	System
Zone Name	<i>Zone title turns purple italic for critical zone(s)</i>		
Zone Tag			
Space type	Select from pull-down list		
Floor Area of zone	Az	sf	
Design population of zone	Pz	P (default value listed; may be overridden)	
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm	
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	Select from pull-down list or leave blank if N/A		
Local recirc. air % representative of ave system return air	Er	%	

Potentially Critical Zones						
Coach 2	Coach1	Team 3	Team 1	Team 2	Team 4	Corridor
18B	18A	42	27	28	40	30
Office space	Office space	Spectator areas	Spectator areas	Spectator areas	Spectator areas	Corridors
190	190	282	765	332	451	400
2	2	22	55	26	30	0
125	125	480	840	525	465	240

Inputs for Operating Condition Analyzed	Name	Units	System
Percent of total design airflow rate at conditioned analyzed	Ds	%	100%
Air distribution type at conditioned analyzed	Select from pull-down list		
Zone air distribution effectiveness at conditioned analyzed	Ez		CS
Primary air fraction of supply air at conditioned analyzed	Ep		1.00

100%	100%	100%	100%	100%	100%	100%
CS	CS	CS	CS	CS	CS	CS
1.00	1.00	1.00	1.00	1.00	1.00	1.00

Results	Name	Units	Value
Ventilation System Efficiency	Ev		0.87
Outdoor air intake required for system	Vot	cfm	1344
Outdoor air per unit floor area	Vot/As	cfm/sf	0.51
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p	9.8
Outdoor air as a % of design primary supply air	Ypd	cfm	48%

Detailed Calculations

Initial Calculations for the System as a whole				
Primary supply air flow to system at conditioned analyzed	Vps	cfm	= VpdDs	= 2800
UncorrectedOA requirement for system	Vou	cfm	= Rps Ps + Ras As	= 1174
Uncorrected OA req'd as a fraction of primary SA	Xs		= Vou / Vps	= 0.42

Initial Calculations for individual zones										
OA rate per unit area for zone	Raz	cfm/sf		0.06	0.06	0.06	0.06	0.06	0.06	0.06
OA rate per person	Rpz	cfm/p		5.00	5.00	7.50	7.50	7.50	7.50	0.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm		125	125	480	840	525	465	240
Unused OA req'd to breathing zone	Vbz	cfm	= Rpz Pz + Raz Az	21.4	21.4	181.9	458.4	214.9	252.1	24.0
Unused OA requirement for zone	Voz	cfm	= Vbz/Ez	21	21	182	458	215	252	24
Fraction of zone supply not directly recirc. from zone	Fa		= Ep + (1-Ep)Er	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fraction of zone supply from fully mixed primary air	Fb		= Ep	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fraction of zone OA not directly recirc. from zone	Fc		= 1-(1-Ez)(1-Ep)(1-Er)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Unused OA fraction required in supply air to zone	Zd		= Voz / Vdz	0.17	0.17	0.38	0.55	0.41	0.54	0.10
Unused OA fraction required in primary air to zone	Zp		= Voz / Vpz	0.17	0.17	0.38	0.55	0.41	0.54	0.10

System Ventilation Efficiency										
Zone Ventilation Efficiency (App A Method)	Evz		= (Fa + FbXs - FcZ) / Fa		1.25	1.25	1.04	0.87	1.01	0.88
System Ventilation Efficiency (App A Method)	Ev		= min (Evz)							0.87
Ventilation System Efficiency (Table 6.3 Method)	Ev		= Value from Table 6.3							0.60

Minimum outdoor air intake airflow				
Outdoor Air Intake Flow required to System	Vot	cfm	= Vou / Ev	= 1344
OA intake req'd as a fraction of primary SA	Y		= Vot / Vps	= 0.48
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	= Vou / Ev	= 1943
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		= Vot / Vps	= 0.69

OA Temp at which Min OA provides all cooling			
OAT below which OA Intake flow is @ minimum	Deg F	=	{(Tp-dTsf)-(1-Y)*(Tr+dTr) = 37

Building:	GBHS Building E
System Tag/Name:	AHU-3
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	1550
Population of area served by system (including diversity)	Ps	P	22
Design primary supply fan airflow rate	Vpsd	cfm	1,930
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.19
OA req'd per person for system area (Weighted average)	Rps	cfm/p	5.6

Inputs for Potentially Critical zones	Name	Units	Potentially Critical Zones		
Zone Name	<i>Zone title turns purple italic for critical zone(s)</i>		Shower Rm	Locker Rm	Office
Zone Tag			38	37	35
Space type	Select from pull-down list		Swimming (pool & deck)	Spectator areas	Office space
Floor Area of zone	Az	sf	474	936	140
Design population of zone	Pz	P (default value listed; may be overridden)	5	15	2
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm	565	1000	365
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	Select from pull-down list or leave blank if N/A				
Local recirc. air % representative of ave system return air	Er		75%	75%	75%

Inputs for Operating Condition Analyzed	Name	Units				
Percent of total design airflow rate at conditioned analyzed	Ds	%	100%	100%	100%	100%
Air distribution type at conditioned analyzed	Select from pull-down list		CS	CS	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez		1.00	1.00	1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep					

Results	Name	Units				
Ventilation System Efficiency	Ev		0.81			
Outdoor air intake required for system	Vot	cfm	510			
Outdoor air per unit floor area	Vot/As	cfm/sf	0.33			
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p	23.2			
Outdoor air as a % of design primary supply air	Ypd	cfm	26%			

Detailed Calculations						
Initial Calculations for the System as a whole						
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	1930
UncorrectedOA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	415
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	=	0.21
Initial Calculations for individual zones						
OA rate per unit area for zone	Raz	cfm/sf				0.48
OA rate per person	Rpz	cfm/p				0.06
Total supply air to zone (at condition being analyzed)	Vdz	cfm				565
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=	227.5
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=	168.7
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	=	228
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	=	169
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	=	1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	=	1.00
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=	0.40
						0.17
						0.05
System Ventilation Efficiency						
Zone Ventilation Efficiency (App A Method)	Evz		=	(Fa + FbXs - FcZ) / Fa	=	0.81
System Ventilation Efficiency (App A Method)	Ev		=	min (Evz)	=	1.05
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	1.16
						0.75
Minimum outdoor air intake airflow						
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	510
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	0.26
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	555
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	0.29
OA Temp at which Min OA provides all cooling						
OAT below which OA Intake flow is @ minimum	Deg F		=	{(Tp-dTsf)-(1-Y)}*(Tr+dTr	=	8

Building:	GBHS Building E
System Tag/Name:	AHU-4 & 5
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	9217
Population of area served by system (including diversity)	Ps	P	500
Design primary supply fan airflow rate	Vpsd	cfm	14,400
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.30
OA req'd per person for system area (Weighted average)	Rps	cfm/p	0.0

Inputs for Potentially Critical zones	Zone Name	Zone Tag	Space type	Floor Area of zone	Design population of zone	Design total supply to zone (primary plus local recirculated)	Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	Local recirc. air % representative of ave system return air	Potentially Critical Zones
	<i>Gym</i>	112		9,217	500	14,400			Gym, stadium (play area) Office space

Inputs for Operating Condition Analyzed	Parameter	Units	Value	100%	100%	100%
Percent of total design airflow rate at conditioned analyzed	Ds	%	100%	100%	100%	100%
Air distribution type at conditioned analyzed				CS	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez		1.00	1.00	1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep					

Results	Parameter	Units	Value
Ventilation System Efficiency	Ev		1.00
Outdoor air intake required for system	Vot	cfm	2765
Outdoor air per unit floor area	Vot/As	cfm/sf	0.30
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p	5.5
Outdoor air as a % of design primary supply air	Ypd	cfm	19%

Detailed Calculations					
Initial Calculations for the System as a whole					
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	= 14400
Uncorrected OA requirement for system	Vou	cfm	=	Rps Ps + Ras As	= 2765
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	= 0.19
Initial Calculations for individual zones					
OA rate per unit area for zone	Raz	cfm/sf		0.30	0.06
OA rate per person	Rpz	cfm/p		0.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm		14400	0
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	= 2765.1 0.0
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	= 2765 0
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	= 1.00 1.00
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	= 1.00 1.00
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	= 1.00 1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	= 0.19 0.00
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	= 0.19 0.00
System Ventilation Efficiency					
Zone Ventilation Efficiency (App A Method)	Evz		=	(Fa + FbXs - FcZ) / Fa	= 1.00 1.19
System Ventilation Efficiency (App A Method)	Ev		=	min (Evz)	= 1.00
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	= 0.96
Minimum outdoor air intake airflow					
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	= 2765
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	= 0.19
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	= 2886
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	= 0.20
OA Temp at which Min OA provides all cooling					
OAT below which OA Intake flow is @ minimum	Deg F		=	((Tp-dTsf)-(1-Y)*(Tr+dTr)	= -17

Building:	GBHS Building E
System Tag/Name:	AHU-6
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	188
Population of area served by system (including diversity)	Ps	P	1
Design primary supply fan airflow rate	Vpsd	cfm	2,500
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.12
OA req'd per person for system area (Weighted average)	Rps	cfm/p	5.0

Inputs for Potentially Critical zones	Potentially Critical Zones		
Zone Name	<i>Laundry Rm</i>		
Zone Tag	46		
Space type	Laundry rooms, central		
Floor Area of zone	Az	sf	188
Design population of zone	Pz	P (default value listed; may be overridden)	1
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm	2,500
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?		Select from pull-down list or leave blank if N/A	
Local recirc. air % representative of ave system return air	Er		

Inputs for Operating Condition Analyzed	Units	Value	100%	100%
Percent of total design airflow rate at conditioned analyzed	Ds	%	100%	100%
Air distribution type at conditioned analyzed		Select from pull-down list	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez		1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep			

Results	Units	Value	
Ventilation System Efficiency	Ev	1.00	
Outdoor air intake required for system	Vot	cfm	28
Outdoor air per unit floor area	Vot/As	cfm/sf	0.15
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p	27.6
Outdoor air as a % of design primary supply air	Ypd	cfm	1%

Detailed Calculations				
Initial Calculations for the System as a whole				
Primary supply air flow to system at conditioned analyzed	Vps	cfm	= VpdDs	= 2500
Uncorrected OA requirement for system	Vou	cfm	= Rps Ps + Ras As	= 28
Uncorrected OA req'd as a fraction of primary SA	Xs		= Vou / Vps	= 0.01
Initial Calculations for individual zones				
OA rate per unit area for zone	Raz	cfm/sf		0.12 0.06
OA rate per person	Rpz	cfm/p		5.00 5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm		2500 0
Unused OA req'd to breathing zone	Vbz	cfm	= Rpz Pz + Raz Az	= 27.6 0.0
Unused OA requirement for zone	Voz	cfm	= Vbz/Ez	= 28 0
Fraction of zone supply not directly recirc. from zone	Fa		= Ep + (1-Ep)Er	= 1.00 1.00
Fraction of zone supply from fully mixed primary air	Fb		= Ep	= 1.00 1.00
Fraction of zone OA not directly recirc. from zone	Fc		= 1-(1-Ez)(1-Ep)(1-Er)	= 1.00 1.00
Unused OA fraction required in supply air to zone	Zd		= Voz / Vdz	= 0.01 0.00
Unused OA fraction required in primary air to zone	Zp		= Voz / Vpz	= 0.01 0.00
System Ventilation Efficiency				
Zone Ventilation Efficiency (App A Method)	Evz		= (Fa + FbXs - FcZ) / Fa	= 1.00 1.01
System Ventilation Efficiency (App A Method)	Ev		= min (Evz)	= 1.00
Ventilation System Efficiency (Table 6.3 Method)	Ev		= Value from Table 6.3	= 1.14
Minimum outdoor air intake airflow				
Outdoor Air Intake Flow required to System	Vot	cfm	= Vou / Ev	= 28
OA intake req'd as a fraction of primary SA	Y		= Vot / Vps	= 0.01
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	= Vou / Ev	= 24 3.36
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		= Vot / Vps	= 0.01 0.12
OA Temp at which Min OA provides all cooling				
OAT below which OA Intake flow is @ minimum	Deg F		= ((Tp-dTsf)-(1-Y))*(Tr+dTr	= -1470

Building:	GBHS Building E
System Tag/Name:	AHU-7
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	1449
Population of area served by system (including diversity)	Ps	P	6
Design primary supply fan airflow rate	Vpsd	cfm	1,300
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.06
OA req'd per person for system area (Weighted average)	Rps	cfm/p	5.0

Inputs for Potentially Critical zones	Zone Name	Zone Tag	Space type	Zone title turns purple italic for critical zone(s)	Potentially Critical Zones		
					Lobby	Concessions	Coat Room
					106	107	105
					Lobbies	Office space	Storage rooms
Floor Area of zone	Az	sf	Select from pull-down list		1,155	176	118
Design population of zone	Pz	P	(default value listed; may be overridden)		5	1	0
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm			1,110	115	75
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?			Select from pull-down list or leave blank if N/A				
Local recirc. air % representative of ave system return air	Er				75%	75%	75%

Inputs for Operating Condition Analyzed	Name	Units				
Percent of total design airflow rate at conditioned analyzed	Ds	%		100%	100%	100%
Air distribution type at conditioned analyzed			Select from pull-down list		CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez				1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep					

Results	Name	Units	
Ventilation System Efficiency	Ev		0.91
Outdoor air intake required for system	Vot	cfm	137
Outdoor air per unit floor area	Vot/As	cfm/sf	0.09
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p	22.8
Outdoor air as a % of design primary supply air	Ypd	cfm	11%

Detailed Calculations						
Initial Calculations for the System as a whole						
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	1300
UncorrectedOA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	124
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	=	0.10
Initial Calculations for individual zones						
OA rate per unit area for zone	Raz	cfm/sf			0.06	0.06
OA rate per person	Rpz	cfm/p			5.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm			1110	115
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=	94.3
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=	94
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	=	1.00
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	=	1.00
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	=	1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	=	0.08
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=	0.08
System Ventilation Efficiency						
Zone Ventilation Efficiency (App A Method)	Evz		=	(Fa + FbXs - FcZ) / Fa	=	1.01
System Ventilation Efficiency (App A Method)	Ev		=	min (Evz)	=	0.91
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	0.96
Minimum outdoor air intake airflow						
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	137
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	0.11
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	129
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	0.10
OA Temp at which Min OA provides all cooling						
OAT below which OA Intake flow is @ minimum	Deg F		=	{(Tp-dTsf)-(1-Y)}*(Tr+dTr	=	-90

Building:	GBHS Building E
System Tag/Name:	AHU-8
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	1417
Population of area served by system (including diversity)	Ps	P	5
Design primary supply fan airflow rate	Vpsd	cfm	900
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.06
OA req'd per person for system area (Weighted average)	Rps	cfm/p	5.0

Inputs for Potentially Critical zones	Zone Name	Zone Tag	Space type	Floor Area of zone	Design population of zone	Design total supply to zone (primary plus local recirculated)	Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	Local recirc. air % representative of ave system return air	Potentially Critical Zones
			Select from pull-down list	Az	Pz	Vdzd	Er		2nd Floor Office
									204/5
									Office space
									Office space
									1,417
									5
									900

Inputs for Operating Condition Analyzed	Parameter	Units	Value	CS	CS
Percent of total design airflow rate at conditioned analyzed	Ds	%	100%	100%	100%
Air distribution type at conditioned analyzed		Select from pull-down list		CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez			1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep				

Results	Parameter	Units	Value
Ventilation System Efficiency	Ev		1.00
Outdoor air intake required for system	Vot	cfm	110
Outdoor air per unit floor area	Vot/As	cfm/sf	0.08
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p	22.0
Outdoor air as a % of design primary supply air	Ypd	cfm	12%

Detailed Calculations						
Initial Calculations for the System as a whole						
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	900
UncorrectedOA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	110
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	=	0.12
Initial Calculations for individual zones						
OA rate per unit area for zone	Raz	cfm/sf				0.06
OA rate per person	Rpz	cfm/p				5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm				900
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=	110.0
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=	110
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	=	1.00
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	=	1.00
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	=	1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	=	0.12
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=	0.12
System Ventilation Efficiency						
Zone Ventilation Efficiency (App A Method)	Evz		=	(Fa + FbXs - FcZ) / Fa	=	1.00
System Ventilation Efficiency (App A Method)	Ev		=	min (Evz)	=	1.00
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	1.03
Minimum outdoor air intake airflow						
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	110
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	0.12
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	107
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	0.12
OA Temp at which Min OA provides all cooling						
OAT below which OA Intake flow is @ minimum	Deg F		=	{(Tp-dTsf)-(1-Y)}*(Tr+dTr	=	-67

Building:	GBHS Building E
System Tag/Name:	AHU-9
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	1966
Population of area served by system (including diversity)	Ps	P	20
Design primary supply fan airflow rate	Vpsd	cfm	1,300
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.06
OA req'd per person for system area (Weighted average)	Rps	cfm/p	20.0

Inputs for Potentially Critical Zones	Potentially Critical Zones		
Zone Name	<i>Weight Room</i>		
Zone Tag	29		
Space type	Health club/weight rooms		
Floor Area of zone	Az	sf	1,966
Design population of zone	Pz	P	20
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm	1,300
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?			
Local recirc. air % representative of ave system return air	Er		

Inputs for Operating Condition Analyzed				
Percent of total design airflow rate at conditioned analyzed	Ds	%	100%	100%
Air distribution type at conditioned analyzed		Select from pull-down list	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez		1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep			

Results			
Ventilation System Efficiency	Ev		1.00
Outdoor air intake required for system	Vot	cfm	518
Outdoor air per unit floor area	Vot/As	cfm/sf	0.26
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p	25.9
Outdoor air as a % of design primary supply air	Ypd	cfm	40%

Detailed Calculations					
Initial Calculations for the System as a whole					
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	= 1300
UncorrectedOA requirement for system	Vou	cfm	=	Rps Ps + Ras As	= 518
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	= 0.40
Initial Calculations for individual zones					
OA rate per unit area for zone	Raz	cfm/sf		0.06	0.06
OA rate per person	Rpz	cfm/p		20.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm		1300	0
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	= 518.0
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	= 518
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	= 1.00
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	= 1.00
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	= 1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	= 0.40
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	= 0.40
System Ventilation Efficiency					
Zone Ventilation Efficiency (App A Method)	Evz		=	(Fa + FbXs - FcZ) / Fa	= 1.00
System Ventilation Efficiency (App A Method)	Ev		=	min (Evz)	= 1.00
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	= 0.75
Minimum outdoor air intake airflow					
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	= 518
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	= 0.40
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	= 689
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	= 0.53
OA Temp at which Min OA provides all cooling					
OAT below which OA Intake flow is @ minimum	Deg F		=	((Tp-dTsf)-(1-Y)*(Tr+dTr	= 29

Building:	GBHS Building F
System Tag/Name:	AHU-1
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	15382
Population of area served by system (including diversity)	Ps	P	345
Design primary supply fan airflow rate	Vpsd	cfm	19,995
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.10
OA req'd per person for system area (Weighted average)	Rps	cfm/p	9.0

Inputs for Potentially Critical zones			
Zone Name	<i>Zone title turns purple italic for critical zone(s)</i>		
Zone Tag			
Space type	Select from pull-down list		
Floor Area of zone	Az	sf	332
Design population of zone	Pz	P (default value listed; may be overridden)	0
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm	95
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	Select from pull-down list or leave blank if N/A		
Local recirc. air % representative of ave system return air	Er		

Entrance	Equipment Storage	Passage 1	PE Plan	Vestibule	PE Plan	Student Lounge
102D	106D	109B	109B	133A	134A	136A
Corridors	Storage rooms	Corridors	Office space	Corridors	Office space	Corridors
	173	180	120	90	118	187
0	0	0	2	0	0	5
95	160	75	110	20	100	100

Inputs for Operating Condition Analyzed										
Percent of total design airflow rate at conditioned analyzed	Ds	%	100%	100%	100%	100%	100%	100%	100%	100%
Air distribution type at conditioned analyzed	Select from pull-down list		CS	CS	CS	CS	CS	CS	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep									

Results			
Ventilation System Efficiency	Ev		0.81
Outdoor air intake required for system	Vot	cfm	5799
Outdoor air per unit floor area	Vot/As	cfm/sf	0.38
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p	16.8
Outdoor air as a % of design primary supply air	Ypd	cfm	29%

Detailed Calculations												
Initial Calculations for the System as a whole												
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	19995						
Uncorrected OA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	4679						
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	=	0.23						
Initial Calculations for individual zones												
OA rate per unit area for zone	Raz	cfm/sf		0.06	0.12	0.06	0.06	0.06	0.06	0.06		
OA rate per person	Rpz	cfm/p		0.00	0.00	0.00	5.00	0.00	5.00	0.00		
Total supply air to zone (at condition being analyzed)	Vdz	cfm		95	160	75	110	20	100	100		
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=	19.9	20.8	10.8	17.2	5.4	7.1	11.2
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=	20	21	11	17	5	7	11
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	=	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	=	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	=	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	=	0.21	0.13	0.14	0.16	0.27	0.07	0.11
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=	0.21	0.13	0.14	0.16	0.27	0.07	0.11
System Ventilation Efficiency												
Zone Ventilation Efficiency (App A Method)	Ezv		=	(Fa + FbXs - FcZ) / Fa	=	1.02	1.10	1.09	1.08	0.96	1.16	1.12
System Ventilation Efficiency (App A Method)	Ev		=	min (Ezv)	=	0.81						
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	0.72						
Minimum outdoor air intake airflow												
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	5799						
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	0.29						
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	6473						
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	0.32						
OA Temp at which Min OA provides all cooling												
OAT below which OA Intake flow is @ minimum	Deg F		=	{(Tp-dTsf)-(1-Y)}(Tr+dTr	=	13						

Building:	GBHS Building F
System Tag/Name:	AHU-1
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	15382
Population of area served by system (including diversity)	Ps	P	345
Design primary supply fan airflow rate	Vpsd	cfm	19,995
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.10
OA req'd per person for system area (Weighted average)	Rps	cfm/p	9.0

Inputs for Potentially Critical zones		Corridor	Health	Secretary	Corridor	Bookkeeper	Asst Principal	Intern
Zone Name								
Zone Tag	<i>Zone title turns purple italic for critical zone(s)</i>	139D	147A	148A	150A	151A	152A	153A
Space type	Select from pull-down list	Corridors	Daycare sickroom	Office space	Corridors	Office space	Office space	Office space
Floor Area of zone	Az sf	680	550	210	700	100	150	180
Design population of zone	Pz P (default value listed; may be overridden)	0	3	1	0	1	2	1
Design total supply to zone (primary plus local recirculated)	Vdzd cfm	575	950	280	330	180	265	70
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	Er Select from pull-down list or leave blank if N/A							
Local recirc. air % representative of ave system return air	Er							

Inputs for Operating Condition Analyzed	Ds	%	100%	100%	100%	100%	100%	100%	100%
Percent of total design airflow rate at conditioned analyzed	Ds	%	100%	100%	100%	100%	100%	100%	100%
Air distribution type at conditioned analyzed	Ez	Select from pull-down list	CS	CS	CS	CS	CS	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ep		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Primary air fraction of supply air at conditioned analyzed									

Results	Ev	0.81
Ventilation System Efficiency	Ev	0.81
Outdoor air intake required for system	Vot cfm	5799
Outdoor air per unit floor area	Vot/As cfm/sf	0.38
Outdoor air per person served by system (including diversity)	Vot/Ps cfm/p	16.8
Outdoor air as a % of design primary supply air	Ypd cfm	29%

Detailed Calculations		Vps	cfm	=	VpdDs	=	19995
Initial Calculations for the System as a whole		Vps	cfm	=	VpdDs	=	19995
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	19995	
Uncorrected OA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	4679	
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	=	0.23	
Initial Calculations for individual zones		Raz	cfm/sf		0.06	0.18	0.06
OA rate per unit area for zone	Raz	cfm/sf		0.06	0.18	0.06	0.06
OA rate per person	Rpz	cfm/p		0.00	10.00	5.00	0.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm		575	950	280	330
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=	40.8	129.0
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=	41	129
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	=	1.00	1.00
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	=	1.00	1.00
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	=	1.00	1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	=	0.07	0.14
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=	0.07	0.14
System Ventilation Efficiency		Ez		=	(Fa + FbXs - FcZ) / Fa	=	1.16
Zone Ventilation Efficiency (App A Method)	Ez		=	(Fa + FbXs - FcZ) / Fa	=	1.16	1.10
System Ventilation Efficiency (App A Method)	Ev		=	min (Ez)	=	0.81	
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	0.72	
Minimum outdoor air intake airflow		Vot	cfm	=	Vou / Ev	=	5799
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	5799	
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	0.29	
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	6473	
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	0.32	
OA Temp at which Min OA provides all cooling		Deg F		=	{(Tp-dTsf)-(1-Y)*(Tr+dTr	=	13
OAT below which OA Intake flow is @ minimum	Deg F		=	{(Tp-dTsf)-(1-Y)*(Tr+dTr	=	13	

Building:	GBHS Building F
System Tag/Name:	AHU-1
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	15382
Population of area served by system (including diversity)	Ps	P	345
Design primary supply fan airflow rate	Vpsd	cfm	19,995
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.10
OA req'd per person for system area (Weighted average)	Rps	cfm/p	9.0

Zone Name	Zone Tag	Space type	Potentially Critical Zones							
			Intern	Basic Math	Business Math	Advanced Math	Bookkeeping	Office Training Lab	Model Office	
			154A	155A	156A	156B	157A	159A	159A	
			Office space	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Office space
			160	725	442	780	725	1360	300	
			1	40	2	40	2	40	5	
			70	1140	660	1250	560	1380	475	

Inputs for Operating Condition Analyzed	Parameter	Units	Value	154A	155A	156A	156B	157A	159A	159A
Percent of total design airflow rate at conditioned analyzed	Ds	%	100%	100%	100%	100%	100%	100%	100%	100%
Air distribution type at conditioned analyzed		Select from pull-down list		CS	CS	CS	CS	CS	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep									

Results	Parameter	Units	Value
Ventilation System Efficiency	Ev		0.81
Outdoor air intake required for system	Vot	cfm	5799
Outdoor air per unit floor area	Vot/As	cfm/sf	0.38
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p	16.8
Outdoor air as a % of design primary supply air	Ypd	cfm	29%

Detailed Calculations										
Initial Calculations for the System as a whole										
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	19995				
Uncorrected OA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	4679				
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	=	0.23				
Initial Calculations for individual zones										
OA rate per unit area for zone	Raz	cfm/sf		0.06	0.12	0.12	0.12	0.12	0.12	0.06
OA rate per person	Rpz	cfm/p		5.00	10.00	10.00	10.00	10.00	10.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm		70	1140	660	1250	560	1380	475
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=	14.6	487.0	73.0	493.6	107.0
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=	15	487	73	494	107
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	=	1.00	1.00	1.00	1.00	1.00
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	=	1.00	1.00	1.00	1.00	1.00
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Er)	=	1.00	1.00	1.00	1.00	1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	=	0.21	0.43	0.11	0.39	0.19
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=	0.21	0.43	0.11	0.39	0.19
System Ventilation Efficiency										
Zone Ventilation Efficiency (App A Method)	Ezv		=	(Fa + FbXs - FcZ) / Fa	=	1.03	0.81	1.12	0.84	1.04
System Ventilation Efficiency (App A Method)	Ev		=	min (Ezv)	=	0.81				
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	0.72				
Minimum outdoor air intake airflow										
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	5799				
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	0.29				
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	6473				
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	0.32				
OA Temp at which Min OA provides all cooling										
OAT below which OA Intake flow is @ minimum	Deg F		=	{(Tp-dTsf)-(1-Y)}(Tr+dTr	=	13				

Building:	GBHS Building F
System Tag/Name:	AHU-1
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	15382
Population of area served by system (including diversity)	Ps	P	345
Design primary supply fan airflow rate	Vpsd	cfm	19,995
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.10
OA req'd per person for system area (Weighted average)	Rps	cfm/p	9.0

Inputs for Potentially Critical zones				Storage	Reproduction Center	Typing and Shorthand Lab	Data Processing Instruction Area	Coordinator's Office	Coordinator's Office	Computer Training Lab
Zone Name	Zone Tag	Space type		160A	163A	164A	167A	168A	169A	160E
Floor Area of zone	Design population of zone	Design total supply to zone (primary plus local recirculated)	Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	Storage rooms	Office space	Computer lab	Computer lab	Office space	Office space	Computer lab
		Select from pull-down list								
Az	Pz	(default value listed; may be overridden)		108	255	1500	1485	150	120	910
Vdzd	Er	Select from pull-down list or leave blank if N/A		0	5	30	40	2	2	40
40				460	1710	1880	100	340	1680	

Inputs for Operating Condition Analyzed										
Percent of total design airflow rate at conditioned analyzed	Ds	%		100%	100%	100%	100%	100%	100%	100%
Air distribution type at conditioned analyzed	Ez	Select from pull-down list		CS	CS	CS	CS	CS	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ep			1.00	1.00	1.00	1.00	1.00	1.00	1.00

Results			
Ventilation System Efficiency	Ev		0.81
Outdoor air intake required for system	Vot	cfm	5799
Outdoor air per unit floor area	Vot/As	cfm/sf	0.38
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p	16.8
Outdoor air as a % of design primary supply air	Ypd	cfm	29%

Detailed Calculations										
Initial Calculations for the System as a whole										
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	19995				
Uncorrected OA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	4679				
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	=	0.23				
Initial Calculations for individual zones										
OA rate per unit area for zone	Raz	cfm/sf		0.12	0.06	0.12	0.12	0.06	0.06	0.12
OA rate per person	Rpz	cfm/p		0.00	5.00	10.00	10.00	5.00	5.00	10.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm		40	460	1710	1880	100	340	1680
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=	13.0	40.3	480.0	578.2	19.0
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=	13	40	480	578	19
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	=	1.00	1.00	1.00	1.00	1.00
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	=	1.00	1.00	1.00	1.00	1.00
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Er)	=	1.00	1.00	1.00	1.00	1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	=	0.32	0.09	0.28	0.31	0.19
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=	0.32	0.09	0.28	0.31	0.19
System Ventilation Efficiency										
Zone Ventilation Efficiency (App A Method)	Ezv		=	(Fa + FbXs - FcZ) / Fa	=	0.91	1.15	0.95	0.93	1.04
System Ventilation Efficiency (App A Method)	Ev		=	min (Ezv)	=	0.81				
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	0.72				
Minimum outdoor air intake airflow										
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	5799				
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	0.29				
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	6473				
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	0.32				
OA Temp at which Min OA provides all cooling										
OAT below which OA Intake flow is @ minimum	Deg F		=	{(Tp-dTsf)-(1-Y)}(Tr+dTr	=	13				

Building:	GBHS Building F
System Tag/Name:	AHU-1
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	15382
Population of area served by system (including diversity)	Ps	P	345
Design primary supply fan airflow rate	Vpsd	cfm	19,995
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.10
OA req'd per person for system area (Weighted average)	Rps	cfm/p	9.0

Inputs for Potentially Critical zones			Teacher Planning	Elevator Machine Room	Electric Room	DE Storage	Distributive Education	Supply	School Store
Zone Name	Zone Tag	Space type	171A	179E	180E	New zone ID	182A	184A	187B
			Office space	Elevator machine rooms	Electrical equipment rooms	Storage rooms	Classrooms (age 9 plus)	Storage rooms	Sales (except as below)
		Select from pull-down list							
Floor Area of zone	Az	sf	750	64	78	80	845	100	575
Design population of zone	Pz	P (default value listed; may be overridden)	25	0	0	0	30	0	25
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm	1380	50	150	135	1590	30	1310
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?		Select from pull-down list or leave blank if N/A							
Local recirc. air % representative of ave system return air	Er								

Inputs for Operating Condition Analyzed	Ds	%	100%	100%	100%	100%	100%	100%	100%	100%
Percent of total design airflow rate at conditioned analyzed										
Air distribution type at conditioned analyzed		Select from pull-down list	CS	CS	CS	CS	CS	CS	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep									

Results	Ev	0.81	
Ventilation System Efficiency			
Outdoor air intake required for system	Vot	cfm	5799
Outdoor air per unit floor area	Vot/As	cfm/sf	0.38
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p	16.8
Outdoor air as a % of design primary supply air	Ypd	cfm	29%

Detailed Calculations										
Initial Calculations for the System as a whole										
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	19995				
Uncorrected OA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	4679				
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	=	0.23				
Initial Calculations for individual zones										
OA rate per unit area for zone	Raz	cfm/sf				0.06	0.12	0.06	0.12	0.12
OA rate per person	Rpz	cfm/p				5.00	0.00	0.00	10.00	7.50
Total supply air to zone (at condition being analyzed)	Vdz	cfm				1380	50	150	135	1590
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=	170.0	7.7	4.7	9.6	401.4
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=	170	8	5	10	401
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	=	1.00	1.00	1.00	1.00	1.00
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	=	1.00	1.00	1.00	1.00	1.00
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	=	1.00	1.00	1.00	1.00	1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	=	0.12	0.15	0.03	0.07	0.25
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=	0.12	0.15	0.03	0.07	0.25
System Ventilation Efficiency										
Zone Ventilation Efficiency (App A Method)	Ezv		=	(Fa + FbXs - FcZ) / Fa	=	1.11	1.08	1.20	1.16	0.98
System Ventilation Efficiency (App A Method)	Ev		=	min (Ezv)	=					0.81
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=					0.72
Minimum outdoor air intake airflow										
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	5799				
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	0.29				
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	6473				
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	0.32				
OA Temp at which Min OA provides all cooling										
OAT below which OA Intake flow is @ minimum	Deg F		=	{(Tp-dTsf)-(1-Y)*(Tr+dTr	=	13				

Building:	GBHS Building F
System Tag/Name:	AHU-1
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	15382
Population of area served by system (including diversity)	Ps	P	345
Design primary supply fan airflow rate	Vpsd	cfm	19,995
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.10
OA req'd per person for system area (Weighted average)	Rps	cfm/p	9.0

Inputs for Potentially Critical zones	Name	Units	System
Zone Name			Office
Zone Tag			188A
Space type			Office space
Floor Area of zone	Az	sf	100
Design population of zone	Pz	P (default value listed; may be overridden)	1
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm	295
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?		Select from pull-down list or leave blank if N/A	
Local recirc. air % representative of ave system return air	Er		

Inputs for Operating Condition Analyzed	Name	Units	System
Percent of total design airflow rate at conditioned analyzed	Ds	%	100%
Air distribution type at conditioned analyzed		Select from pull-down list	CS
Zone air distribution effectiveness at conditioned analyzed	Ez		1.00
Primary air fraction of supply air at conditioned analyzed	Ep		

Results	Name	Units	System
Ventilation System Efficiency	Ev		0.81
Outdoor air intake required for system	Vot	cfm	5799
Outdoor air per unit floor area	Vot/As	cfm/sf	0.38
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p	16.8
Outdoor air as a % of design primary supply air	Ypd	cfm	29%

Detailed Calculations				
Initial Calculations for the System as a whole				
Primary supply air flow to system at conditioned analyzed	Vps	cfm	= VpdDs	= 19995
Uncorrected OA requirement for system	Vou	cfm	= Rps Ps + Ras As	= 4679
Uncorrected OA req'd as a fraction of primary SA	Xs		= Vou / Vps	= 0.23
Initial Calculations for individual zones				
OA rate per unit area for zone	Raz	cfm/sf		0.06
OA rate per person	Rpz	cfm/p		5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm		295
Unused OA req'd to breathing zone	Vbz	cfm	= Rpz Pz + Raz Az	= 11.0
Unused OA requirement for zone	Voz	cfm	= Vbz/Ez	= 11
Fraction of zone supply not directly recirc. from zone	Fa		= Ep + (1-Ep)Er	= 1.00
Fraction of zone supply from fully mixed primary air	Fb		= Ep	= 1.00
Fraction of zone OA not directly recirc. from zone	Fc		= 1-(1-Ez)(1-Ep)(1-Er)	= 1.00
Unused OA fraction required in supply air to zone	Zd		= Voz / Vdz	= 0.04
Unused OA fraction required in primary air to zone	Zp		= Voz / Vpz	= 0.04
System Ventilation Efficiency				
Zone Ventilation Efficiency (App A Method)	Ezv		= (Fa + FbXs - FcZ) / Fa	= 1.20
System Ventilation Efficiency (App A Method)	Ev		= min (Ezv)	= 0.81
Ventilation System Efficiency (Table 6.3 Method)	Ev		= Value from Table 6.3	= 0.72
Minimum outdoor air intake airflow				
Outdoor Air Intake Flow required to System	Vot	cfm	= Vou / Ev	= 5799
OA intake req'd as a fraction of primary SA	Y		= Vot / Vps	= 0.29
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	= Vou / Ev	= 6473
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		= Vot / Vps	= 0.32
OA Temp at which Min OA provides all cooling				
OAT below which OA Intake flow is @ minimum	Deg F		= {(Tp-dTsf)-(1-Y)*(Tr+dTr	= 13

Building:	GBHS Building F
System Tag/Name:	AHU-2
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	17103
Population of area served by system (including diversity)	Ps	P	302
Design primary supply fan airflow rate	Vpsd	cfm	18,590
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.10
OA req'd per person for system area (Weighted average)	Rps	cfm/p	10.3

Inputs for Potentially Critical zones				Elec	Typewriting Lab	Typewriting Lab	Typewriting Lab	Gymnastics	Corridor	Typewriting Lab
Zone Name	Zone Tag	Space type		203A	206A	206B	207A	213A	215A	216A
Floor Area of zone	Design population of zone	Design total supply to zone (primary plus local recirculated)	Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	Electrical equipment rooms	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Disco/dance floors	Corridors	Classrooms (age 9 plus)
			Select from pull-down list	25	1050	1050	1075	1900	910	1222
			(default value listed; may be overridden)	0	25	25	25	20	0	25
			Select from pull-down list or leave blank if N/A	280	1170	1110	1050	2360	265	1255

Inputs for Operating Condition Analyzed				100%	100%	100%	100%	100%	100%	100%
Percent of total design airflow rate at conditioned analyzed	Air distribution type at conditioned analyzed	Zone air distribution effectiveness at conditioned analyzed	Primary air fraction of supply air at conditioned analyzed	CS	CS	CS	CS	CS	CS	CS
				1.00	1.00	1.00	1.00	1.00	1.00	1.00

Results				0.87
Ventilation System Efficiency	Ev			0.87
Outdoor air intake required for system	Vot	cfm		5608
Outdoor air per unit floor area	Vot/As	cfm/sf		0.33
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p		18.6
Outdoor air as a % of design primary supply air	Ypd	cfm		30%

Detailed Calculations

Initial Calculations for the System as a whole					
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	= 18590
Uncorrected OA requirement for system	Vou	cfm	=	Rps Ps + Ras As	= 4873
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	= 0.26

Initial Calculations for individual zones										
OA rate per unit area for zone	Raz	cfm/sf		0.06	0.12	0.12	0.12	0.06	0.06	0.12
OA rate per person	Rpz	cfm/p		0.00	10.00	10.00	10.00	20.00	0.00	10.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm		280	1170	1110	1050	2360	265	1255
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=	1.5	376.0	376.0	379.0	514.0
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=	2	376	379	514	397
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	=	1.00	1.00	1.00	1.00	1.00
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	=	1.00	1.00	1.00	1.00	1.00
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	=	1.00	1.00	1.00	1.00	1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	=	0.01	0.32	0.34	0.36	0.22
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=	0.01	0.32	0.34	0.36	0.22

System Ventilation Efficiency										
Zone Ventilation Efficiency (App A Method)	Evz		=	(Fa + FbXs - FcZ) / Fa	=	1.26	0.94	0.92	0.90	1.04
System Ventilation Efficiency (App A Method)	Ev		=	min (Evz)	=	0.87				
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	0.76				

Minimum outdoor air intake airflow					
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	= 5608
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	= 0.30
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	= 6439
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	= 0.35

OA Temp at which Min OA provides all cooling			
OAT below which OA Intake flow is @ minimum	Deg F	=	{(Tp-dTsf)-(1-Y)*(Tr+dTr) = 16

Building:	GBHS Building F
System Tag/Name:	AHU-2
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	17103
Population of area served by system (including diversity)	Ps	P	302
Design primary supply fan airflow rate	Vpsd	cfm	18,590
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.10
OA req'd per person for system area (Weighted average)	Rps	cfm/p	10.3

Inputs for Potentially Critical Zones		Potentially Critical Zones						
Zone Name		Typewriting Lab	Model Kitchen	Child Development	Storage	Observation	Lecture	Foods and Nutrition
Zone Tag	<i>Zone title turns purple italic for critical zone(s)</i>	217A	224A	226A	227A	228A	229A	231A
Space type	Select from pull-down list	Classrooms (age 9 plus)	Break rooms	Classrooms (age 9 plus)	Storage rooms	Corridors	Classrooms (age 9 plus)	Classrooms (age 9 plus)
Floor Area of zone	Az sf	1248	1410	880	171	90	839	1340
Design population of zone	Pz P (default value listed; may be overridden)	25	15	20	0	0	20	20
Design total supply to zone (primary plus local recirculated)	Vdzd cfm	2010	560	885	210	30	925	1680
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	Er Select from pull-down list or leave blank if N/A							
Local recirc. air % representative of ave system return air	Er							

Inputs for Operating Condition Analyzed										
Percent of total design airflow rate at conditioned analyzed	Ds %	100%	100%	100%	100%	100%	100%	100%	100%	100%
Air distribution type at conditioned analyzed	Ez Select from pull-down list	CS	CS	CS	CS	CS	CS	CS	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep									

Results			
Ventilation System Efficiency	Ev		0.87
Outdoor air intake required for system	Vot cfm		5608
Outdoor air per unit floor area	Vot/As cfm/sf		0.33
Outdoor air per person served by system (including diversity)	Vot/Ps cfm/p		18.6
Outdoor air as a % of design primary supply air	Ypd cfm		30%

Detailed Calculations										
Initial Calculations for the System as a whole										
Primary supply air flow to system at conditioned analyzed	Vps cfm	=	VpdDs	=	18590					
Uncorrected OA requirement for system	Vou cfm	=	Rps Ps + Ras As	=	4873					
Uncorrected OA req'd as a fraction of primary SA	Xs	=	Vou / Vps	=	0.26					
Initial Calculations for individual zones										
OA rate per unit area for zone	Raz cfm/sf		0.12	0.06	0.12	0.12	0.06	0.12	0.12	
OA rate per person	Rpz cfm/p		10.00	5.00	10.00	0.00	0.00	10.00	10.00	
Total supply air to zone (at condition being analyzed)	Vdz cfm		2010	560	885	210	30	925	1680	
Unused OA req'd to breathing zone	Vbz cfm	=	Rpz Pz + Raz Az	=	399.8	159.6	305.6	20.5	5.4	300.7
Unused OA requirement for zone	Voz cfm	=	Vbz/Ez	=	400	160	306	21	5	301
Fraction of zone supply not directly recirc. from zone	Fa	=	Ep + (1-Ep)Er	=	1.00	1.00	1.00	1.00	1.00	1.00
Fraction of zone supply from fully mixed primary air	Fb	=	Ep	=	1.00	1.00	1.00	1.00	1.00	1.00
Fraction of zone OA not directly recirc. from zone	Fc	=	1-(1-Ez)(1-Ep)(1-Er)	=	1.00	1.00	1.00	1.00	1.00	1.00
Unused OA fraction required in supply air to zone	Zd	=	Voz / Vdz	=	0.20	0.29	0.35	0.10	0.18	0.33
Unused OA fraction required in primary air to zone	Zp	=	Voz / Vpz	=	0.20	0.29	0.35	0.10	0.18	0.33
System Ventilation Efficiency										
Zone Ventilation Efficiency (App A Method)	Evz	=	(Fa + FbXs - FcZ) / Fa	=	1.06	0.98	0.92	1.16	1.08	0.94
System Ventilation Efficiency (App A Method)	Ev	=	min (Evz)	=	0.87					
Ventilation System Efficiency (Table 6.3 Method)	Ev	=	Value from Table 6.3	=	0.76					
Minimum outdoor air intake airflow										
Outdoor Air Intake Flow required to System	Vot cfm	=	Vou / Ev	=	5608					
OA intake req'd as a fraction of primary SA	Y	=	Vot / Vps	=	0.30					
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot cfm	=	Vou / Ev	=	6439					
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y	=	Vot / Vps	=	0.35					
OA Temp at which Min OA provides all cooling										
OAT below which OA Intake flow is @ minimum	Deg F	=	{(Tp-dTsf)-(1-Y)}/(Tr+dTr)	=	16					

Building:	GBHS Building F
System Tag/Name:	AHU-2
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	17103
Population of area served by system (including diversity)	Ps	P	302
Design primary supply fan airflow rate	Vpsd	cfm	18,590
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.10
OA req'd per person for system area (Weighted average)	Rps	cfm/p	10.3

Inputs for Potentially Critical zones			Clothing and Textiles	Classroom	Home and Family Life	Storage	Upholstering and Work Area	Paint Storage	Teacher Planning
Zone Name	Zone Tag	Space type	232A	234A	235A	236A	237A	239A	241A
			Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Storage rooms	Classrooms (age 9 plus)	Storage rooms	Office space
Zone Name	<i>Zone title turns purple italic for critical zone(s)</i>								
Zone Tag									
Space type	Select from pull-down list								
Floor Area of zone	Az	sf	1000	351	350	344	1145	223	480
Design population of zone	Pz	P (default value listed; may be overridden)	20	10	20	0	25	0	7
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm	925	400	660	105	1170	620	920
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	Select from pull-down list or leave blank if N/A								
Local recirc. air % representative of ave system return air	Er								

Inputs for Operating Condition Analyzed			100%	100%	100%	100%	100%	100%	100%
Percent of total design airflow rate at conditioned analyzed	Ds	%	100%	100%	100%	100%	100%	100%	100%
Air distribution type at conditioned analyzed	Select from pull-down list								
Zone air distribution effectiveness at conditioned analyzed	Ez		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep								

Results			0.87
Ventilation System Efficiency	Ev		0.87
Outdoor air intake required for system	Vot	cfm	5608
Outdoor air per unit floor area	Vot/As	cfm/sf	0.33
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p	18.6
Outdoor air as a % of design primary supply air	Ypd	cfm	30%

Detailed Calculations									
Initial Calculations for the System as a whole									
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	18590			
UncorrectedOA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	4873			
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	=	0.26			

Initial Calculations for individual zones									
OA rate per unit area for zone	Raz	cfm/sf		0.12	0.12	0.12	0.12	0.12	0.06
OA rate per person	Rpz	cfm/p		10.00	10.00	10.00	0.00	10.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm		925	400	660	105	1170	920
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=	320.0	142.1	242.0	41.3
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=	320	142	242	41
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	=	1.00	1.00	1.00	1.00
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	=	1.00	1.00	1.00	1.00
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	=	1.00	1.00	1.00	1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	=	0.35	0.36	0.37	0.39
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=	0.35	0.36	0.37	0.39

System Ventilation Efficiency									
Zone Ventilation Efficiency (App A Method)	Evz		=	(Fa + FbXs - FcZ) / Fa	=	0.92	0.91	0.90	0.87
System Ventilation Efficiency (App A Method)	Ev		=	min (Evz)	=	0.87			
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	0.76			

Minimum outdoor air intake airflow						
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	5608
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	0.30
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	6439
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	0.35

OA Temp at which Min OA provides all cooling						
OAT below which OA Intake flow is @ minimum	Deg F		=	{(Tp-dTsf)-(1-Y)*(Tr+dTr)	=	16

Building:	GBHS Building F
System Tag/Name:	AHU-3 & 4
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	7954
Population of area served by system (including diversity)	Ps	P	100% diversity
Design primary supply fan airflow rate	Vpsd	cfm	10,500
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.27
OA req'd per person for system area (Weighted average)	Rps	cfm/p	0.0

Inputs for Potentially Critical Zones	Zone Name	Zone Tag	Zone title turns purple italic for critical zone(s)	Potentially Critical Zones		
				Gym 121E	Locker Rm 1 129E	Locker Rm 2 114E
Space type			Select from pull-down list	Gym, stadium (play area)	Spectator areas	Spectator areas
Floor Area of zone	Az	sf		7,000	324	630
Design population of zone	Pz	P	(default value listed; may be overridden)	30	0	0
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm		8,360	1070	1070
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?			Select from pull-down list or leave blank if N/A			
Local recirc. air % representative of ave system return air	Er					

Inputs for Operating Condition Analyzed	Ds	%	100%	100%	100%	100%
Percent of total design airflow rate at conditioned analyzed	Ds	%	100%	100%	100%	100%
Air distribution type at conditioned analyzed		Select from pull-down list		CS	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez			1.00	1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep					

Results	Ev	0.95	
Ventilation System Efficiency	Ev	0.95	
Outdoor air intake required for system	Vot	cfm	2261
Outdoor air per unit floor area	Vot/As	cfm/sf	0.28
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p	75.4
Outdoor air as a % of design primary supply air	Ypd	cfm	22%

Detailed Calculations						
Initial Calculations for the System as a whole						
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	10500
Uncorrected OA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	2157
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	=	0.21
Initial Calculations for individual zones						
OA rate per unit area for zone	Raz	cfm/sf				0.30
OA rate per person	Rpz	cfm/p				0.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm				8360
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=	2100.0
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=	2100
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	=	1.00
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	=	1.00
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	=	1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	=	0.25
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=	0.25
System Ventilation Efficiency						
Zone Ventilation Efficiency (App A Method)	Evz		=	(Fa + FbXs - FcZ) / Fa	=	0.95
System Ventilation Efficiency (App A Method)	Ev		=	min (Evz)	=	0.95
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	0.90
Minimum outdoor air intake airflow						
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	2261
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	0.22
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	2400
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	0.23
OA Temp at which Min OA provides all cooling						
OAT below which OA Intake flow is @ minimum	Deg F		=	((Tp-dTsf)-(1-Y))*(Tr+dTr	=	-7

Building:	GBHS Building F
System Tag/Name:	AHU-5
Operating Condition Description:	
Units (select from pull-down list)	IP

Inputs for System	Name	Units	System
Floor area served by system	As	sf	3000
Population of area served by system (including diversity)	Ps	P	0
Design primary supply fan airflow rate	Vpsd	cfm	3,800
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf	0.13
OA req'd per person for system area (Weighted average)	Rps	cfm/p	0.0

Inputs for Potentially Critical Zones	Potentially Critical Zones
Zone Name	<i>Boiler Room</i> Crawlspce Offices
Zone Tag	129E
Space type	Wood/metal shop Office space
Floor Area of zone	Az sf 1,750 1250
Design population of zone	Pz P (default value listed; may be overridden) 0 0
Design total supply to zone (primary plus local recirculated)	Vdzd cfm 3,000 800
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	Er Select from pull-down list or leave blank if N/A
Local recirc. air % representative of ave system return air	Er

Inputs for Operating Condition Analyzed	Ds	%	100%	100%	100%
Percent of total design airflow rate at conditioned analyzed	Ds	%	100%	100%	100%
Air distribution type at conditioned analyzed	Ez	Select from pull-down list	CS	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez		1.00	1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep				

Results	Ev	1.00
Ventilation System Efficiency	Ev	1.00
Outdoor air intake required for system	Vot	391
Outdoor air per unit floor area	Vot/As	0.13
Outdoor air per person served by system (including diversity)	Vot/Ps	#DIV/0!
Outdoor air as a % of design primary supply air	Ypd	10%

Detailed Calculations					
Initial Calculations for the System as a whole					
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	= 3800
Uncorrected OA requirement for system	Vou	cfm	=	Rps Ps + Ras As	= 390
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	= 0.10
Initial Calculations for individual zones					
OA rate per unit area for zone	Raz	cfm/sf			0.18 0.06
OA rate per person	Rpz	cfm/p			10.00 5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm			3000 800
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	= 315.0 75.0
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	= 315 75
Fraction of zone supply not directly recirc. from zone	Fa		=	Ep + (1-Ep)Er	= 1.00 1.00
Fraction of zone supply from fully mixed primary air	Fb		=	Ep	= 1.00 1.00
Fraction of zone OA not directly recirc. from zone	Fc		=	1-(1-Ez)(1-Ep)(1-Er)	= 1.00 1.00
Unused OA fraction required in supply air to zone	Zd		=	Voz / Vdz	= 0.11 0.09
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	= 0.11 0.09
System Ventilation Efficiency					
Zone Ventilation Efficiency (App A Method)	Evz		=	(Fa + FbXs - FcZ) / Fa	= 1.00 1.01
System Ventilation Efficiency (App A Method)	Ev		=	min (Evz)	= 1.00
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	= 1.05
Minimum outdoor air intake airflow					
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	= 391
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	= 0.10
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	= 373 17.72
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	= 0.10 0.05
OA Temp at which Min OA provides all cooling					
OAT below which OA Intake flow is @ minimum	Deg F		=	((Tp-dTsf)-(1-Y)*(Tr+dTr)	= -93