Technical Assignment One

ASHREA Standard 62.1 and Standard 90.1 Compliance



Richard T. Flood Jr. & Sally Elliot Flood Athletic Center Salisbury, CT

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Table of Content

Executive Summary	3
ASHREA Standard 62.1	
Section 5 Compliance	4
Section 6 Procedure	5,6
ASHREA Standard 90.1	
Section 5 Building Envelope	7
Section 6 Heating, Ventilating, and Air Conditioning	8,9
Section 7 Service Water Heating	9
Section 9 Lighting	9
Appendix A	10-17
Calculation Spreadsheet for Outside Air Requirements	
References	18

Executive Summary

Technical assignment one was given as a task to students in AE481. Student with mechanical option were required to use ASHRAE Standard 62.1 and ASHRAE Standard 90.1 to evaluate the building.

ASHRAE Standard 62.1 contains the information about ventilation. Certain ventilation is required for the building to control the air quality. In section 5, Local capture of contaminants was considered due to the consideration of amount of sulfur dioxide, particles, carbon monoxide, oxidants, nitrogen dioxide, and lead. Also, dehumidification was considered because of the mold growth in the building. Section 6 explains about procedure to calculate the required value of design outdoor air intake flow.

ASHRAE Standard 90.1 covers the energy design evaluation. Required R-value for the building can be calculated in section 5. Section 6 carries Heating, Ventilating, and Air Conditioning information, which deals with compliance of efficiency of equipments. In Section 7, efficiency of boiler can be evaluated. Section 9 contains data to calculate Lighting Power Density.

According to the results of data, Richard T. Flood Jr., & Sally Elliot Flood Athletic Center can be improved in outdoor air intake flow. Squash court and wrestling room do not allow enough outside air to enter the area and should be considered due to the air quality of the building.

ASHRAE 62.1 - 2007 Section 5

5.3 Exhaust Duct Location

All exhaust ducts are located away from occupied spaces.

5.5 Airstream Surfaces

Building system uses dehumidifier in the ice rink and material surfaces are determined to be resistant to mold growth.

5.7 Local Capture of Contaminants

All mechanical rooms use exhaust fans to discharge the potential contaminants generated by the equipment.

5.10 Dehumidification System

Building system provides ventilating and dehumidifying unit due to the ice rink in the building. Also, the air is heated and dehumidified in Air Handling Units. Occupied spaces in the building maintain relative humidity less than 65%.

5.14 Access for Inspection, Cleaning, and Maintenance

Ventilation equipment is installed with sufficient working spaces for routine inspection, maintenance, or calibration.

5.15 Building Envelope and Interior Surfaces

Exterior wall provides to prevent liquid water. All pipes and ducts are insulated due to the condensation on interior surfaces.

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

Building is part of school facilities and all spaces are non-smoking area.

ASHREAE 62.1 - 2007 Section 6 Procedure

The procedure to achieve the required value of design outdoor air intake flow is shown as below.

$$V_{bz} = R_{p} * P_{z} + R_{a} * A_{z}$$
(6-1)

 $\begin{array}{l} A_z = \text{zone floor area (ft2)} \\ P_z = \text{zone population (table 6-1)} \\ R_p = \text{outdoor air flow rate (table 6-1)} \\ R_a = \text{outdoor airflow rate (table 6-1)} \\ V_{bz} = \text{breathing zone outdoor air flow} \end{array}$

$$V_{oz} = V_{bz} / E_z \tag{6-2}$$

 V_{oz} = design zone outdoor airflow $E_z = 1$ zone air distribution effectiveness (table 6-2)

$$Z_{p} = V_{oz} / V_{pz}$$
(6-5)

 Z_p = zone primary outdoor air fraction V_{pz} = zone primary air flow

$$V_{ou} = D * \Sigma_{all \ zones} \ (R_p * P_z) + \Sigma_{all \ zones} \ (R_a * A_z) \ \ (6\text{-}6)$$

 V_{ou} = design uncorrected outdoor air intake D = occupant diversity

$$\mathbf{D} = \mathbf{P}_{\rm s} / \boldsymbol{\Sigma}_{\rm all \ zones} \mathbf{P}_{\rm z} \tag{6-7}$$

 P_s = system population

$$V_{ot} = V_{ou} / E_v \tag{6-8}$$

V_{ot} = design outdoor air intake flow

 $E_v =$ system ventilation efficiency (table 6-3)

	Woong June Chung
Richard T. Flood Jr.,	& Sally Elliot Flood Athletic Center
	Salisbury, CT

	required OA	OA CFM		Comply?
AHU - 1, AHU - 2	4508	17600	basketball court	yes
AHU - 4	618	2950	Storage	yes
AHU - 5	1906	640	squash court	no
AHU - 6	1936	1500	wrestling room, locker room	no
AHU - 7	741	800	weight room, locker room	yes
AHU - 8	416	855	corridor of second floor	yes
AHU - 9	815	1400	athlete waiting room	yes
AHU - 10	69	360	Offices	yes

Air Handling Unit 1 and 2 have excessive amount of outside air intake due to the audiences of basketball game event. Air Handling Units for squash court and wrestling room do not comply with ASHRAE 62.1-2007.

The spread sheet for calculation is provided in Appendix A.

ASHRAE 90.1 - 2007 Section 5 Building Envelope

	Wall Gross Area(sf)	Glass Area(sf)	Max Glass Area(sf)	Comply?
West	13865	3028.15	5546	yes
East	13865	1541.37	5546	yes
North	11718	3520.29	4687.2	yes
South	11718	0	4687.2	yes

Vertical glazing area has to be less than 40% of gross area.

Climate Zone of Connecticut is 5 from ASHREAE 90.1 -2007 Appendix B Table B-1. According to Table 5.5-5, required R-values of roof, wall above grade and slab on grade floor area shown as below.

		Required R-value	Actual R-value	Comply?
Roof	insulated	20	54.4	yes
Wall above grade	mass	11.4	40.941	yes
Slab on grade floors	unheated	NR	13.6	yes

All of actual R-values exceed greatly, because the facility holds ice rink which needs more insulation. If the heat enters the building easily, it will cost more money to maintain the ice rink condition.

ASHRAE 90.1 - 2007 Section 6 Heating, Ventilating, and Air Conditioning

The gross area of the building exceeds $25,000 \text{ ft}^2$. Mandatory provision method will be used to determine the compliance with ASHREAE 90.1 section 6. With variable volume, CFM*0.0015 should be greater than horsepower that was used for the equipment.

Ice Rink Ventilating & Dehumidifying Unit								
	HP	Comply?						
IRDU-1	10000	15	15	yes				

Fan	CFM	CFM * 0.0015	HP	Comply?
EF-1	2000	3	1	yes
EF-2	150	0.225	0.068	yes
EF-3	800	1.2	0.333	yes
EF-4	75	0.1125	0.027	yes
EF-5	740	1.11	0.346	yes
EF-6	900	1.35	0.333	yes
EF-7	75	0.1125	0.027	yes
EF-8	300	0.45	0.114	yes
EF-9	300	0.45	0.114	yes
EF-10	4400	6.6	2	yes
EF-11	6950	10.425	3	yes
EF-12	200	0.3	0.143	yes
EF-13	3500	5.25	0.75	yes
EF-14	340	0.51	0.125	yes
EF-15	12500	18.75	5	yes
EF-16	6270	9.405	3	yes
EF-17	11000	16.5	10	yes
EF-18	5675	8.5125	3	yes
EF-19	3100	4.65	3	yes
EF-20	3200	4.8	0.5	yes
SAF -1	400	0.6	0.167	yes

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	Salisbury, CT

AHU	CFM	CFM * 0.0015	HP	Comply?
AHU-1	15400	23.1	10	yes
AHU-2	15400	23.1	10	yes
AHU-4	5675	8.5125	3	yes
AHU-5	11000	16.5	10	yes
AHU-6	6950	10.425	5	yes
AHU-7	6270	9.405	5	yes
AHU-8	10000	15	7.5	yes
AHU-9	4550	6.825	3	yes
AHU-10	1200	1.8	1	yes

All the equipment units comply with ASHRAE 90.1-2007.

Section 7 Service Water Heating

Boiler	IBR gross output (MBH)	IBR net output (MBH)	Efficiency	Required Efficiency	Comply?
B-1	3957	3441	86.96%	80%	yes
B-2	3957	3441	86.96%	80%	yes
B-3	1281	1114	86.96%	80%	yes
B-4	1281	1114	86.96%	80%	yes

The required efficiency for the boilers is 80%. All the boilers have an efficiency of 86.96% and complies with ASHRAE 90.1-2007.

Section 9 Lighting

According to the Table 9.5.1, Lighting Power Density for the gymnasium is 1.1 W/ft^2 The LPD of the facility is 0.93 W/ ft² does not exceed the allowable value. Therefore it complies with ASHRAE 90.1-2007

Appendix A Calculation Spreadsheet for Outside Air Requirements

AHU – 1, AHU - 2

Building	•	Delete Zone	Richard T. Flood Jr. & Sally Elliot Flood Athletic Cent						etic Cent		
System	Tag/Name:	Delete Zolle	AHU - 1, AHU - 2								
Operatin	g Condition Description:	Add Zono	Basketball Court						,		
Units (se	elect from pull-down list)	Aud 2011e	IP								
	OA reg'd per person for system area	(Weighted average	Rps	cfm/p					0.0		
Inputs fo	r Potentially Critical zones									Potentially C	ritical Zones
_	Zone Name		Zone ti	itle tum	s pur	ple italic f	or critical zo	ne(s)	enter name	enter name
	Zone Tag	-								AHU - 1	AHU - 2
	Show Values p	er Zone								Gvm.	Gvm.
	Space type									stadium	stadium
				Select	from	oull-down	n list			(play area)	(play area)
	Floor Area of zone		A7	sf						7 513	7513
	Design population of zone		P7	P	(def	ault value	listed: may	be o	verridder	225.39	225.39
	Design total supply to zone (primary	nius local recirculat	Vdzd	cfm	(0.0.		instee, integ		- cincuci	15 400	15400
	Induction Terminal Unit, Dual Fan D	ual Duct or Transfe	Fan2	Select	from	null-dowr	list or leav	e ble	nk if N/A	10,400	10400
-	Local regire, air % representative of s	we system return ei	Er	Jeleu	il Official	pun-uowi	i list of reav			7.5%	75%
Inputs fo	Concentration Condition Analyzed	ive system return at									1011
inputs it	Percent of total design airflow rate at	conditioned analy	De	04					100%	100%	100%
	Air distribution type at conditioned a	nelvzed	03	Select	from	upull-down	- lic'		10070	000	00%
	An distribution type at conditioned a	conditioned analyz	E-	Seleci	nom	i puli-dowi	Show c	o de s	for Ez	1.00	1.00
	Zone all distribution ellectiveness at	conditioned analyz	5-							1.00	1.00
Desults	Primary air fraction of supply air at d	onditioned analyze	Ep		-						
Results	Vestilation System Efficiency		E.						4.00		
	Outdate air intelease united for system	-	EV	-					1.00		
-	Outdoor air Intake required for system	1	VOL	cim					4008		
	Outdoor air per unit floor area	<i>e</i>	VOUAS	crm/sr					0.30		
	Outdoor air per person served by syst	em (including dive	VOt/Ps	cfm/p					10.0		
	Outdoor air as a % of design primary	supply air	тра	cfm					15%		
Detailed	Calculations							-			
Initial Ca	alculations for the System as a whole	•									
	Primary supply air flow to system at c	= onditioned analyze	Vos	cfm	=	VodDs		=	30800		
	UncorrectedOA requirement for systemet	m	Vou	ofm	=	Ros Ps +	Rac Ac	=	4508		
	Uncorrected OA regid as a fraction of	primary SA	Xe		=	Vou / Vos		=	0.15		
Initial Ca	alculations for individual zones	printing of t	10			*****	·		0.10		
initial Ge			Paz.	ofm/sf						0.30	0.30
	OA rate per dim area for 20ne		Roz	ofm/n						0.00	0.00
	Total supply air to zone (at condition	(being englyzed)	Vda	ofm						15400	15400
	Unused QA read to breathing zone	i being analyzed)	Vuz	ofm	_		Boz Az	_		2252.9	2252.9
	Unused OA requirement for zone		Voz	ofm		Vbz/Ez	Raz Az			2203.5	2203.5
	Eraction of zone supply not directly a	anira fram anna	502	um	- 2	V02/E2	-VEr	- 2		1.00	1.00
	Fraction of zone supply not directly in	eard mon zone	га			Ep + (1-E	.p)⊏i			1.00	1.00
	Fraction of zone supply from fully mi	xed primary air	FD		-			-		1.00	1.00
	Haused OA feeting required in rectly rect	c. nom zone	74		-	1-(1-EZ)(1	-=p)(1-=r)	-		1.00	1.00
	Unused OA fraction required in supp	y air to zone	20		=	VOZ / VOZ		=		0.15	0.15
Curton	Unused OA traction required in prima	ary air to zone	Zp		=	voz / vpz	-	=		0.15	0.15
system	Zee Vertilation Efficiency	(-+					-			4.00	4.00
	Zone Ventilation Efficiency (App A Method)		EVZ		=	(F8 + Fb)	G-FCZ)/F8	. =	4.00	1.00	1.00
System Ventilation Efficiency (App A Method)		EV		=	min (Evz)	T-LI-	=	1.00			
Ventilation System Efficiency (Table 6.3 Method)		Ev		=	Value fro	m Table 6.3		1.00			
Minimun	n outdoor air intake airflow										
	Outdoor Air Intake Flow required to S	System	Vot	cfm	=	Vou / Ev		=	4508		
	OA intake req'd as a fraction of prima	ary SA	Y		=	Vot / Vps		=	0.15		
	Outdoor Air Intake Flow required to S	system (Table 6.3 N	Vot	cfm	=	Vou / Ev		=	4491	16.36	
	OA intake req'd as a fraction of prima	ary SA (Table 6.3 N	Y		=	Vot / Vps		=	0.15	0.00	
OA Tem	p at which Min OA provides all cooli	ng									
	OAT below which OA Intake flow is (2 minimum		Deg F	=	{(Tp-dTsf))-(1-Y)*(Tr+d	=	-44		

Building	:		Delete Zene	Richar	d T. Flo	od J	r. & Sally	Elliot Flood	Athl	etic Cent		
System Tag/Name:					AHU - 4							
Operating Condition Description:					e]		
Units (select from pull-down list) Add Zone			IP									
Inputs fo	r System			Name	Units					System		
-	Floor area served b	y system		As	sf					5150		
	Population of area	served by system	(including diversity	Ps	P		100%	diversity		0		
	Design primary sup	oly fan airflow rat	e	Vosd	cfm					5,675		
	OA reo'd per unit a	rea for system (We	eighted average)	Ras	cfm/sf					0.12		
	OA reg'd per perso	n for system area	(Weighted average	Ros	cfm/p					0.0		
Inputs fo	r Potentially Critica	l zones	(Potentially C	ritical Zones
_	Zone Name			Zone t	itle tum:	s pur	ple italic i	for critical zo	ne(s)	enter name	enter name
	Zone Tao		-								enter tag	enter tag
		Show Values p	er Zone								Storage	Office
	Space type -				Select	from	oull-dow	n list			rooms	space
	Floor Area of zone			47	of						5 150	
-	Design population	of zone		Pz	P	(def	ault value	listed: may	he r	werridden	0,700	0
	Design total supply	to zone (primen/	olus local recirculat	Vdzd	cfm	(ae)	Son value			emuuel	5.875	0
	Induction Termine	Unit Duel Fee D	ual Duct or Transfer	Fan2	Select	from	upull-dow	n list or leave	ble	ank if N/A	0,070	
-	Local regire air %	enresentative of a	we system return ai	Fr	Jelea	agitt	pan-uow	. ist of reave		a as 11 1974	7504	7.504
Inputs fo	Construction Condition	on Analyzed	we system return at	-		-			_			2 0 75
mputs 10	Percent of total do	tion airflow rate of	conditioned sock	De	94					100%	100%	100%
	Air distribution tree	and an ownate a	nelvzed	03	Select	from	upull-dow	n lis		100%	100%	100%
	Zano oir distribution type	a offectiveness of	conditioned applys	E -	Select	nom	i pun-dow	Show co	de	s for Ez	1.00	1.00
	Zone all distributio	of supply pit of or	conditioned analyz	50							1.00	1.00
Desults	Frimary air fraction	or suppry air at o	onutioned analyze	Ер		-						
Results	Ventilation Custom	Cfficience:		E						4.00		
-	Ventilation System	Emiciency	_	EV	-					1.00		
-	Outdoor air Intake I	required for system	1	VOL	crm					618		
	Outdoor air per uni	t floor area		VOUAS	cfm/sf					0.12		
	Outdoor air per per	son served by syst	em (including diver	VOUPS	crm/p					#DIV/0!		
	Outdoor air as a %	of design primary	supply air	rpd	cfm					11%		
D-t-ll-d	O-level-firms								_			
Detailed	Calculations for the S	vetom as a whole										
initial Ca	Primary supply air i	flow to custom at a	<u>e</u> onditioned analyze	Ver	of m	_	VedDe		_	5875		
-	Uncorrocted OA rea	uiromont for curto	m analyze	Vou	ofm		Pos Do +	Pac Ac	_	810		
-	Uncorrected OA reg	d or a fraction of	inimony SA	Vou	Cam		Vou /Vo	Ras As	_	0.11		
Initial Ca	Inconcelled OA rec	d as a naction of	primary on	~		-	vou / vp	2	-	0.11		
initial Ca	OA rate per unit er	nuual zones		Baa	of on /of						0.42	0.08
-	OA rate per unit an	earlor zone		Raz Dee	cim/si						0.12	0.00
-	Tatal supply sists	Tono (at condition		Nda Vda	cim/p						5875	5.00
-	Haused QA sacid to	zone (at condition	rbeing analyzed)	Voz	dim	-	Dee De	Dee Ae			90/5	0
-	Unused OA regid to	breatning zone		VDZ	dm	-	Kpz Hz +	Raz Az	-		018.0	0.0
-	Gradies of require	ment for zone		VOZ	am	=	VDZ/EZ	-15-	=		018	1.00
-	Fraction of zone su	ppiy not directly r	earc. from zone	Fa Fb		=	Ep + (1-E	:p)er	=		1.00	1.00
-	Fraction of zone su	pply from fully mi	xed primary air	PD Fo		=	Ep A (A E) V		=		1.00	1.00
-	Fraction of zone O/	A not directly recir	c. from zone	FC Z		=	1-(1-EZ)(1-Ep)(1-Er)	=		1.00	1.00
-	Unused OA fraction	required in suppl	iy air to zone	20		=	voz / Vd	z	=		0.11	0.00
	Unused OA fraction	required in prima	ary air to zone	Zp		=	voz / Vp	z	=		0.11	0.00
System	ventilation Efficience	<u>2V</u>	1 - 1113	-								
-	Zone Ventilation E	mciency (App A N	lethod)	EVZ		=	(Fa + Fb)	xs-Foz)/Fa	=		1.00	1.11
System Ventilation Efficiency (App A Method)		Ev		=	min (Evz)	=	1.00				
	Ventilation System	Efficiency (Table	6.3 Method)	Ev		=	Value fro	m Table 6.3	=	1.04		
Minimun	n outdoor air intake	airflow										
	Outdoor Air Intake	Flow required to 9	System	Vot	cfm	=	Vou / Ev		=	618		
	OA intake req'd as	a fraction of prima	ary SA	Y		=	Vot / Vps		=	0.11		
-	Outdoor Air Intake	Flow required to 9	System (Table 6.3 N	Vot	cfm	=	Vou / Ev		=	594	24.40	
	OA intake req'd as	a fraction of prima	ary SA (Table 6.3 M	Y		=	Vot / Vps		=	0.10	0.04	
OA Temp	at which Min OA	provides all cooli	nq		_							
	OAT below which (DA Intake flow is (2 minimum		Deg F	=	{(Tp-dTsf)-(1-Y)*(Tr+d	=	-84		

AHU-5

Building				Richar	d T. Flo	od J						
System	Tag/Name:		AHU -	5								
Operatin	a Condition Descri	ption:		Squas	h Court							
Units (select from pull-down list) Add Zone												
	Population of area served by system (including diversity				P		100%	diversity		191		
	Design primary sup	oly fan airflow rate		Vosd	cfm					11.000		
	OA reg'd per unit a	rea for system (We	ighted average)	Ras	cfm/sf					0.30		
	OA reg'd per persor	n for system area	Weighted average	Rps	cfm/p					0.0		
Inputs fo	r Potentially Critica	l zones									Potentially C	ritical Zones
	Zone Name			Zone ti	itle tum	s pur	ple italic f	or critical zo	ne(s)	enter name	enter name
	Zone Tag	Channy Malurana and	. 7								enter tag	enter tag
		anow values pe	a zone								Gym,	Office
	Space type										stadium	space
					Select	from	pull-dowr	n list			(play area)	
	Floor Area of zone				sf						6,352	
	Design population	of zone		Pz	P	(def	ault value	listed; may	be o	verridder	190.56	0
	Design total supply	to zone (primary	olus local recircula	Vdzd	cfm						11,000	
	Induction Terminal	l Unit, Dual Fan D	al Duct or Transfe	Fan?	Select	from	pull-dowr	list or leave	e bla	ank if N/A		
	Local recirc. air % r	representative of a	ve system return a	i Er							75%	75%
Inputs fo	r Operating Conditi	on Analyzed										
	Percent of total des	sign airflow rate at	conditioned analy	Ds	%					100%	100%	100%
	Air distribution type	e at conditioned a	nalyzed		Select	from	pull-dowr	1 lis	da	for Er	CS	CS
	Zone air distributio	n effectiveness at	conditioned analy.	z Ez				SHOW CO	Jues	STOPEZ	1.00	1.00
	Primary air fraction	of supply air at co	nditioned analyze	Ep								
<u>Results</u>												
	Ventilation System	Efficiency		Ev						1.00		
	Outdoor air intake r	required for system		Vot	cfm					1906		
	Outdoor air per unit floor area			Vot/As	cfm/sf					0.30		
	Outdoor air per per	son served by syste	em (including dive	Vot/Ps	cfm/p					10.0		
	Outdoor air as a % of design primary supply air				cfm					17%		
	A. 1. 1. 1.											
Detailed	Calculations											
initial Ca	Discussions for the S	lystem as a whole		V	-	_	Ved De		_	44000		
	Uncorrected OA rea	now to system at o	nomoneo anaryz	Vou	dm	-	Pos Po +	Pac Ac	-	1000		
	Uncorrected OA reg	ultement for system	n primony SA	Vou	am	-	Nou / Vo	Ras As		0.17		
Initial Ca	louistions for indiv	idual zonos	primary SA	~		-	vou / vps	>	-	0.17		
initial Ca	OA rate per unit an	nutar zones		Baz	of colof						0.20	0.06
	OA rate per unit an	ea for zone		Roz	cfm/n						0.00	5.00
	Total supply air to:	zone (et condition	heing enelyzed)	Vdz	ofm						11000	0.00
	Unused QA regid to	breathing zone	comg analyzed)	Vbz	cfm	=	Roz Pz +	Raz Az	=		1905.6	0.0
	Unused OA require	ment for zone		Voz	cfm	=	Vbz/Ez		=		1906	0.0
	Fraction of zone su	poly not directly re	circ. from zone	Fa		=	Ep + (1-E	in)Er	=		1.00	1.00
	Fraction of zone su	poly from fully mit	red primary air	Fb		=	Ep		=		1.00	1.00
	Fraction of zone Or	A not directly recir	from zone	Fo		=	1-(1-Ez)(1	-Ep)(1-Er)	=		1.00	1.00
	Unused OA fraction	required in suppl	v air to zone	Zd		=	Voz / Vdz	,,	=		0.17	0.00
Unused OA fraction required in primary air to zone			70		=	Voz / Voz	,	=		0.17	0.00	
System	Ventilation Efficience	CV	,					-				
Zone Ventilation Efficiency (App A Method)		Evz		=	(Fa + Fb)	(s - FcZ) / Fa	=		1.00	1.17		
	System Ventilation Efficiency (App A Method)		Ev		=	min (Evz))	=	1.00			
	Ventilation System Efficiency (Table 6.3 Method)		Ev		=	Value fro	m Table 6.3	=	0.98			
Minimun	n outdoor air intake	airflow										
	Outdoor Air Intake	Flow required to S	ystem	Vot	cfm	=	Vou / Ev		=	1906		
	OA intake reg'd as a fraction of primary SA		Y		=	Vot / Vps		=	0.17			
	Outdoor Air Intake Flow required to System (Table 6.3 N			Vot	cfm	=	Vou / Ev		=	1951		
	OA intake reg'd as	a fraction of prima	ry SA (Table 6.3 M	Y		=	Vot / Vps		=	0.18		
OA Tem	at which Min OA p	provides all cooli	19									
	OAT below which (DA Intake flow is @) minimum		Deg F	=	{(Tp-dTsf)-(1-Y)*(Tr+d	=	-26		

Building:	Richar	d T. Flo	od J									
System Tag/Name:					6							
Operating Condition Description: Add Zone					ing Roo	m, L	ocker Ro	om				
Units (select from pull-down list)				IP								
Inputs to	r System			Name	Units					System		
	Floor area served by system			As	sf					6454		
	Population of area served by	y system (includir	ig diversity	Ps	P		100%	diversity		194		
	Design primary supply fan ai	rflow rate		Vpsd	cfm					6,950		
	OA req'd per unit area for sys	stem (Weighted a	iverage)	Ras	cfm/sf					0.30		
	OA req'd per person for syste	m area (Weighte	ed average	Rps	cfm/p					0.0		
Inputs fo	r Potentially Critical zones										Potentially C	ritical Zones
	Zone Name			Zone t	itle tum	s pui	ple italic :	for critical zo	ne(s)	enter name	enter name
	Zone Tag Show V	alues per Zone									enter tag	enter tag
											Gym,	Office
	Space type										stadium	space
					Select	from	pull-dow	n list		(play area)		
	Floor Area of zone			Az	sf						6,454	
	Design population of zone			Pz	P	(def	ault value	listed; may	be o	verridder	193.62	0
	Design total supply to zone (primary plus loca	I recircula	Vdzd	cfm						6,950	
	Induction Terminal Unit, Dua	al Fan Dual Duct	or Transfe	Fan?	Select	from	pull-dow	n list or leave	e bla	nk if N/A		-
	Local recirc. air % representa	ative of ave syste	m return a	Er							75%	75%
Inputs fo	r Operating Condition Analyz	zed										
	Percent of total design airflo	w rate at condition	oned analy	Ds	96					100%	100%	100%
	Air distribution type at condit	tioned analyzed			Select	from	pull-dow	n lisi			CS	CS
	Zone air distribution effective	eness at conditio	ned analy;	Ez				Show co	de s	s for Ez	1.00	1.00
	Primary air fraction of supply	air at condition	ed analyze	Ep								
Results				<u> </u>								
	Ventilation System Efficience	x		Ev						1.00		
	Outdoor air intake required for	or system		Vot	cfm					1936		
	Outdoor air per unit floor area				cfm/sf					0.30		
	Outdoor air per person served by system (including diver				cfm/p					10.0		
	Outdoor air as a % of design	primary supply a	ir a	Yod	cfm					28%		
Detailed	Calculations											
Initial Ca	Iculations for the System as	a whole										
	Primary supply air flow to sys	stem at condition	ed analyze	Vps	cfm	=	VpdDs		=	6950		
	UncorrectedOA requirement	for system		Vou	cfm	=	Rps Ps +	Ras As	=	1936		
1	Uncorrected OA reg'd as a fra	action of primary	SA	Xs		=	Vou / Vp	s	=	0.28		
Initial Ca	lculations for individual zon	ies										
	OA rate per unit area for zon	ie		Raz	cfm/sf						0.30	0.06
1	OA rate per person			Rpz	cfm/p						0.00	5.00
	Total supply air to zone (at o	condition being a	nalyzed)	Vdz	cfm						6950	0
	Unused OA reg'd to breathing	g zone		Vbz	cfm	=	Rpz Pz +	Raz Az	=		1936.2	0.0
	Unused OA requirement for a	zone		Voz	cfm	=	Vbz/Ez		=		1936	0
1	Fraction of zone supply not o	directly recirc. fro	m zone	Fa		=	Ep + (1-E	Ep)Er	=		1.00	1.00
	Fraction of zone supply from	fully mixed prim	ary air	Fb		=	Ep		=		1.00	1.00
1	Fraction of zone OA not dire	ctly recirc. from a	one	Fo		=	1-(1-Ez)(1-Ep)(1-Er)	=		1.00	1.00
1	Unused OA fraction required	in supply air to :	one	Zd		=	Voz / Vd	7	=		0.28	0.00
1	Unused OA fraction required	in primary air to	zone	70		=	Voz / Vo	-	=		0.28	0.00
System \	System Ventilation Efficiency										0.20	0.00
<u>oj stemi</u>	Zone Ventilation Efficiency ((App A Method)		Evz		=	(Fa + Fb)	Xs - EcZ) / Ea	=		1.00	1.28
System Ventilation Efficiency (App A Method)			Ev		=	min (Evz)	=	1.00			
Ventilation System Efficiency (App A Method)			Ev		=	Value fro	m Table 6.3	=	0.87			
Minimum outdoor air intake airflow						i di de li d			0.01			
	Outdoor Air Intake Flow requ	ired to System		Vot	cfm	=	Vou / Ev		=	1936		
	Outdoodr Air Intake Flow required to System			Y		=	Vot / Vos		=	0.28		
-	Outdoor Air Intake Elow room	ured to System (Table 6.2.1	Vot	ofm	-	Vou / Ev		-	2222		
	OA intake read as a fraction	of primary SA (T	able 6.2 M	ly l	ann	-	Vot / Ver		-	0.22		
	at which Min OA provides	all cooling	able 0.5 K				vor/vps			0.32		
<u>on remp</u>	OAT below which OA Inteke	flow is @ minim	um		Deg E	=	//To-dTef	ALLAN TITA	=	11		
	over below which over make	nea is te minim	and the		Degr		The second	1 - 1 / LITE	_			

Building	Richar	d T. Flo	od J									
System Tag/Name:					7							
Operating Condition Description: Add Zone					t Room,	Loc						
Units (select from pull-down list)												
Inputs fo	r System			Name	Units					System		
	Floor area served by	system		As	sf					6178		
	Population of area se	erved by system (including diversity	Ps	P		100%	diversity		0		
	Design primary supply	y fan airflow rate		Vpsd	cfm					6,270		
	OA reg'd per unit are	a for system (We	ighted average)	Ras	cfm/sf					0.12		
	OA reg'd per person f	or system area (Weighted average	Rps	cfm/p					0.0		
Inputs fo	r Potentially Critical	zones	· ·								Potentially C	ritical Zones
_	Zone Name			Zone ti	tle tum	s pur	ple italic i	for critical zo	ne(s)	enter name	enter name
	Zone Tag		_								enter tag	enter tag
	-	Show Values pe	r Zone							Í	Storage	Office
	Space type				Select	from	oull-dow	n list			rooms	space
	Floor Area of zone			47	of		panaom	11120			8 178	
	Design population of	7000		P7	P	(def	ault value	listed: may		werridder	0,170	0
	Design population of	zone (primopur	lus local regiraula	Vdzd	ofm	(ue)	aan varue	nated, may	Je (Mennuder	8 270	0
	Induction Terminel II	Init Duel Foo D	al Duct or Transfe	Eac2	Salact	from	oull down	n list or leave	bla	nk if M/A	0,270	
	Local ragina air % rag	mit, Duar Fall Di	an Duct or Transfe	Fan?	Select	nom	pun-dow	inst or reave	018	INK ILIWA	7,504	75%
In such a fee	Locarrectic all % rep	Analysis d	ve system return al	EI							7 0 70	/ 0 70
inputs to	Properating Condition	<u>n Analyzed</u>	and the second second	D-						4000/	4000/	100%
	Percent of total desig	in airriow rate at	conditioned analy	US	76 Colored		and the states	11.1		100%	100%	100%
	Air distribution type a	it conditioned ar	nalyzed	-	Select	Trom	pull-dow	Show co	de	s for Ez	US LOS	65
	Zone air distribution (effectiveness at (conditioned analyz	EZ				0			1.00	1.00
	Primary air fraction of	f supply air at co	nditioned analyze	Ep								
Results				_								
	Ventilation System E	fficiency		Ev						1.00		
	Outdoor air intake rec	quired for system		Vot	cfm					741		
	Outdoor air per unit f	loor area		Vot/As	cfm/sf					0.12		
	Outdoor air per perso	n served by syste	em (including dive	Vot/Ps	cfm/p					#DIV/0!		
	Outdoor air as a % of	design primary	supply air	Ypd	cfm					12%		
Detailed	Calculations											
Initial Ca	Iculations for the Sys	stem as a whole										
	Primary supply air flo	w to system at o	onditioned analyze	Vps	cfm	=	VpdDs		=	6270		
	UncorrectedOA requi	rement for syster	n	Vou	cfm	=	Rps Ps +	Ras As	=	741		
	Uncorrected OA req'd	l as a fraction of	primary SA	Xs		=	Vou / Vp	5	=	0.12		
Initial Ca	Iculations for individ	ual zones										
	OA rate per unit area	for zone		Raz	cfm/sf						0.12	0.06
	OA rate per person			Rpz	cfm/p						0.00	5.00
	Total supply air to zo	ne (at condition	being analyzed)	Vdz	cfm						6270	0
	Unused OA reg'd to b	reathing zone		Vbz	cfm	=	Rpz Pz +	Raz Az	=		741.4	0.0
	Unused OA requirem	ent for zone		Voz	cfm	=	Vbz/Ez		=		741	0
	Fraction of zone supp	oly not directly re	circ. from zone	Fa		=	Ep + (1-E	Ep)Er	=		1.00	1.00
	Fraction of zone supp	bly from fully mix	ed primary air	Fb		=	Ep		=		1.00	1.00
	Fraction of zone OA	not directly recire	c. from zone	Fc		=	1-(1-Ez)(*	1-Ep)(1-Er)	=		1.00	1.00
	Unused OA fraction re	equired in suppl	y air to zone	Zd		=	Voz / Vd	z	=		0.12	0.00
	Unused OA fraction re	equired in prima	rv air to zone	Zo		=	Voz / Voz	z	=		0.12	0.00
System	Ventilation Efficiency											
	Zone Ventilation Effi	ciency (App A M	ethod)	Evz		=	(Fa + Fb)	(s - EcZ) / Ea	=		1.00	1 12
System Ventilation Efficiency (App A Method)			Ev		=	min (Evz)	=	1.00			
Ventilation System Efficiency (Table 6.3 Method)			Ev		=	Value fro	m Table 6.3	-	1.03			
Minimun	n outdoor air intake a	irflow					, and the					
	Outdoor Air Intake Ek	ow required to S	vstem	Vot	cfm	=	Vou / Ev		=	741		
	OA intake regid as a f	fraction of prime	N SA	Y	2	=	Vot / Vos		-	0.12		
	Outdoor Air Inteke Ek	ow required to S	ystem (Table 8.2.1	Vot	cfm	-	Vou / Ev		-	719	22.02	
	OA inteke regid os of	fraction of prime	ystern (Table 0.5 h	v.	Cana	-	Vot / Ver		-	0.11	22.82	
OA Tom	at which Min OA pro	wides all ocoli	iy on (rable 0.5 li				vouv vps			0.11	0.03	
OA Temp	OAT below which OA	Inteks flow is 6	nu nainimum		Dec 5	_	(To dTe		_	72		
	OAT DEIOW WITCH OP	a make now is (a	c mannum		Degin		The start	Mini (nita	-	-12		

Building			Richar	d T Elo	. ho							
System	Tag/Name:		Delete Zone	AHU -	8							
Operatir	Corrid	or										
Units (select from pull-down list) Add Zone												
01112 [31						_						
Inputs fo	or System			Name	Units					System		
inputs is	Floor area served	hy system		Δe	of	-				6938		
	Population of area	a served by system	(including diversity	Pe	P	-	100%	diversity		0000		
-	Design primary su	only fan airflow rate	(morouning orversity	Voed	of m		10070	diversity		10,000		
-	OA regid per unit	area for system (We	- viabted everege\	Rec	ofm/sf					0.06		
-	OA regid per units	area for system (we	(Weighted average)	Res	ofm/n					0.00		
Inputs fo	or Potentially Critic	al zones	(weighted average	i tps	Gintep					0.0	Potentially C	ritical Zones
inputs it	Zone Name	di Lone s		Zone t	itle turn	0.000	mle italic	for critical zo	nel	•)	enter name	enter name
	Zone Tag			Loncia		, pui	pre nano		1		enter tan	enter tan
	Space type	Show Values p	er Zone		Select	from	null-dow	n list			Corridors	• Office
	Eloor Area of zone	<u></u>		A7	sf		pan aon				6 938	0
	Design population	- Lof zone		P7	P	(def	fault value	listed: may	be (overridder	0,000	0
	Design total suppl	v to zone (primerv)	olus local recirculat	Vdzd	cfm	(00	aun varae	instea, may		oveniouei	10 000	
	Induction Termina	I Unit Duel Fen D	ual Duct or Transfe	Ean2	Select	from	oull-dow	n list or leave	a ble	ook if N/A	10,000	
-	Local regire air %	representative of a	ve system return of	Fr	Jereu	- non	pundow	in this of reality		and they A	7.5%	75%
Inputs fr	or Operating Condit	tion Analyzed	ive system retain at	-		-						
inputs it	Percent of total de	sion airflow rate at	conditioned analy	Ds	96	-				100%	100%	100%
-	Air distribution ton	e et conditioned a	nelvzed		Select	from	oull-dow	n lic'		100.0	0000	600
	Zone air distributiv	e al continuneu a	conditioned enalyz	E-	Jeleu	- IIOII	i pull-uow	Show c	o de	s for Ez	1.00	1.00
	Primony pir fraction	on enectiveness at	conditioned analyz	50							1.00	1.00
Poculto	Frimary air fractio	ir or suppry air at o	nuttioned analyze	ср	-	-			-			
ite suits	Ventilation System	n Efficiency		Ev						1.00		
-	Outdoor oir inteke	required for system		Vot	den	-				416		
	Outdoor air make	it floor area		Vot/Ac	ofm/sf	-				0.06		
	Outdoor air per un	in noor area	en (including dive	Vot/De	cfm/s					4DIV/01		
	Outdoor air per pe	ason served by syst	em (including diver	Votes	cfm/p					#DIV/0:		
	Outdoor air as a %	or design primary	supply all	rpu	am					470		
Detailed	Calculations								-			
Initial C:	alculations for the	System as a whole										
muarca	Primary supply air	flow to system at a	E onditioned enalyze	Voe	ofm	_	VodDe		_	10000		
	Uncorrocted QA ro	now to system at o	onumoneu anaryze	Vou	dm		Pos Do 4	Rec Ac	_	418		
	Uncorrected OA re	duitement for syste	primon/ SA	Vou	am		Vou /Vo	Ras As	_	0.04		
Initial C	alculations for indi	vidual zonos	primary SA	~		-	vou / vp	5	_	0.04		
initial Ga	OA rate per unit a	ron for zono		Por	of m/of						0.08	0.08
	OA rate per unit a	rea for zone		Dez	ofm/n						0.00	5.00
	Total supply air to	Tone (at condition	being applyzed)	Nd-	cim/p						10000	5.00
	Housed QA reside	zone (at condition	being analyzed)	Vuz	ofm	-	Der De 1	Boz Az	_		418.0	0.0
	Unused OA regid t	o breatning zone		Voz	dim	-	Npz HZ +	Raz Az	-		410.3	0.0
	Unused OA require	ement for zone		Voz	am	=	VDZ/EZ		-		416	1.00
	Fraction of zone s	upply not directly re	earc. from zone	Fa Eb		-	Ep + (1-E	ep)er	-		1.00	1.00
	Fraction of zone s	upply from fully mi	ked primary air	Fo		=	= p				1.00	1.00
	Haution of zone C	A not directly rear	c. nom zone	70		-	1-(1-EZ)(1.00	1.00
	Unused OA fractio	n required in suppl	y air to zone	20		=	voz / vo	z	=		0.04	0.00
Custom	Unused OA fractio	n required in prima	ary air to zone	ZР		=	voz / vp	z	-		0.04	0.00
aystem	Zono Vontilation	Efficiency (Apr. A. N	lathad)	Eve		-		Va E	_		1.00	1.04
	Zone ventilation t	Efficiency (App A N	Method)	EVZ			(Fatto)	лз-год)/га \		4.00	1.00	1.04
	Ventilation System	n Efficiency (App A	6.2 Method)	Ev			Volue fr	/ Table 6.5		1.00		
Minimum	rentriation system	n Enrolency (Table	0.5 Methody	20		-	value no	in Table 0.3	1	1.13		
winnun	Outdoor Air Intak	Elow required to S	vetem	Vot	ofm	-	Vou / Ex		-	440		
	OA inteke reciding	a fraction of prime	nystem ny SA	V	Gilli	-	Vot / Vot		-	416		
	Outdoor Air lately	Element of prima	iny OA System (Table 6.2.5	Vet	-		Vou / En		-	0.04	40.70	
	Outdoor Air Intake	a fraction of stime	ystem (Table 0.3 N	Vol	am	1	Vot / Vet		1	3/0	40.70	
	n at which Min OA	provides all esal	ny SA (Table 0.3 M				vor/vps			0.04	0.10	
OA rem	OAT below which	OA Inteke flow is 6	ninimum		Deg 5	-	//To-dTe	N.(1.V)*(Tete	-	-326		
	OAT DEIGW WHICH	OA make now is (g mannun		Degin	_	"The second	1 (1 TO)	_	-000		

System TagRame: Delete Zone Attu - s Units (select from pull-down list) Ad Zone Attu - s Inputs for System Name Units (select from pull-down list) System Population of area served by system Name Units (select from pull-down list) System Population of area served by system Name Units (select from pull-down list) System Population of area served by system Name Units (select from pull-down list) System OA red of per unit area for system (Vieglistic average) Pas drift 4 250 OA red of per unit area for system Pas drift 2 200 Per entrally Zone Name Zone Name Zone Name Select from pull-down list Reception Zone Name Zone Name Zone Name Select from pull-down list Reception Poeting population of zone Par P (default value listed, may be ovenidee 3883 Poeting population of zone Par Select from pull-down list Reception 3883 Poeting population of zone Par Select from pull-down list	Building: Delate Zees					Richar	d T. Flo	od Ji						
Operating Condition Description: Add Zone Athele Walling Room Insults for System Add Zone Athele Walling Room 3833 Population of area served by system (including diversity Op area primery pupp) for any served by system (including diversity Op Area of per person for trystem area. (Weighted average Zone Name Potentially Critical zones Potentially Critical zones Zone Name Zone Name Zone Inter Common Puppe Inter Atheney System (including diversity) Read diring Potentially Critical Zones Zone Tag Show Values per Zone Select from puppe Inter Atheney System (including diversity) Potentially Critical Zones Zone Name Zone Inter Lange puppe Inter Atheney System (including diversity) Readed from pul-I-down list Readed from pul-I-down list Readed from any Enter Atheney System (including Atheney System Stank Strange Readed from pul-I-down list Readed from System Stank Strange Readed from pul-I-down list Readed from System Stank Strange Readed from pul-I-down list Readed from System Stank Strange Readed from pul-I-down list Readed from System Stank Strange Readed from pul-I-down list Readed from System Stank Strange Readed from pul-I-down list Readed from System Stank Strange Readed from Stank Strange Readed from pul-I-down list Readed from Stank Strange R	System 1	Tag/Name:		Delete Zor	ie –	AHU - S	9							
Units (select from pull-down list) Non 2019 Inputs for System Name Units Filefor area served by system Name Units Filefor area served by system Name Units Outs for System Signam Signam Outs for System Name Units Outs for System Signam Signam Design total supply to some (primary puls local recruits) Cone the fum pull-down list Signam Design pulsition of zone Az of Design total supply to zone (primary plus local recruits) Cone Select from pull-down list Indust for Area of zone Az of Design total supply to zone (primary plus local recruits) Cone Select from pull-down list Indust for Area of zone Az of Design total supply at a conditioned analyzed Select from pull-down list Select from pull-down list Indust for Area of zone Select from pull-down list Select from pull-down list Indust for Area of zone Select	Operatin	g Condition Descrip	ption:			Athlete	Wating	Roc						
Inputs for System Name Units System Protorares served by system (including diversity) As af As af Protorares served by system (including diversity) As af 3883 3883 OA read op control system area (Weighted average) Rea dmp 0.08 0.08 0.08 Data for Chertally Critical cones Stow Values per Zone Select from pull-down list 0.08 0.09	Units (select from pull-down list) Add Zone					IP		· · · ·						
Inputs for System Name Units System Production of area served by system (Rodult of area served by system (including diversity) Ps P 100% (SSS) OA red per preson for system area (Weighted average) Ras dmis 0.08 0.09 OA red per preson for system area (Weighted average) Ras dmis 0.09 0.09 Zone Tag Show Values per Zone Select from pull-down list enter tag tag														
Ploor sets served by system (including diversity) As # 1005 3883 Design primary supply fan airflow rate Vpad dm 1005 diversity 4.550 OA reqid per unit area for system (Veighted average) Rs dmip 0.08 0.08 Jourts for Potentially Critical Jones 2.00 Filter fame 5.00 Potentially Critical Zones Jourts for Potentially Critical Jones 2.00 Filter fame 2.00 Filter fame 6.00 Prior fame Show Values per Zone 2.00 Filter fame 2.00 Filter fame 6.00 Design population of zone Az d 4 4 6.00 10.040 10.053 10.095 </td <td>Inputs fo</td> <td>r System</td> <td></td> <td></td> <td></td> <td>Name</td> <td>Units</td> <td></td> <td></td> <td></td> <td></td> <td>System</td> <td></td> <td></td>	Inputs fo	r System				Name	Units					System		
Population of area served by system (including diversity OA reqd per unit area for system area (Weighted average) OA reqd per person for system area (Weighted average) OA reqd per person for system area (Weighted average) DA reqd per person for system area (Weighted average) Potentially Critical Zones (Weighted average) Potentially Critical Zones (Weighted average) Zone Tag Stow Values per Zone Select from pull-down list asses Potentially Critical Zones (Weighted average) Design population of zone Design population of zone (Contineting Tamphy to zon (Prigning Tamphy to zon) (Prigning Tamphy to zon) (P		Floor area served b	y system			As	sf					3883		
Design primary supply fan airflow rate OA reg'd per unit area for system (Weighted average indust for Ortentially Critical zones Zone Name Verdig are present for system area (Weighted average drivp Potentially Critical Zones 50 Jone Name Zone Name Cone Values per Zone Potentially Critical Zones 70 Potentially Critical Zones 70 Zone Name Zone Yale Show Values per Zone Potentially Critical Zones 70 Potentially Critical Zones 70 Space type Show Values per Zone Select from pull-down list Reception 70 Select from pull-down list Design total supply to zone (primary plus local reducular Industor Terminal Unit, Dual Fan Doub Cut or Transite Local reduce ait's representative of area system Select from pull-down list or leave blank if NA Select from pull-down list 4.650 Inputs for Operating Confilton Analyzed Per cart of total design airflow rate at conditioned analyzed Done air distribution type area to conditioned analyzed Done air distribution type area to conditioned analyzed Doubtor air par person served by system (including divid) (Second analyze Doubtor air par person served by system (including divid) (Second analyze Doubtor air par person served by system (including divid) (Second analyze Doubtor air par person served by system (including divid) (Second analyze Doubtor air par person served by system (including divid) (Second analyze Doubtor air par person served by system (including divid) (Second analyze Doubtor air par person served by system (including divid) (Second analyze Doubtor air par person served by system (including divid) (Second analyze Doubtor air person served by		Population of area	served by system (including div	versity	Ps	P		100%	diversity		116		
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OA regrd per person for system area (Weighted average public for Orthonal Victical Zones) 50 Potentially Critical Zones Jone Name Zone Name Zone Name Zone Itile turns puple (faile for orthoal zone) Enter name enter tag Space type Show Values per Zone Zone Itile turns puple (faile for orthoal zone) Enter tag enter tag enter tag Design population of zone Az st genet tag areas rooms Design total supply to zone (primary plus local recirculat Victic Terminal Unit, Dual Fan Dual Duc or Trinstel Fan? Select from pull-down list or leave blank if NA 116.49 0 Induction Terminal Unit, Dual Fan Dual Duc or Trinstel Fan? Select from pull-down list or leave blank if NA 100% 100% 100% Induction Terminal Unit protein tage and tabulation of part and tabulation of part analyzed Ds % 100% 100% 100% 100% Percent of total design atriftom rate at conditioned analyzed Ds % 100% <td< td=""><td></td><td>OA reg'd per unit a</td><td>rea for system (We</td><td>ighted avera</td><td>ge)</td><td>Ras</td><td>cfm/sf</td><td></td><td></td><td></td><td></td><td>0.06</td><td></td><td></td></td<>		OA reg'd per unit a	rea for system (We	ighted avera	ge)	Ras	cfm/sf					0.06		
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Total supply air to zone (at condition being analyzed) Unused OA req'd to breathing zoneVdzcfm45500Unused OA req'd to breathing zoneVbzcfm=Rpz Pz + Raz Az=815.40.0Unused OA req'd to breathing zoneVozcfm=Voz/Ez=8150Fraction of zone supply not directly recirc. from zoneFa=Ep + (1-Ep)Er=1.001.00Fraction of zone of raction required in supply air to zoneFb=Ep=1.001.00Unused OA fraction required in supply air to zoneZd=Voz / Vdz=0.180.00Unused OA fraction required in supply air to zoneZd=Voz / Vpz=0.180.00System Ventilation Efficiency(Ap A Method)Evz=(Fa + FbXs - FcZ) / Fa=1.001.18System Ventilation Efficiency (Table 6.3 Method)Ev=min (Evz)=1.001.18Outdoor Air Intake Flow required to SystemVotcfm=Voz / Vps=0.97Minimum outdoor Air Intake Flow required to SystemVotcfm=Vou / Ev=845OA intake req'd as a fraction of primary SAY=Vot / Vps=0.18OAT below which OA Intake flow is @ minimumDeg F=((Tp-dTsf)-(1-Y)*(Tr+d)=-23		OA rate per person				Rpz	cfm/p						5.00	0.00
Unused OA requirement for zoneVbzcfm=Rpz Pz + Raz Az= 815.4 0.0Unused OA requirement for zoneVozcfm=Vbz/Ez= 815.4 0.0Fraction of zone supply not directly recirc. from zoneFa=Ep + (1-Ep)Er= 1.00 1.00Fraction of zone och not directly recirc. from zoneFb=Ep + (1-Ep)Er= 1.00 1.00Unused OA fraction required in supply air to zoneZd=Voz / Vdz= 0.18 0.00Unused OA fraction required in primary air to zoneZd=Voz / Vdz= 0.18 0.00Unused OA fraction required in primary air to zoneZd=Voz / Vdz= 0.18 0.00System Ventilation Efficiency(App A Method)Evz=(Fa + FbXs - FoZ) / Fa = 1.00 1.18 System Ventilation System Efficiency (App A Method)Ev=wine (Evz)= 1.00 1.18 Outdoor Air Intake Flow required to SystemVotcfm=Vou / Ev= 815 OA intake req'd as a fraction of primary SAY=Vot / Vps= 0.18 OA intake req'd as a fraction of primary SA (Table 6.3 NY=Vot / Vps= 0.18 OA below which OA Intake flow is @ minimumDeg F= $((Tp-dTsf)-(1-Y)^*(Tr+d) =23$ 23		Total supply air to :	zone (at condition	being analy.	zed)	Vdz	cfm						4550	0
Unused OA requirement for zoneVozcfmVoz/Ez= $\$15$ 0Fraction of zone supply not diredly recirc. from zoneFa=Ep + (1-Ep)Er= 1.00 1.00 Fraction of zone OA not diredly recirc. from zoneFa=Ep + (1-Ep)Er= 1.00 1.00 Fraction of zone OA not diredly recirc. from zoneFc= $1-(1-Ez)(1-Ep)(1-Er)$ = 1.00 1.00 Unused OA fraction required in supply air to zoneZd=Voz / Vdz= 0.18 0.00 Unused OA fraction required in primary air to zoneZd=Voz / Vpz= 0.18 0.00 System Ventilation Efficiency(App A Method)Evz= $(Fa + FbXs - FcZ) / Fa$ 1.00 1.18 System Ventilation Efficiency (App A Method)Ev=min (Evz)= 1.00 1.18 Outdoor Air Intake ainflowEv=Vot drm=Vot / Vps= 0.18 Outdoor Air Intake Flow required to System (Table 6.3 NY=Vot / Vps= 0.18 OA intake regid as a fraction of primary SA (Table 6.3 NY=Vot / Vps= 0.18 OAT below which OA Intake flow is @ minimumDeg F ${(Tp-dTsf)-(1-Y)^*(Tr+d)} = -23$ -23		Unused OA reg'd to	breathing zone			Vbz	cfm	=	Rpz Pz +	Raz Az	=		815.4	0.0
Fraction of zone supply not directly recirc. from zone Fraction of zone supply from fully mixed primary air Fraction of zone OA not directly recirc. from zone Fraction of zone OA not directly recirc. from zone Fraction of zone OA not directly recirc. from zone Unused OA fraction required in supply air to zone ZdFa $=$ Ep $=$ 1.00 1.00 Unused OA fraction required in supply air to zone Unused OA fraction required in primary air to zone Zone Ventilation Efficiency Ventilation Efficiency (App A Method) Ventilation Efficiency (App A Method) Ventilation System Ventilation Efficiency (Table 6.3 Method) Ev Evz $=$ $(Fa + FbXs - FcZ) / Fa$ 1.00 1.00 Minimum outdoor air intake airflow OA intake reqid as a fraction of primary SA OA intake reqid as a fraction of primary SA OA intake reqid as a fraction of primary SA (Table 6.3 N VVotcfm $=$ Vou / Ev $=$ 840 OA Teelow which OA Intake flow is @ minimumDeg F $=$ $(Tp-dTsf)-(1-Y)^*(Tr+d)$ $=$ -23		Unused OA require	ment for zone			Voz	cfm	=	Vbz/Ez		=		815	0
Fraction of zone supply from fully mixed primary air Fraction of zone OA not directly recirc. from zone Unused OA fraction required in supply air to zone Unused OA fraction required in primary air to zone ZdFb=Ep=1.001.00Unused OA fraction required in supply air to zone Unused OA fraction required in primary air to zone Zone Ventilation Efficiency System Ventilation Efficiency (App A Method) Ventilation Efficiency (Table 6.3 Method)Evz= $(Fa + FbXs - FcZ) / Fa =$ 1.001.00System Ventilation Efficiency (Table 6.3 Method) Ventilation System Efficiency (Table 6.3 Method) Outdoor Air Intake Flow required to System OA intake req'd as a fraction of primary SA OA intake req'd as a fraction of primary SA (Table 6.3 N OA Teblow which OA Intake flow is @ minimumVot Vent fraction frimer Vot Vent fraction of primary SA (Table 6.3 N Vent fraction OA intake flow is @ minimumNot Deg F $(Tp-dTsf)(1-Y)^*(Tr+d) =$ 23		Fraction of zone su	pply not directly re	circ. from zo	ne	Fa		=	Ep + (1-E	p)Er	=		1.00	1.00
Fraction of zone OA not directly recirc. from zone Fc = 1-(1-Ez)(1-Ez)(1-Ez) = 1.00 1.00 Unused OA fraction required in supply air to zone Zd = Voz / Vdz = 0.18 0.00 System Ventilation Efficiency Zp = Voz / Vpz = 0.18 0.00 System Ventilation Efficiency (App A Method) Evz = (Fa + FbXs - FcZ) / Fa = 1.00 1.18 System Ventilation Efficiency (App A Method) Evz = (Fa + FbXs - FcZ) / Fa = 1.00 1.18 Weitilation System Efficiency (Table 6.3 Method) Ev = min (Evz) = 1.00 1.18 Minimum outdoor air intake ainflow Vot cm Vou / Ev = 815 OA intake regid as a fraction of primary SA Y = Vou / Vps = 0.18 OA intake regid as a fraction of primary SA (Table 6.3 N) Y = Vot / Vps = 0.18 OA telow which OA Intake flow is @ minimum Deg F = ((Tp-dTsf)-(1-Y)*(Tr+d) = -23		Fraction of zone su	pply from fully mix	ed primary a	ir	Fb		=	Ep		=		1.00	1.00
Unused OA fraction required in supply air to zone Zd = Voz / Vdz = 0.18 0.00 System Ventilation Efficiency Zp = Voz / Vpz = 0.18 0.00 Zone Ventilation Efficiency Zp = Voz / Vpz = 0.18 0.00 System Ventilation Efficiency (App A Method) Evz = (Fa + FbXs - FcZ) / Fa = 1.00 1.18 System Ventilation Efficiency (App A Method) Evz = min (Evz) = 1.00 1.18 Oventilation System Efficiency (Table 6.3 Method) Ev = via of the second		Fraction of zone O/	A not directly recirc	o. from zone		Fo		=	1-(1-Ez)(1	-Ep)(1-Er)	=		1.00	1.00
Unused OA fraction required in primary air to zone Zp = Voz / Vpz = 0.18 0.00 System Ventilation Efficiency Zone Ventilation Efficiency (App A Method) Evz = (Fa + FbXs - FcZ) / Fa = 1.00 1.18 System Ventilation Efficiency (App A Method) Evz = min (Evz) = 1.00 1.18 Ventilation System Efficiency (Table 6.3 Method) Ev = Value from Table 6.3 = 0.97 Minimum outdoor air intake airflow Vot ofm = Vou / Ev = 815 Outdoor Air Intake Flow required to System Vot ofm = Vou / Ev = 840 Outdoor Air Intake Flow required to System (Table 6.3 N Vot ofm = Vot / Vps = 0.18 OA intake req'd as a fraction of primary SA (Table 6.3 N Y = Vot / Vps = 0.18 OA Tenp at which Min OA provides all cooling Deg F = ([Tp-dTsf]-(1-Y)^*(Tr+d') = -23		Unused OA fraction	required in supply	y air to zone		Zd		=	Voz / Vdz	2	=		0.18	0.00
System Ventilation Efficiency Zone Ventilation Efficiency (App A Method) Evz = (Fa + FbXs - FcZ) / Fa = 1.00 1.18 System Ventilation Efficiency (App A Method) Ev = min (Evz) = 1.00 1.18 Ventilation System Efficiency (Table 6.3 Method) Ev = win (Evz) = 1.00 1.18 Minimum outdoor air intake airflow Outdoor Air Intake Flow required to System Vot cfm Vou / Ev = 815 OA intake req'd as a fraction of primary SA Y = Vot / Vps = 0.18 0.18 OA intake req'd as a fraction of primary SA (Table 6.3 N) Vot cfm = Vou / Ev = 840 OA intake req'd as a fraction of primary SA (Table 6.3 N) Y = Vot / Vps = 0.18 0.18 OA Tenp at which Min OA provides all cooling Deg F = {(Tp-dTsf)-(1-Y)*(Tr+d) = -23		Unused OA fraction	required in prima	ry air to zone	2	Zp		=	Voz / Vpz	2	=		0.18	0.00
Zone Ventilation Efficiency (App A Method) Evz = (Fa + FbXs - FcZ) / Fa = 1.00 1.18 System Ventilation Efficiency (App A Method) Ev = min (Evz) = 1.00 1.18 Ventilation System Efficiency (Table 6.3 Method) Ev = min (Evz) = 1.00 1.18 Minimum outdoor air intake airflow Ev = Value from Table 6.2 = 0.97 Outdoor Air Intake Flow required to System Vot dm = Vou / Ev = 815 OA intake regid as a fraction of primary SA Y = Vot /Vps = 0.18 OA intake regid as a fraction of primary SA (Table 6.3 N Vot cfm = Vot /Vps = 0.18 OA intake regid as a fraction of primary SA (Table 6.3 N Y = Vot /Vps = 0.18 OA table which OA Intake flow is @ minimum Deg F = ((Tp-dTaf)-(1-Y)*(Tr+d) = -23	System \	Ventilation Efficience	<u>ev</u>											
System Ventilation Efficiency (App A Method) Ev = min (Evz) = 1.00 Ventilation System Efficiency (Table 6.3 Method) Ev = Value from Table 6.2 = 0.97 Minimum outdoor air intake airflow Ev = Value from Table 6.2 = 0.97 Outdoor Air Intake Flow required to System Vot cfm = Vou / Ev = 815 OA intake req'd as a fraction of primary SA Y = Vot / Vps = 0.18 Outdoor Air Intake Flow required to System (Table 6.3 N Vot cfm = Vou / Ev = 840 OA intake req'd as a fraction of primary SA (Table 6.3 N Vot cfm = Vou / Ev = 840 OA intake req'd as a fraction of primary SA (Table 6.3 N V Y = Vot / Vps = 0.18 OA Temp at which Min OA provides all cooling Deg F = {(Tp-dTsf)-(1-Y)*(Tr+d') = -23		Zone Ventilation E	fficiency (App A M	ethod)		Evz		=	(Fa + Fb)	(s - FcZ) / Fa	a =		1.00	1.18
Ventilation System Efficiency (Table 6.3 Method) Ev = Value from Table 6.3 = 0.97 Minimum outdoor air intake airflow Outdoor Air Intake Flow required to System Vot cfm = Vou / Ev = 815 OA intake req'd as a fraction of primary SA Y = Vot / Vps = 0.18 Outdoor Air Intake Flow required to System (Table 6.3 N/Vot cfm = Vou / Ev = 840 OA intake req'd as a fraction of primary SA (Table 6.3 N/Vot cfm = Vot / Vps = 0.18 OA intake req'd as a fraction of primary SA (Table 6.3 N/Vot cfm = Vot / Vps = 0.18 OA Tenp at which Min OA provides all cooling OAT below which OA Intake flow is @ minimum Deg F = {(Tp-dTsf)-(1-Y)*(Tr+d) = -23	System Ventilation Efficiency (App A Method)			Ev		=	min (Evz))	=	1.00				
Minimum outdoor air intake airflow Outdoor Air Intake Flow required to System Vot dfm = Vou / Ev = 815 OA intake regid as a fraction of primary SA Y = Vot / Vps = 0.18 Outdoor Air Intake Flow required to System (Table 6.3 N Vot dfm = Vou / Ev = 840 OA intake regid as a fraction of primary SA (Table 6.3 N Vot dfm = Vou / Ev = 840 OA intake regid as a fraction of primary SA (Table 6.3 N Vot dfm = Vot / Vps = 0.18 OA Tenp at which Min OA provides all cooling OAT below which OA Intake flow is @ minimum Deg F = {(Tp-dTsf)-(1-Y)*(Tr+d) = -23	Ventilation System Efficiency (Table 6.3 Method)			Ev		=	Value fro	m Table 6.3	3 =	0.97				
Outdoor Air Intake Flow required to System Vot cfm = Vou / Ev = 815 OA intake req'd as a fraction of primary SA Y = Vot / Vps = 0.18 Outdoor Air Intake Flow required to System (Table 6.3 N Vot cfm = Vou / Ev = 840 OA intake req'd as a fraction of primary SA (Table 6.3 N V cfm = Vot / Vps = 0.18 OA Temp at which Min OA provides all cooling OAT below which OA Intake flow is @ minimum Deg F = {(Tp-dTsf)-(1-Y)*(Tr+d) = -23	Minimun	n outdoor air intake	airflow											
OA intake req'd as a fraction of primary SA Y = Vot / Vps = 0.18 Outdoor Air Intake Flow required to System (Table 6.3 N/OA intake req'd as a fraction of primary SA (Table 6.3 N/OA intake req'd as a fraction of primary SA (Table 6.3 N/Y) Vot cfm = Vou / Ev = 840 OA Temp at which Min OA provides all cooling Vot cfm = Vot / Vps = 0.18 OAT below which OA Intake flow is @ minimum Deg F = {(Tp-dTsf)-(1-Y)*(Tr+d) = -23		Outdoor Air Intake	Flow required to S	ystem		Vot	cfm	=	Vou / Ev		=	815		
Outdoor Air Intake Flow required to System (Table 6.3 N Vot ofm = Vou / Ev = 840 OA intake req'd as a fraction of primary SA (Table 6.3 N Y = Vot / Vps = 0.18 OA Tenp at which Min OA provides all cooling OAT below which OA Intake flow is @ minimum Deg F = {(Tp-dTsf)-(1-Y)*(Tr+d = -23		OA intake req'd as	a fraction of prima	ry SA		Y		=	Vot / Vps		=	0.18		
OA intake reg'd as a fraction of primary SA (Table 6.3 M Y = Vot / Vps = 0.18 OA Temp at which Min OA provides all cooling Deg F = {(Tp-dTsf)-(1-Y)*(Tr+d = -23)		Outdoor Air Intake	Flow required to S	ystem (Table	e 6.3 I	Vot	cfm	=	Vou / Ev		=	840		
OA Temp at which Min OA provides all cooling OAT below which OA Intake flow is @ minimum Deg F = {(Tp-dTsf)-(1-Y)*(Tr+d = -23)		OA intake req'd as	a fraction of prima	ry SA (Table	6.3 N	Y		=	Vot / Vps		=	0.18		
OAT below which OA Intake flow is @ minimum Deg F = {(Tp-dTsf)-(1-Y)*(Tr+d = -23	OA Temp	at which Min OA p	provides all coolin	19										
		OAT below which (DA Intake flow is @	2 minimum			Deg F	=	{(Tp-dTsf)-(1-Y)*(Tr+d	=	-23		

Building:	Richar	d T. Flo	od J									
System 1	AHU -	10										
Operating Condition Description:					5							
Units (se	IP											
Inputs fo	Inputs for System			Name	Units					System		
	Floor area served I	by system		As	sf					815		
	Population of area	a served by system	(including diversity	Ps	P		100%	diversity		4		
	Design primary sur	oply fan airflow rat	e	Vosd	cfm					1.200		
	OA regid per unit a	area for system (We	- eighted average)	Ras	cfm/sf					0.06		
	OA regid per perso	n for system area	(Weighted average)	Ros	cfm/p					5.0		
Inputs fo	r Potentially Critica	al zones	(p						Potentially C	rifical Zones
	Zone Name			Zone t	itle turn	2 000	nle italic i	for critical zo	ne(s)	enter name	enter name
	Zone Ten			20112 1		1		01 0111001 20		/	enter tan	enter tan
	Snare type	Show Values p	er Zone		Select	from	null-dow	n list			Office	Office
	Eloor Area of zone			47	of	il Offi	pundown	1 1131			215	Onice
	Design population	of zono		D-7	D	(def	oult volue	listed: may	ho o	vorriddor	4.075	0
	Design population	to zone (primory)	olus local regireulai	Vdad	r efen	(dei	aun varue	insted, may	be o	ventuder	4.075	v
	Design total supply	y to zone (primary	plus local recircular	V020	Calaat	6	and the second	. list as la sur		-L G NUA	1,200	_
	Induction Termina	il Unit, Dual Fan D	ual Duct or Transfe	ran?	Select	Trom	pull-dow	n list of leave	2 018	INK IT INVA	;	7.5.1
Inc. A. C.	Local recirc. air %	representative of a	ave system return al	Er							10%	10%
inputs to	r Operating Condit	ion Analyzed	t and the set of the set	De	0/					40.024	1000	4000
	Percent of total de	sign airflow rate at	conditioned analy	Us	%					100%	100%	100%
	Air distribution typ	e at conditioned a	nalyzed	_	Select	from	pull-dow	h lis	dae	for Er	CS	CS
	Zone air distributio	on effectiveness at	conditioned analyz	Ez				311010 00	ue :		1.00	1.00
	Primary air fraction	n of supply air at $lpha$	onditioned analyze	Ep								
Results												
	Ventilation System	n Efficiency		Ev						1.00		
	Outdoor air intake	required for system	n	Vot	cfm					69		
	Outdoor air per un	it floor area		Vot/As	cfm/sf					0.09		
	Outdoor air per person served by system (including diver				cfm/p					17.0		
	Outdoor air as a %	of design primary	supply air	Ypd	cfm					6%		
Detailed	Calculations											
Initial Ca	Iculations for the	System as a whole	<u>e</u>									
	Primary supply air	flow to system at o	conditioned analyze	Vps	cfm	=	VpdDs		=	1200		
	UncorrectedOA rec	quirement for syste	m	Vou	cfm	=	Rps Ps +	Ras As	=	69		
1	Uncorrected OA re	q'd as a fraction of	f primary SA	Xs		=	Vou / Vp	5	=	0.06		
Initial Ca	Iculations for indiv	vidual zones										
	OA rate per unit ar	rea for zone		Raz	cfm/sf						0.06	0.06
1	OA rate per person	1		Rpz	cfm/p						5.00	5.00
	Total supply air to	zone (at condition	being analyzed)	Vdz	cfm						1200	0
	Unused OA rea'd t	o breathing zone		Vbz	cfm	=	Rpz Pz +	Raz Az	=		69.3	0.0
1	Unused OA require	ement for zone		Voz	cfm	=	Vbz/Ez		=		69	0
1	Fraction of zone su	upply not directly n	ecirc. from zone	Fa		=	Ep + (1-E	o)Er	=		1.00	1.00
1	Fraction of zone si	upply from fully mi	xed primary air	Fb		=	Ep		=		1.00	1.00
	Fraction of zone O	A not directly recir	c from zone	Fo		=	1-(1-EzV)	1-Ep)(1-Er)	=		1.00	1.00
	Unused OA fraction	n required in suppl	ly air to zone	Zd		=	Voz / Vd	7	=		0.08	0.00
-	Unused OA fraction	n required in prime	any air to zone	70		-	Voz / Voz	-	-		0.00	0.00
System Ventilation Efficiency						7027 vp.		_		0.00	0.00	
Zana Ventilation Efficiency (App & Mathed)		Eve		-	(Ea + Eb)		_		1.00	1.08		
System Ventilation Efficiency (App A Method)			Evz		-	min (Ever	s-rez)/ra	-	1.00	1.00	1.00	
System Ventilation Efficiency (App A Method)			Ev			Volue for	m Table 8.3		1.00			
ventilation System Efficiency (Table 6.3 Method)			20		-	value no	in lable 0.3	-	1.09			
Minimum outdoor air intake airflow			14-4	-	_	N=						
-	Outdoor Air Intake Flow required to System		VOI	am	=	VOU / EV		=	69			
-	OA intake reg'd as	a traction of prima	ary SA	Y		=	vot / Vps		=	0.06		
-	Outdoor Air Intake	Flow required to S	system (Table 6.3 M	Vot	drm	=	VOU / EV		=	63	5.85	
	OA intake regid as	a traction of prima	ary SA (Table 6.3 M	Ŷ		=	vot / Vps		=	0.05	0.08	
OA Temp	at which Min OA	provides all cooli	nq		_							
	OAT below which	OA Intake flow is (2 minimum		Deg F	=	{(Tp-dTsf)-(1-Y)*(Tr+d	=	-222		

Reference

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

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