Technical Report One

ASHRAE Standards 62.1 AND 90.1 Analysis

9/23/2011

New Castle Center for Delaware Hospice, Inc.

New Castle, DE

Image By: Skanska

Zachary Klixbull

Penn State University

Architectural Engineering

Advisor: Professor Bahnfleth

Mechanical Option

Table of Contents

Executive Summary

The purpose of this report is to see if New Castle Center for Delaware Hospice is compliance with ASHREA Standard 62.1-2007 and Standard 90.1-2007. New Castle Center for Delaware Hospice is a two story building of 65,000 SF medical and administration. Image 1 (page 4) shows the location of the site for Google maps. Throughout the report New Castle Center for Delaware Hospice may show as DE Hospice to shorten the name. The DE Hospice is divided into two buildings connected by a Lobby area. Building A is a one story building with the main entrance and patient area facilities for the DE Hospice. The support services and administration are in the two story building B. Building A has patient rooms open to an outside patio and a courtyard for the inner patient rooms. DE Hospice has aluminum curtain wall systems with manufactured stone for the lower part of the exterior wall for the first floor and manufactured stone for some exterior walls. The manufactured stone is also used chimney on the East side of building B. The building is topped with asphalt shingles on the gable roof and cupolas. Windows are cladwood windows with louvers for shading.

ASHREA Standard 62.1-2007 Analysis has two parts, section 5 systems and equipment and section 6 ventilation rate procedures. In section 5 the buildings is looked at equipment and system issues such as preventing mold growth, re-entry of contaminated air, and particulate filtration. Section 6 the building is determined whether it meets ventilation and exhaust requirements at design conditions.

ASHREA Standard 90.1-2007 is looking at the building's compliance with energy design. Section 5 covers Building Envelope effects of insulation and glazing. Section 6 Heating, Ventilation, and Air Conditioning systems cover the design and efficiency of systems like the air handling unit electric motor efficiency. Section 7 Service Water Heating looking at boiler and hot water storage efficiency. Section 9 Lighting covering the power density of the lights throughout the building.

Mechanical System Overview

The DE Hospice is a geothermal based mechanical cooling and heating system. The geothermal wells are under the east parking lot and in to the mechanical room in the basement. Then it is piped up to the attic where heat pump units and energy recovery units are. The water to water geothermal heat pump exchanges the energy from 20% glycol source to the R410A refrigerant.

The refrigerant goes to heat pump units throughout the attic and the three ventilation heat pumps. The mechanical system does use two energy recover units that are located in the attic with the heat pumps. There are eight mechanical rooms in the attic. One mechanical room in the attic is not in line with an energy recovery unit or ventilation heat pump unit, it receives outside air directly to a regular heat pump. (see ASHREA Standard 62.1-2007 section 6 and appendix for more information on the mechanical ventilation)

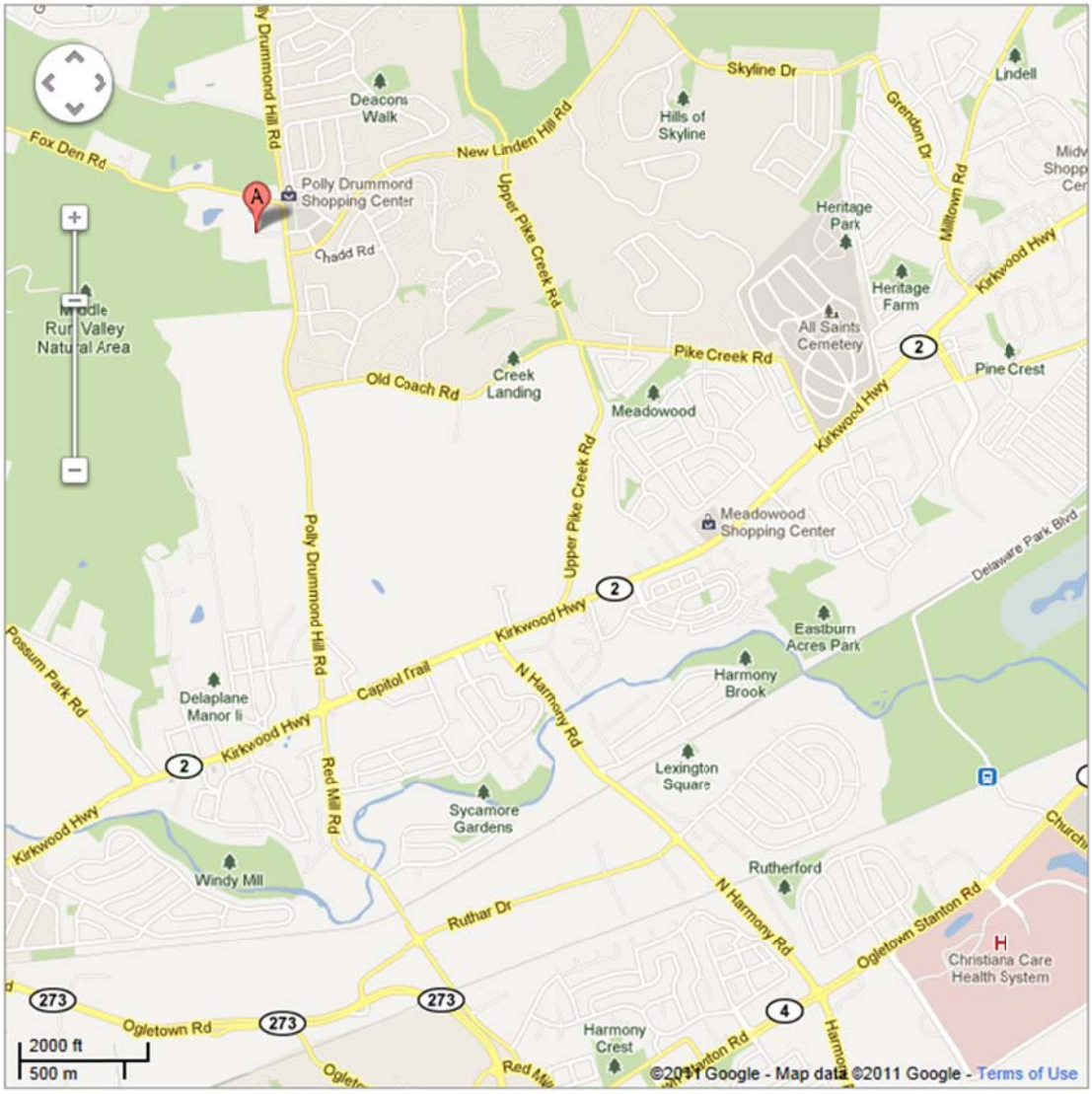


Image 1: A is the location of site, Image by maps.google.com

ASHRAE 62.1

Section 5 Analysis

Section 5.1 Natural Ventilation

Natural ventilation for this building is not possibly, because the windows do not open.

Section 5.2 Ventilation Air Distribution

The ventilation air distribution has the ability to be adjusted to achieve balance air distribution. The ventilation rate schedule (table 1, page 5) shows the air distribution to the different rooms listed in table 1.

Section 5.3 Exhaust Duct Location

Most exhaust ducts end in the attic space, where exhaust fans are negatively pressurizing the space relative to the spaces below and the outside.

Section 5.4 Ventilation Air Distribution

The rooms' ventilation system controls are manual set with heat pump units or heat pump units, energy recovery units or heat pump and VHP having a fixed position for minimum supply airflow.

Section 5.5 Airstream Surfaces

Sheet metal and metal fasteners are used for ducts making it mold growth and erosion resistant. The airstream surfaces of HVAC systems are mold growth and erosion resistant.

Section 5.6 Outdoor Air Intakes

Outdoor air intakes are located a safe distance away from outdoor contaminant sources and exhaust fans in accordance with ASHRAE 62.1-2007 Table 5-1. Select louvers are used to rain and wind penetration.

Ventilation Rate Schedule

Area Designation	Pressure Relationship to Adjacent Area	Minimum Air Change of Outdoor Air per Hour	Minimum Total Air Changes per Hour	All Air Exhausted Directly to Outdoors	Space Air Recirculate within Room
Resident room	Equal	2	2	Optional	Optional
Resident area corridor	Equal	Optional	4	Optional	Optional
Physical therapy	Negative	2	6	Optional	Optional
Occupational therapy	Negative	2	6	Optional	Optional
Soiled workroom	Negative	2	10	Yes	No
Clean workroom	Negative	2	4	Optional	Optional
Toilet room	Negative	Optional	10	Yes	No
Bathroom	Negative	Optional	10	Yes	No
Janitor's closet	Negative	Optional	10	Yes	No
Sterilizer equip. rm.	Negative	Optional	10	Yes	No
Line chute room	Negative	Optional	10	Yes	No
trash chute room	Negative	Optional	10	Yes	No
Food Preparation	Equal	2	10	Yes	Yes
Warewashing room	Negative	Optional	10	Yes	Yes
Dietary day storage	Equal	Optional	2	Yes	No
Laundry, general	Equal	2	10	Yes	No
Soiled line sorting	Negative	Optional	10	Yes	No
Clean line storage	Positive	Optional	2	Yes	No
Special care room	Negative	2	12	Yes	No
Dining	Equal	2	4	Optional	Optional
Activity room	Equal	4	6	Optional	Optional
Resident gathering	Equal	4	4	Optional	Optional

Table 1: Ventilation Rate Schedule for M001 of drawings

Section 5.8 Combustion Air

All combustion air from boiler, generator and other fuel-burning appliances has sufficient air for combustion and removal of combustion products.

Section 5.9 Particulate Matter Removal

All Air Handling Units and Make-up Air Unit should have disposable panel filters with MERV (ASHRAE 52.2) 7.

Section 5.10 Dehumidification

Building is designed for 50% RH +/- 5% with the building being positively pressurized.

Section 5.11 Drain Pans

The energy recovery units, heat pump units and coiling coils meet minimum requirements for drain pans slope, outlet, seal, and size.

Section 5.12 Finned-Tube Coils and Heat Exchangers

Cooling coils and heat exchangers have at least 18 inches of access space for cleaning.

Section 5.13 Humidifiers and Water-Spray Systems

Humidification is to be handled by return air.

Section 5.14 Access for Inspection, Cleaning, and maintenance

All equipment with access doors has sufficient working space for inspection and routine maintenance.

Section 5.15 Building Envelope and Interior Surfaces

Building envelope has weather barrier on walls and membrane roofing. Pipes and ducts that could reach temperature lower then dew-point are insulated.

Section 5.16 Buildings with Attached Parking Garages

The building has a parking lot, no parking garage.

Section 5.17 Air Classification and Recirculation

The building is mostly Air Class 1, except for kitchen (Air Class 4) and restrooms (Air Class 2), which are exhausted out of space to outdoors.

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

The building is medical office and no smoking is allowed within the building.

Section 6 Analysis

Ventilation Rate Procedure

Ventilation Heat Pump Units (VHP-1 thru -3) and Energy Recovery units (ERU-1 and-2) has been taken analysis of for the ventilation rate procedure. In this section the five zones that are identified in DWG-1,-2,-3 and -4 (pages 11-14).

Breathing Zone Outdoor Airflow (Vbz)

$Vbz = Rp * Pz + Ra*Az$ (Eq 6-1)

Zone Outdoor Airflow (Voz)

$Voz = Vbz/Ez$ (Eq 6-2)

Single-Zone System (Vot)

$Vot = Voz$ (Eq 6-3)

100% Outdoor Air Systems

$Vot = \sum_{\text{all zones}} Voz$ (Eq 6-4)

Zone Primary Outdoor Air Fraction (Zp)

$Zp = Voz/Vpz$ (Eq 6-5).

Uncorrected Outdoor Air Intake (Vou)

$Vou = D*\sum_{\text{all zones}} (RP*Pz) + \sum_{\text{all zones}} (Ra+Az)$ (Eq 6-6)

$D = Ps/\sum_{\text{all zones}} Pz$ (Eq 6-7)

Outdoor Air Intake (Vot)

$Vot = Vou/Ev$ (Eq 6-8)

Where

Az = zone floor area (SF)

Pz = zone population (Table 6-1)

Rp = outdoor airflow rate per person (CFM/Person)

Ra = outdoor airflow rate per unit area (CFM/SF)

Ez = zone air distribution effectiveness (Table 6-2)

Vpz = zone primary airflow

Ps = system population

D = occupant diversity

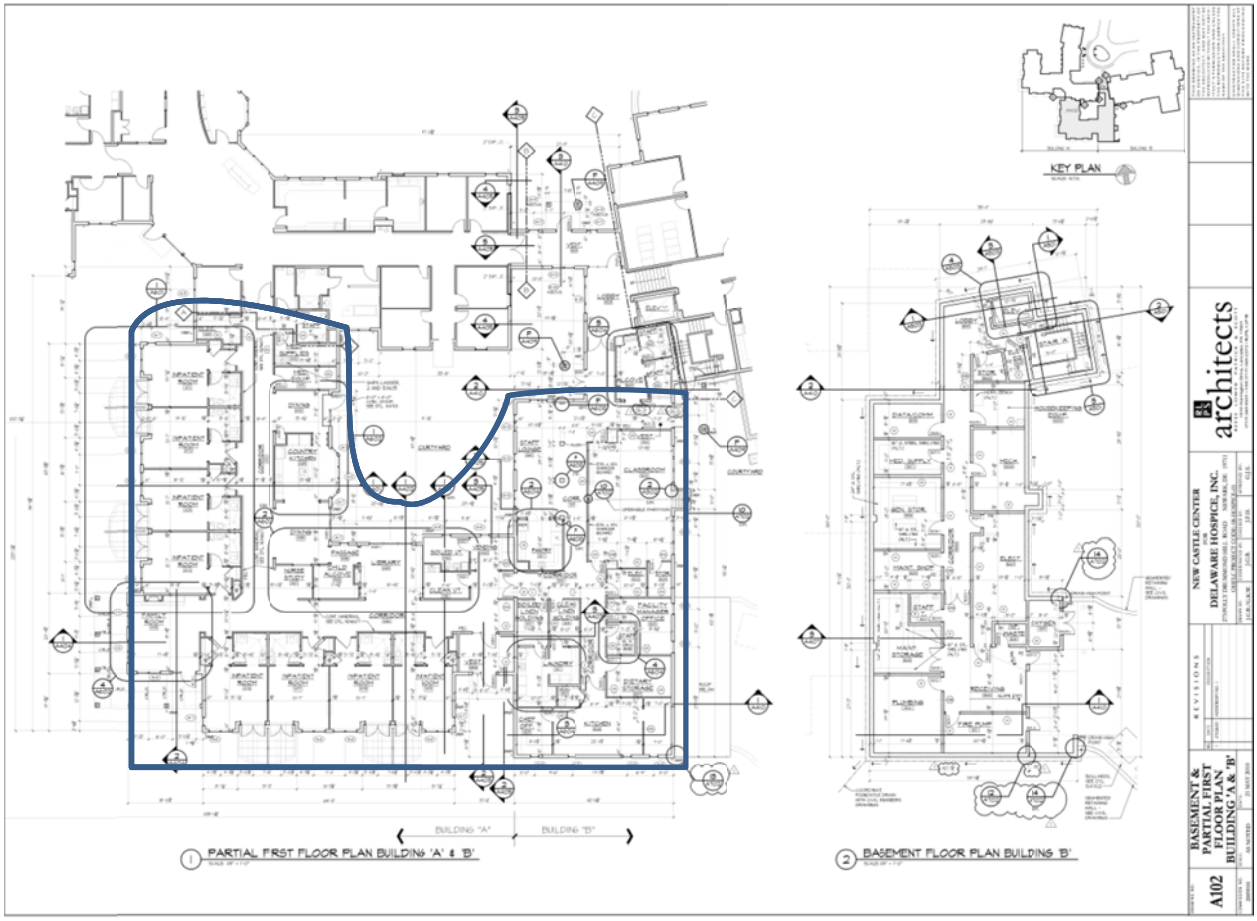
Ev = system ventilation efficiency based on max Zp (Table 6-3)

In the appendix have further calculations for ventilation rate procedure and values of the define information for calculation above. All information for this calculation came from drawings and specification provide by Skanska.

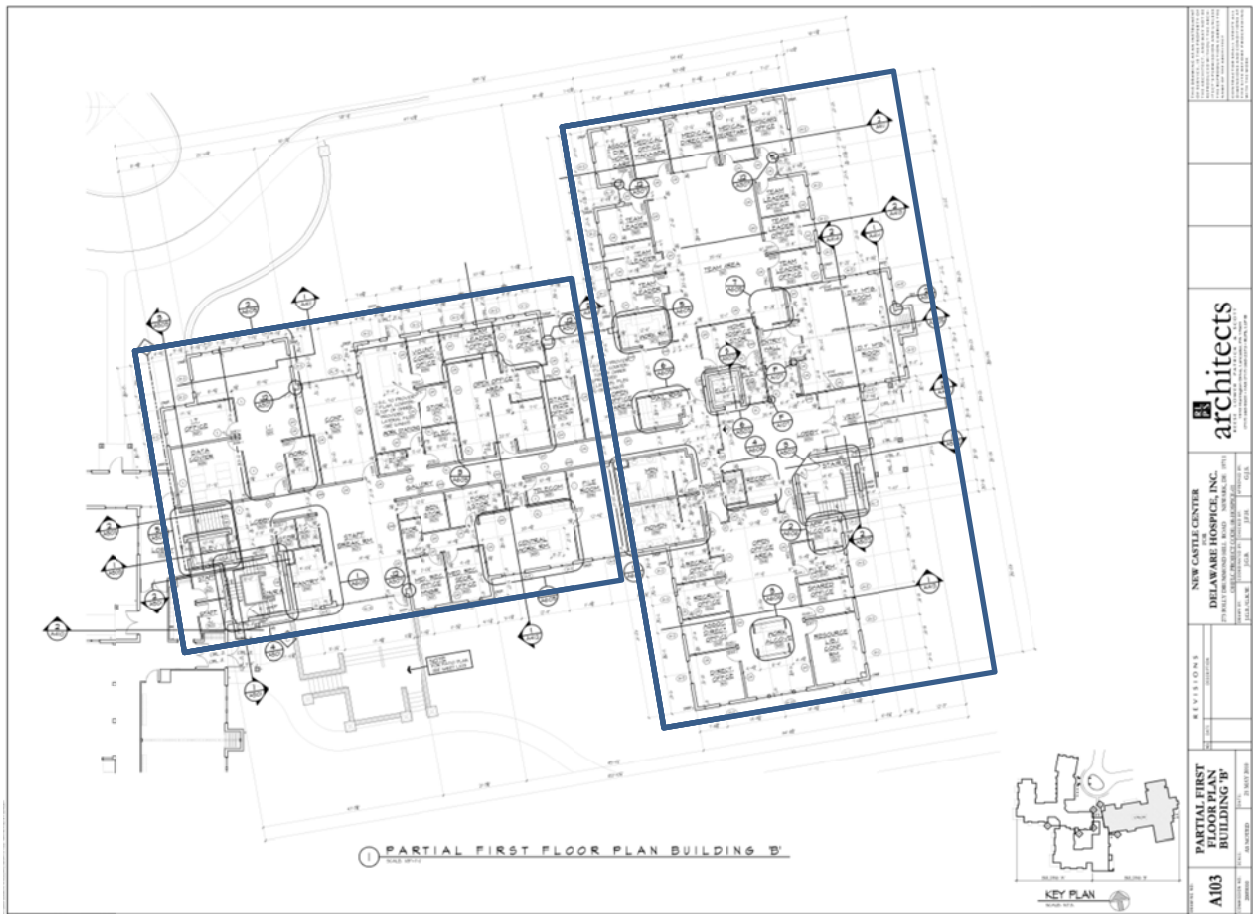
Section 6 Results

VHP-1 has a ventilation system efficiency of 95% with critical zone being the large conference room. VHP-2 has a ventilation system efficiency of 68% with critical zone being a conference room. VHP-3 has 255% outdoor air as a % of design primary supply air. This shows a low design primary supply fan airflow rate. ERU-1 has 404% outdoor air as a % of design primary supply air. This shows a low design primary supply fan airflow rate. ERU-2 has 510% outdoor air as a % of design primary supply air. This shows a low design primary supply fan airflow rate

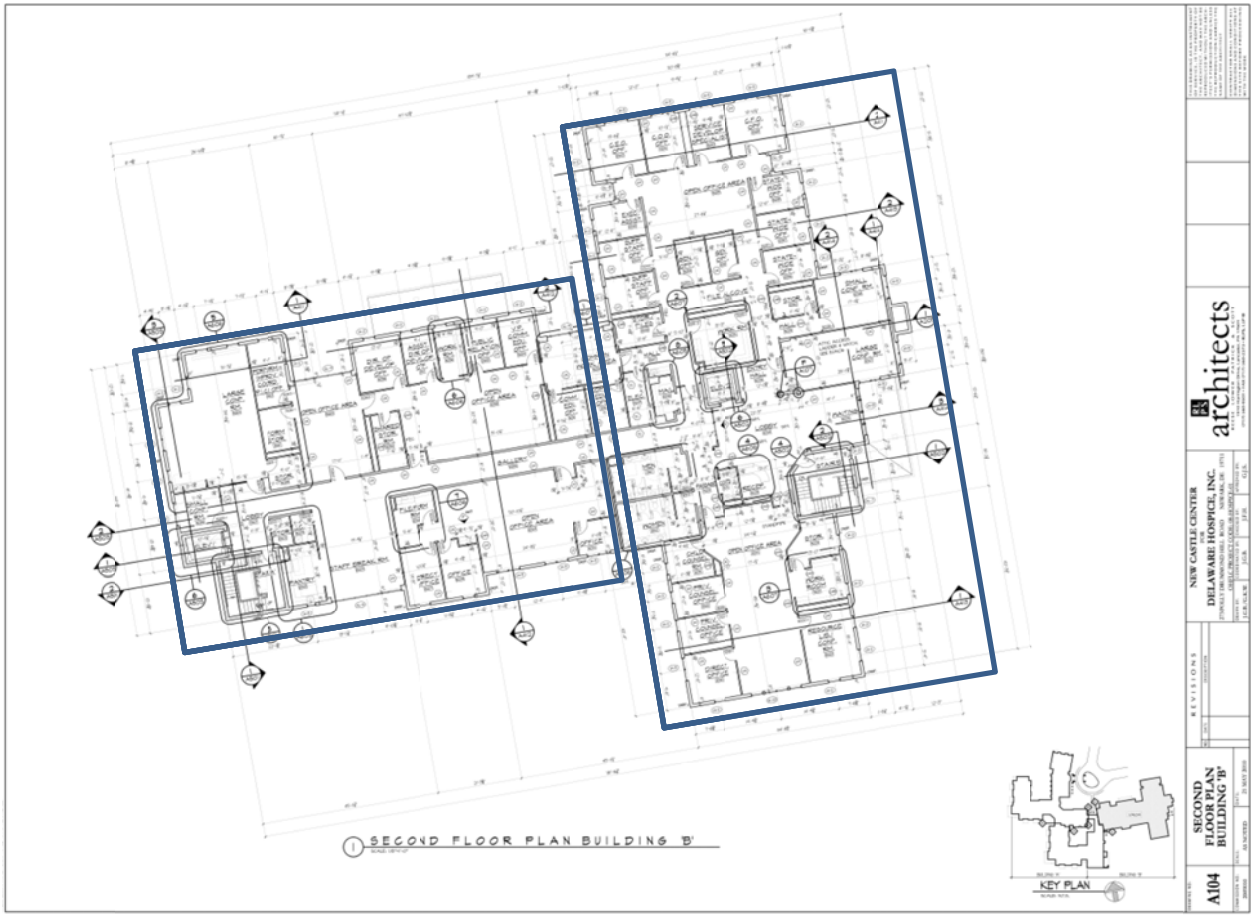
DWG 1: From left to right: ERU-1 (see appendix pages 28-30), VHP-1 (see appendix pages 19-20)



DWG 2: ERU-2 (see appendix pages 31-33)



DWG 3: From left to right: VHP-2 (see appendix pages 21-23), VHP-3 (see appendix pages 24-27)



DWG 4: From left to right: VHP-2 (see appendix pages 21-23), VHP-3 (see appendix pages 24-27)

ASHRAE 90.1

Section 5 Analysis- building Envelope

Section 5.1.4 Climate

The site is in New Castle, DE, climate zone 4. See Fig. 5.1.4

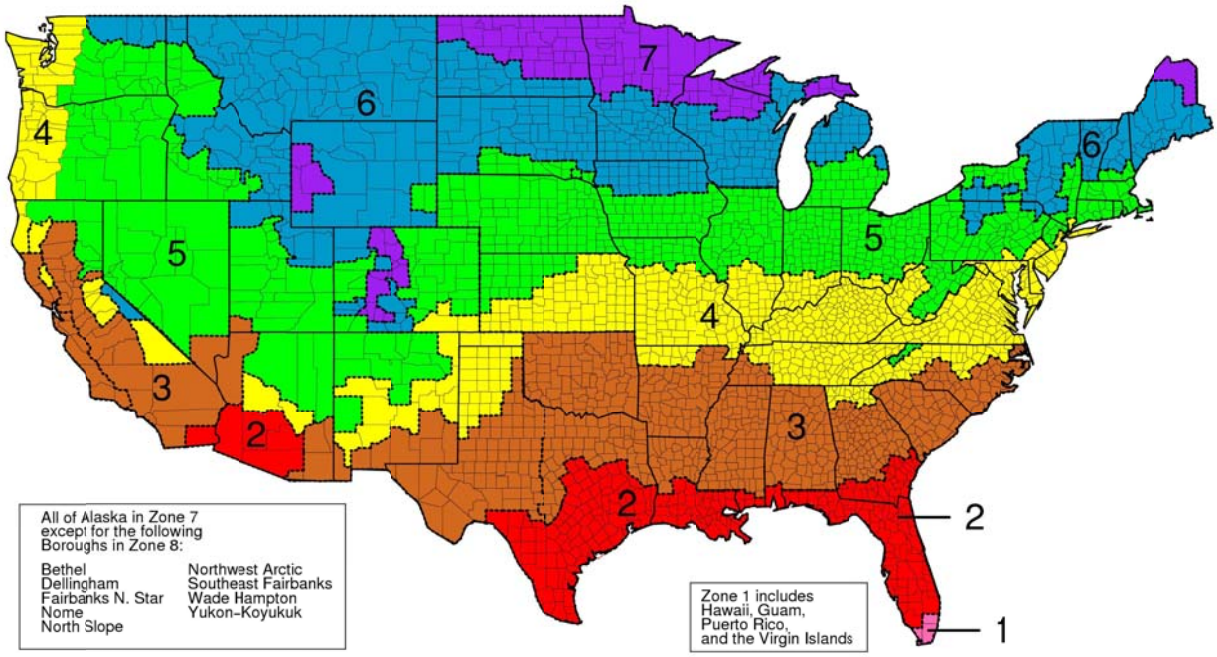


Fig. 5.4.1 United State Locations (image by resourcecenter.pnl.gov)

Section 5.5 Prescriptive Building Envelope Option

The building envelope was analyzed by prescriptive building procedure. Table 5.5-4 from ASHRAE Standard 90.1-2007 was used for building envelope requirements for climate zone 4A. Table 2 shows vertical fenestration area being less than 40% of the gross wall area. Table3

shows minimum insulation value for the building's type of material and also shows minimum glassing insulation value and maximum shading coefficient.

Fenestration Area

Façade	Glass (SF)	Gross Wall (SF)	Glass %	Complies
North	1328	6291	21.1%	Yes
East	1240	6812	18.2%	Yes
South	1563	7139	21.9%	Yes
West	1694	6294	26.9%	Yes

Table 2

Construction	Description	90.1 Zone 4		Building		Complies
		U Max	R Min	U-Factor	R-Value	
Roof	Insulation Entirely above Deck	0.048	20	0.020	49	Yes
Walls	Mass	0.104	9.5	0.067	15	Yes
Floors	Mass	0.087	8.3	0.087	8.3	Yes
Fenestration		U Max	SHGC Max	U-Factor	SHGC	
Metal Framing	Windows	0.55	0.4	0.28	0.40	Yes
Metal Framing	Doors	0.85	0.4	0.28	0.40	Yes

Table 3

Section 6 Analysis- Heating, Ventilating, and Air Conditioning

The building's gross are exceeds 25,000 SF. Mandatory provisions' zone isolation procedure was used for table 3. Fans are variable volume, so CFM * 0.0015 should be greater than horsepower for that equipment.

Fans	CFM	CFM*0.0015	HP	Comply
EF-1,2	125	3/16	1/4	No
EF-3	175	21/80	1/15	Yes
EF-4	200	3/10	9/79	Yes
EF-5	100	3/20	3/28	Yes
EF-6,7	200	3/10	9/79	Yes
EF-8	1400	2 1/10	1/2	Yes
EF-9	700	1 1/20	1/4	Yes
EF-10	100	3/20	1/4	No
EF-11	150	9/40	1/4	No
EF-12,13	2175	3 21/80	1/4	Yes
EF-14	1750	2 5/8	1/6	Yes
EF-15	2700	4 1/20	1/3	Yes
EF-16	2300	3 9/20	1/4	Yes
EF-17	3000	4 1/2	1/4	Yes
KEF-1	1400	2 1/10	1/2	Yes
VEF-1	250	3/8	1/4	No

Fans	CFM	CFM*0.0015	HP	Comply
HP-1	260	2/5	1/10	No
HP-2	330	1/2	1/10	N0
HP-3	430	2/3	1/10	No
HP-4	530	3/4	1/4	No
HP-5	710	1	1/4	No
HP-6	940	1 2/5	1/2	No
HP-7	1150	1 5/7	1/2	No
HP-8	1260	1 8/9	1/2	No
HP-9	1710	2 4/7	3/4	No
VHP-1	1250	1 7/8	1	Yes
VHP-2	2140	3 1/5	2	No
VHP-3	2265	3 2/5	2	No
MAU-1	1120	1 2/3	1/2	No
ERU-1	1555	2 1/3	1 1/2	No
ERU-2	1825	2 3/4	2	No

Table 4

Section 9 Analysis- Lighting

According to Table 9.6.1 of ASHREA Standards 90.1-2007, the building –specific space type of exam/treatment has a limit of 1.5 W/SF. The building has been designed to 1.5 W/SF and therefore it complies with ASHREA Standards 90.1-2007.

ASHREA Standards 90.1 Results

TH DE Hospice does well for ASHREA Standards 90.1 until the supply air fans HP is overall to low for section 6 of analysis (table 4), it doesn't comply. DE Hospice does comply with all other sections of ASHREA Standards 90.1.

Reference

ASHREA, 2007, ANSI/ASHARE, Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality. American Sociaty of Heating, Refrigerating, and Air Conditioning Engineers, Inc. Atlanta, GA

ASHREA, 2007, ANSI/ASHARE, Standard 90.1-2007, Energy Standard for Buildings Except Low-rise Residenrial Buildings. American Sociaty of Heating, Refrigerating, and Air Conditioning Engineers, Inc. Atlanta, GA

Building:	DE Hospice Building A
System Tag/Name:	VHP-1
Operating Condition Description:	Ventilation Heat Pump
Units (select from pull-down list)	IP

Item	Name	Units	Formula / Note	System	1	2	3	4	5	6	7
Inputs for System											
Floor area served by system	As	sf		3365							
Population of area served by system (including diversity)	Ps	P	100% diversity	103							
Design primary supply fan airflow rate	Vpsd	cfm		1,250							
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		5.0							
Inputs for Potentially Critical zones					Potentially Critical Zones						
Zone Name			*Zone title turns purple italic for critical zone(s)*		HP-2	HP-5	HP-2	HP_9	HP_4	HP-5	*HP-7*
Zone Tag					1	2	3	4	5	6	7
Space type			Select from pull-down list		Libraries	Office space	Corridors	Corridors	Conference/meeting	Corridors	Conference/meeting
Floor Area of zone	Az	sf			120	120	350	315	200	460	600
Design population of zone	Pz	P	(default value listed; may be overridden)		1.2	0.6	0	0	10	0	30
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm			330	710	430	1710	530	710	1150
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	%		630%	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			0.95							
Outdoor air intake required for system	Vot	cfm		900							
Outdoor air per unit floor area	Vot/As	cfm/sf		0.27							
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p		8.7							
Outdoor air as a % of design primary supply air	Ypd	cfm		72%							
Detailed Calculations											
Initial Calculations for the System as a whole											
Primary supply air flow to system at conditioned analyzed	Vps	cfm	= VpdDs =	7870							
UncorrectedOA requirement for system	Vou	cfm	= Rps Ps + Ras As =	852							
Uncorrected OA req'd as a fraction of primary SA	Xs		= Vou / Vps =	0.11							
Initial Calculations for individual zones											
OA rate per unit area for zone	Raz	cfm/sf			0.12	0.06	0.06	0.06	0.06	0.06	0.06
OA rate per person	Rpz	cfm/p			5.00	5.00	0.00	0.00	5.00	0.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm			330	710	430	1710	530	710	1150
Unused OA req'd to breathing zone	Vbz	cfm	= Rpz Pz + Raz Az =		20.4	10.2	21.0	18.9	62.0	27.6	186.0
Unused OA requirement for zone	Voz	cfm	= Vbz/Ez =		20	10	21	19	62	28	186
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 =		0.06	0.01	0.05	0.01	0.12	0.04	0.16
Unused OA fraction required in primary air to zone	Zp		= Voz / Vpz =		0.06	0.01	0.05	0.01	0.12	0.04	0.16
System Ventilation Efficiency											
Zone Ventilation Efficiency (App A Method)	Evz		= (Fa + FbXs - FcZ) / Fa =		1.05	1.09	1.06	1.10	0.99	1.07	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 =	0.99							
Minimum outdoor air intake airflow											
Outdoor Air Intake Flow required to System	Vot	cfm	= Vou / Ev =	900							
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 =	862	38.06						
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		= Vot / Vps =	0.11	0.04						
OA Temp at which Min OA provides all cooling											
OAT below which OA Intake flow is @ minimum		Deg F	= {(Tp-dTsf)-(1-Y)*(Tr+dTrf)} =	-77							

VHP-1

Building:	DE Hospice Building A				
System Tag/Name:	VHP-1				
Operating Condition Description:	Ventilation Heat Pump				
Units (select from pull-down list)	IP				

Description	Name	Units	Formula / Note	System	Zone 8	Zone 9
Inputs for System						
Floor area served by system	As	sf		3365		
Population of area served by system (including diversity)	Ps	P	100% diversity	103		
Design primary supply fan airflow rate	Vpsd	cfm		1,250		
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		5.0		
Inputs for Potentially Critical zones						
Zone Name			*Zone title turns purple italic for critical zone(s)*		HP-7	HP-7
Zone Tag					8	9
Space type			Select from pull-down list		Conference/meeting	Conference/meeting
Floor Area of zone	Az	sf			600	600
Design population of zone	Pz	P	(default value listed; may be overridden)		30	30
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm			1150	1150
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	%		630%	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			0.95		
Outdoor air intake required for system	Vot	cfm		900		
Outdoor air per unit floor area	Vot/As	cfm/sf		0.27		
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p		8.7		
Outdoor air as a % of design primary supply air	Ypd	cfm		72%		
Detailed Calculations						
Initial Calculations for the System as a whole						
Primary supply air flow to system at conditioned analyzed	Vps	cfm	= VpdDs =	7870		
UncorrectedOA requirement for system	Vou	cfm	= Rps Ps + Ras As =	852		
Uncorrected OA req'd as a fraction of primary SA	Xs		= Vou / Vps =	0.11		
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			1150	1150
Unused OA req'd to breathing zone	Vbz	cfm	= Rpz Pz + Raz Az =		186.0	186.0
Unused OA requirement for zone	Voz	cfm	= Vbz/Ez =		186	186
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 =		0.16	0.16
Unused OA fraction required in primary air to zone	Zp		= Voz / Vpz =		0.16	0.16
System Ventilation Efficiency						
Zone Ventilation Efficiency (App A Method)	Evz		= (Fa + FbXs - FcZ) / Fa =		0.95	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 =	0.99		
Minimum outdoor air intake airflow						
Outdoor Air Intake Flow required to System	Vot	cfm	= Vou / Ev =	900		
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 =	862		
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		= Vot / Vps =	0.11		
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)} =	-77		

VHP-1

Building:	DE Hospice Building B										
System Tag/Name:	VHP-2										
Operating Condition Description:	Ventilation Heat Pump										
Units (select from pull-down list)	IP										
Inputs for System	**Name**	**Units**			**System**						
Floor area served by system	As	sf			6165						
Population of area served by system (including diversity)	Ps	P	100% diversity		94						
Design primary supply fan airflow rate	Vpsd	cfm			2,140						
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			5.0						
Inputs for Potentially Critical zones											
Zone Name			*Zone title turns purple italic for critical zone(s)*			HP-2	HP-8	HP-8	HP-3	HP-3	HP-8	HP-8
Zone Tag						1	2	3	4	5	6	7
Space type			Select from pull-down list			Conference/meeting	Office space	Office space	Office space	Office space	Office space	Office space
Floor Area of zone	Az	sf				120	765	765	130	310	950	350
Design population of zone	Pz	P	(default value listed; may be overridden)			6	3.825	3.825	0.65	1.55	4.75	1.75
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm				330	1260	1260	430	430	1260	1260
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	%			677%	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				**0.68**							
Outdoor air intake required for system	Vot	cfm			**1896**							
Outdoor air per unit floor area	Vot/As	cfm/sf			**0.23**							
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p			**20.2**							
Outdoor air as a % of design primary supply air	Ypd	cfm			**89%**							
Detailed Calculations												
Initial Calculations for the System as a whole												
Primary supply air flow to system at conditioned analyzed	Vps	cfm	= VpdDs	=	14490							
UncorrectedOA requirement for system	Vou	cfm	= Rps Ps + Ras As	=	1289							
Uncorrected OA req'd as a fraction of primary SA	Xs		= Vou / Vps	=	0.09							
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	5.00	5.00	5.00	5.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm				330	1260	1260	430	430	1260	1260
Unused OA req'd to breathing zone	Vbz	cfm	= Rpz Pz + Raz Az	=		37.2	65.0	65.0	11.1	26.4	80.8	29.8
Unused OA requirement for zone	Voz	cfm	= Vbz/Ez	=		37	65	65	11	26	81	30
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	=		0.11	0.05	0.05	0.03	0.06	0.06	0.02
Unused OA fraction required in primary air to zone	Zp		= Voz / Vpz	=		0.11	0.05	0.05	0.03	0.06	0.06	0.02
System Ventilation Efficiency												
Zone Ventilation Efficiency (App A Method)	Evz		= (Fa + FbXs - FcZ) / Fa	=		0.98	1.04	1.04	1.06	1.03	1.02	1.07
System Ventilation Efficiency (App A Method)	Ev		= min (Evz)	=	**0.68**							
Ventilation System Efficiency (Table 6.3 Method)	Ev		= Value from Table 6.3	=	0.74							
Minimum outdoor air intake airflow												
Outdoor Air Intake Flow required to System	Vot	cfm	= Vou / Ev	=	**1896**							
OA intake req'd as a fraction of primary SA	Y		= Vot / Vps	=	**0.13**							
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	= Vou / Ev	=	1740	**156.39**						
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		= Vot / Vps	=	0.12	**0.08**						
OA Temp at which Min OA provides all cooling												
OAT below which OA Intake flow is @ minimum		Deg F	= {(Tp-dTsf)-(1-Y)*(Tr+dTrf	=	-58							

VHP-2

Building:	DE Hospice Building B										
System Tag/Name:	VHP-2										
Operating Condition Description:	Ventilation Heat Pump										
Units (select from pull-down list)	IP										
Inputs for System	**Name**	**Units**		**System**							
Floor area served by system	As	sf		8185							
Population of area served by system (including diversity)	Ps	P	100% diversity	94							
Design primary supply fan airflow rate	Vpsd	cfm		2,140							
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		5.0							
Inputs for Potentially Critical zones					**Potentially Critical Zones**						
Zone Name			*Zone title turns purple italic for critical zone(s)*		HP-2	HP-8	HP-2	*HP-4*	HP-5	HP-2	HP-3
Zone Tag					8	9	10	11	12	13	14
Space type		Select from pull-down list			Office space	Conference/meeting	Office space	Conference/meeting	Office space	Office space	Office space
Floor Area of zone	Az	sf			325	425	110	700	120	260	110
Design population of zone	Pz	P	(default value listed; may be overridden)		1.625	21.25	0.55	35	0.6	1.3	0.55
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm			330	1260	330	530	710	330	430
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	%		677%	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			0.68							
Outdoor air intake required for system	Vot	cfm		1896							
Outdoor air per unit floor area	Vot/As	cfm/sf		0.23							
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p		20.2							
Outdoor air as a % of design primary supply air	Ypd	cfm		89%							
Detailed Calculations											
Initial Calculations for the System as a whole											
Primary supply air flow to system at conditioned analyzed	Vps	cfm	= VpdDs =	14490							
UncorrectedOA requirement for system	Vou	cfm	= Rps Ps + Ras As =	1289							
Uncorrected OA req'd as a fraction of primary SA	Xs		= Vou / Vps =	0.09							
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	5.00	5.00	5.00	5.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm			330	1260	330	530	710	330	430
Unused OA req'd to breathing zone	Vbz	cfm	= Rpz Pz + Raz Az =		27.6	131.8	9.4	217.0	10.2	22.1	9.4
Unused OA requirement for zone	Voz	cfm	= Vbz/Ez =		28	132	9	217	10	22	9
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 =		0.08	0.10	0.03	0.41	0.01	0.07	0.02
Unused OA fraction required in primary air to zone	Zp		= Voz / Vpz =		0.08	0.10	0.03	0.41	0.01	0.07	0.02
System Ventilation Efficiency											
Zone Ventilation Efficiency (App A Method)	Evz		= (Fa + FbXs - FcZ) / Fa =		1.01	0.98	1.06	0.68	1.07	1.02	1.07
System Ventilation Efficiency (App A Method)	Ev		= min (Evz) =	0.68							
Ventilation System Efficiency (Table 6.3 Method)	Ev		= Value from Table 6.3 =	0.74							
Minimum outdoor air intake airflow											
Outdoor Air Intake Flow required to System	Vot	cfm	= Vou / Ev =	1896							
OA intake req'd as a fraction of primary SA	Y		= Vot / Vps =	0.13							
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	= Vou / Ev =	1740							
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+dTrf =	-58							

VHP-2

Building:	DE Hospice Building B										
System Tag/Name:	VHP-2										
Operating Condition Description:	Ventilation Heat Pump										
Units (select from pull-down list)	IP										
Inputs for System	**Name**	**Units**		**System**							
Floor area served by system	As	sf		8185							
Population of area served by system (including diversity)	Ps	P	100% diversity	94							
Design primary supply fan airflow rate	Vpsd	cfm		2,140							
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		5.0							
Inputs for Potentially Critical zones											
Zone Name	*Zone title turns purple italic for critical zone(s)*				HP-6	HP-3	HP-4	HP-2	HP-3	HP-4	HP-7
Zone Tag					15	16	17	18	19	20	21
Space type		Select from pull-down list			Office space	Office space	Office space	Office space	Office space	Corridors	Office space
Floor Area of zone	Az	sf			750	80	600	325	260	600	130
Design population of zone	Pz	P	(default value listed; may be overridden)		3.75	0.4	3	1.625	1.3	0	0.65
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm			940	430	530	330	430	530	1150
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	%		677%	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			**0.68**							
Outdoor air intake required for system	Vot	cfm		**1896**							
Outdoor air per unit floor area	Vot/As	cfm/sf		**0.23**							
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p		**20.2**							
Outdoor air as a % of design primary supply air	Ypd	cfm		**89%**							
Detailed Calculations											
Initial Calculations for the System as a whole											
Primary supply air flow to system at conditioned analyzed	Vps	cfm	= VpdDs =	14490							
UncorrectedOA requirement for system	Vou	cfm	= Rps Ps + Ras As =	1289							
Uncorrected OA req'd as a fraction of primary SA	Xs		= Vou / Vps =	0.09							
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	5.00	5.00	5.00	0.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm			940	430	530	330	430	530	1150
Unused OA req'd to breathing zone	Vbz	cfm	= Rpz Pz + Raz Az =		63.8	6.8	51.0	27.6	22.1	36.0	11.1
Unused OA requirement for zone	Voz	cfm	= Vbz/Ez =		64	7	51	28	22	36	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 =		0.07	0.02	0.10	0.08	0.05	0.07	0.01
Unused OA fraction required in primary air to zone	Zp		= Voz / Vpz =		0.07	0.02	0.10	0.08	0.05	0.07	0.01
System Ventilation Efficiency											
Zone Ventilation Efficiency (App A Method)	Evz		= (Fa + FbXs - FcZ) / Fa =		1.02	1.07	0.99	1.01	1.04	1.02	1.08
System Ventilation Efficiency (App A Method)	Ev		= min (Evz) =	**0.68**							
Ventilation System Efficiency (Table 6.3 Method)	Ev		= Value from Table 6.3 =	0.74							
Minimum outdoor air intake airflow											
Outdoor Air Intake Flow required to System	Vot	cfm	= Vou / Ev =	**1896**							
OA intake req'd as a fraction of primary SA	Y		= Vot / Vps =	**0.13**							
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	= Vou / Ev =	1740							
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+dTrf =	-58							

VHP-2

Building:	DE Hospice Building B										
System Tag/Name:	VHP-3										
Operating Condition Description:	Ventilation Heat Pump										
Units (select from pull-down list)	IP										
Inputs for System	**Name**	**Units**		**System**							
Floor area served by system	As	sf		12880							
Population of area served by system (including diversity)	Ps	P	100% diversity	187							
Design primary supply fan airflow rate	Vpsd	cfm		2,265							
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		5.0							
Inputs for Potentially Critical zones											
Zone Name	*Zone title turns purple italic for critical zone(s)*				HP-8	HP-7	HP-2	HP-6	HP-6	HP-4	HP-5
Zone Tag					1	2	3	4	5	6	7
Space type		Select from pull-down list			Office space	Office space	Office space	Office space	Libraries	Booking/waiting	Conference/meeting
Floor Area of zone	Az	sf			815	815	170	310	220	450	450
Design population of zone	Pz	P	(default value listed; may be overridden)		4.075	4.075	0.85	1.55	2.2	22.5	22.5
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm			1,260	1150	330	940	940	530	710
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	%		779%	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			**0.39**							
Outdoor air intake required for system	Vot	cfm		**5766**							
Outdoor air per unit floor area	Vot/As	cfm/sf		**0.45**							
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p		**30.8**							
Outdoor air as a % of design primary supply air	Ypd	cfm		**255%**							
Detailed Calculations											
Initial Calculations for the System as a whole											
Primary supply air flow to system at conditioned analyzed	Vps	cfm	= VpdDs =	17650							
UncorrectedOA requirement for system	Vou	cfm	= Rps Ps + Ras As =	2223							
Uncorrected OA req'd as a fraction of primary SA	Xs		= Vou / Vps =	0.13							
Initial Calculations for individual zones											
OA rate per unit area for zone	Raz	cfm/sf			0.06	0.06	0.06	0.06	0.12	0.06	0.06
OA rate per person	Rpz	cfm/p			5.00	5.00	5.00	5.00	5.00	7.50	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm			1260	1150	330	940	940	530	710
Unused OA req'd to breathing zone	Vbz	cfm	= Rpz Pz + Raz Az =		69.3	69.3	14.5	26.4	37.4	195.8	139.5
Unused OA requirement for zone	Voz	cfm	= Vbz/Ez =		69	69	14	26	37	196	140
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 =		0.05	0.06	0.04	0.03	0.04	0.37	0.20
Unused OA fraction required in primary air to zone	Zp		= Voz / Vpz =		0.05	0.06	0.04	0.03	0.04	0.37	0.20
System Ventilation Efficiency											
Zone Ventilation Efficiency (App A Method)	Evz		= (Fa + FbXs - FcZ) / Fa =		1.07	1.07	1.08	1.10	1.09	0.76	0.93
System Ventilation Efficiency (App A Method)	Ev		= min (Evz) =	**0.39**							
Ventilation System Efficiency (Table 6.3 Method)	Ev		= Value from Table 6.3 =	n/a							
Minimum outdoor air intake airflow											
Outdoor Air Intake Flow required to System	Vot	cfm	= Vou / Ev =	**5766**							
OA intake req'd as a fraction of primary SA	Y		= Vot / Vps =	**0.33**							
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	= Vou / Ev =	n/a							
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		= Vot / Vps =	n/a							
OA Temp at which Min OA provides all cooling											
OAT below which OA Intake flow is @ minimum		Deg F	= {(Tp-dTsf)-(1-Y)*(Tr+dTrf =	20							

Building:	DE Hospice Building B
System Tag/Name:	VHP-3
Operating Condition Description:	Ventilation Heat Pump
Units (select from pull-down list)	IP

Inputs for System	Name	Units		System
Floor area served by system	As	sf		12380
Population of area served by system (including diversity)	Ps	P	100% diversity	187
Design primary supply fan airflow rate	Vpsd	cfm		2,265
OA req'd per unit area for system (Weightec average)	Ras	cfm/sf		0.10
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			HP-3	HP-6	HP-3	HP-5	HP-6	HP-5	HP-9		
Zone Tag			8	9	10	11	12	13	14		
Space type			Corridors	Booking/waiting	Conference/meeting	Office space	Office space	Office space	Office space		
Floor Area of zone	Az	sf	335	1600	250	375	700	380	1160		
Design population of zone	Pz	P	0	80	12.5	1.875	3.5	1.9	5.8		
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm	430	940	430	710	940	710	1710		
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?											
Local recirc air fr representative of sys system return air	Er										

Zone title turns purple (italic for critical zone(s))

Select from pull-down list

(default value listed; may be overridden)

Select from pull-down list or leave blank if N/A

Inputs for Operating Condition Analyzed											
Percent of total design airflow rate at conditioned analyzed	Ds	%	779%	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			**0.39**								
Outdoor air intake required for system	Vot	cfm		**5766**								
Outdoor air per unit floor area	Vot/As	cfm/sf		**0.45**								
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p		**30.8**								
Outdoor air as a % of design primary supply air	Ypd	cfm		**265%**								

Detailed Calculations													
Initial Calculations for the System as a whole													
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	17650							
Uncorrected OA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	2223							
Uncorrected OA req'd as a fraction of primary SA	Xs		=	Vou / Vps	=	0.13							
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					0.00	7.50	5.00	5.00	5.00	5.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm					430	940	430	710	940	710	1710
Unused OA req'd to breathing zone	Voz	cfm	=	Rpz Pz + Raz Az	=		20.1	696.0	77.5	31.9	59.5	32.3	98.6
Unused OA requirement for zone	Voz	cfm	=	Vbz/Ez	=		20	696	78	32	60	32	99
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	=		0.05	0.74	0.18	0.04	0.06	0.05	0.06
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=		0.05	0.74	0.18	0.04	0.06	0.05	0.06
System Ventilation Efficiency													
Zone Ventilation Efficiency (App A Method)	Evz		=	(Fa + FbXs - FcZ) / Fa	=		1.08	0.39	0.95	1.08	1.06	1.08	1.07
System Ventilation Efficiency (App A Method)	Ev		=	min (Evz)	=	**0.39**							
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	n/a							
Minimum outdoor air intake airflow													
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	**5766**							
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	**0.33**							
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	n/a							
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	n/a							
OA Temp at which Min OA provides all cooling													
OAT below which OA intake flow is @ minimum		Deg F	=	((Tp-dTsf)-(1-Y)*Tr+dTri	=	20							

Building:	DE Hospice Building B
System Tag/Name:	VHP-3
Operating Condition Description:	Ventilation Heat Pump
Units (select from pull-down list)	IP

Item	Name	Units	Formula / Note	System							
Inputs for System	**Name**	**Units**		**System**							
Floor area served by system	As	sf		12000							
Population of area served by system (including diversity)	Ps	P	100% diversity	187							
Design primary supply fan airflow rate	Vpsd	cfm		2,265							
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		5.0							
Inputs for Potentially Critical zones											
Zone Name			*Zone title turns purple italic for critical zone(s)*		HP-5	HP-5	HP-4	HP-5	HP-4	HP-4	HP-4
Zone Tag					15	16	17	18	19	20	21
Space type			Select from pull-down list		Office space	Office space	Office space	Office space	Office space	Office space	Office space
Floor Area of zone	Az	sf			900	350	375	1060	375	835	360
Design population of zone	Pz	P	(default value listed; may be overridden)		4.5	1.75	1.875	5.3	1.875	4.175	1.8
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm			710	710	530	710	530	530	530
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	%		779%	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			**0.39**							
Outdoor air intake required for system	Vot	cfm		**5766**							
Outdoor air per unit floor area	Vot/As	cfm/sf		**0.45**							
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p		**30.8**							
Outdoor air as a % of design primary supply air	Ypd	cfm		**255%**							
Detailed Calculations											
Initial Calculations for the System as a whole											
Primary supply air flow to system at conditioned analyzed	Vps	cfm	= VpdDs =	17650							
UncorrectedOA requirement for system	Vou	cfm	= Rps Ps + Ras As =	2223							
Uncorrected OA req'd as a fraction of primary SA	Xs		= Vou / Vps =	0.13							
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	5.00	5.00	5.00	5.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm			710	710	530	710	530	530	530
Unused OA req'd to breathing zone	Vbz	cfm	= Rpz Pz + Raz Az =		76.5	29.8	31.9	90.1	31.9	71.0	30.6
Unused OA requirement for zone	Voz	cfm	= Vbz/Ez =		77	30	32	90	32	71	31
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 =		0.11	0.04	0.06	0.13	0.06	0.13	0.06
Unused OA fraction required in primary air to zone	Zp		= Voz / Vpz =		0.11	0.04	0.06	0.13	0.06	0.13	0.06
System Ventilation Efficiency											
Zone Ventilation Efficiency (App A Method)	Evz		= (Fa + FbXs - FcZ) / Fa =		1.02	1.08	1.07	1.00	1.07	0.99	1.07
System Ventilation Efficiency (App A Method)	Ev		= min (Evz) =	**0.39**							
Ventilation System Efficiency (Table 6.3 Method)	Ev		= Value from Table 6.3 =	n/a							
Minimum outdoor air intake airflow											
Outdoor Air Intake Flow required to System	Vot	cfm	= Vou / Ev =	**5766**							
OA intake req'd as a fraction of primary SA	Y		= Vot / Vps =	**0.33**							
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	= Vou / Ev =	n/a							
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		= Vot / Vps =	n/a							
OA Temp at which Min OA provides all cooling											
OAT below which OA Intake flow is @ minimum		Deg F	= {(Tp-dTsf)-(1-Y)*(Tr+dTrf =	20							

Building:	DE Hospice Building B						
System Tag/Name:	VHP-3						
Operating Condition Description:	Ventilation Heat Pump						
Units (select from pull-down list)	IP						

Item	Name	Units	Formula / Note	System	HP-3	HP_5	HP-4
Inputs for System							
Floor area served by system	As	sf		12880			
Population of area served by system (including diversity)	Ps	P	100% diversity	187			
Design primary supply fan airflow rate	Vpsd	cfm		2,265			
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		5.0			
Inputs for Potentially Critical zones							
Zone Name			*Zone title turns purple italic for critical zone(s)*		HP-3	HP_5	HP-4
Zone Tag					22	23	24
Space type			Select from pull-down list		Office space	Office space	Office space
Floor Area of zone	Az	sf			110	110	375
Design population of zone	Pz	P	(default value listed; may be overridden)		0.55	0.55	1.875
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm			430	710	530
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	%		779%	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							
Ventilation System Efficiency	Ev			**0.39**			
Outdoor air intake required for system	Vot	cfm		**5766**			
Outdoor air per unit floor area	Vot/As	cfm/sf		**0.45**			
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p		**30.8**			
Outdoor air as a % of design primary supply air	Ypd	cfm		**255%**			
Detailed Calculations							
Initial Calculations for the System as a whole							
Primary supply air flow to system at conditioned analyzed	Vps	cfm	= VpdDs =	17650			
UncorrectedOA requirement for system	Vou	cfm	= Rps Ps + Ras As =	2223			
Uncorrected OA req'd as a fraction of primary SA	Xs		= Vou / Vps =	0.13			
Initial Calculations for individual zones							
OA rate per unit area for zone	Raz	cfm/sf			0.06	0.06	0.06
OA rate per person	Rpz	cfm/p			5.00	5.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm			430	710	530
Unused OA req'd to breathing zone	Vbz	cfm	= Rpz Pz + Raz Az =		9.4	9.4	31.9
Unused OA requirement for zone	Voz	cfm	= Vbz/Ez =		9	9	32
Fraction of zone supply not directly recirc. from zone	Fa		= Ep + (1-Ep)Er =		1.00	1.00	1.00
Fraction of zone supply from fully mixed primary air	Fb		= Ep =		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
Unused OA fraction required in supply air to zone	Zd		= Voz / Vdz =		0.02	0.01	0.06
Unused OA fraction required in primary air to zone	Zp		= Voz / Vpz =		0.02	0.01	0.06
System Ventilation Efficiency							
Zone Ventilation Efficiency (App A Method)	Evz		= (Fa + FbXs - FcZ) / Fa =		1.10	1.11	1.07
System Ventilation Efficiency (App A Method)	Ev		= min (Evz) =	**0.39**			
Ventilation System Efficiency (Table 6.3 Method)	Ev		= Value from Table 6.3 =	n/a			
Minimum outdoor air intake airflow							
Outdoor Air Intake Flow required to System	Vot	cfm	= Vou / Ev =	**5766**			
OA intake req'd as a fraction of primary SA	Y		= Vot / Vps =	**0.33**			
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	= Vou / Ev =	n/a			
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		= Vot / Vps =	n/a			
OA Temp at which Min OA provides all cooling							
OAT below which OA Intake flow is @ minimum		Deg F	= {(Tp-dTsf)-(1-Y)*(Tr+dTrf =	20			

Building:	DE Hospice Building A										
System Tag/Name:	ERU-1										
Operating Condition Description:	Energy Recovery										
Units (select from pull-down list)	IP										
Inputs for System	**Name**	**Units**		**System**							
Floor area served by system	As	sf		4400							
Population of area served by system (including diversity)	Ps	P	100% diversity	81							
Design primary supply fan airflow rate	Vpsd	cfm		1,555							
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		5.0							
Inputs for Potentially Critical zones											
Zone Name			*Zone title turns purple italic for critical zone(s)*		*HP-6*	HP-4	HP-3	HP-5	HP-3	HP-3	HP-3
Zone Tag					1	2	3	4	5	6	7
Space type		Select from pull-down list			Restaurant dining rooms	Bedroom/living room	Bedroom/living room	Restaurant dining rooms	Bedroom/living room	Bedroom/living room	Reception areas
Floor Area of zone	Az	sf			450	270	270	315	270	270	385
Design population of zone	Pz	P	(default value listed; may be overridden)		31.5	2.7	2.7	22.05	2.7	2.7	11.55
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm			330	530	430	1710	430	430	430
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	%		567%	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			**0.13**							
Outdoor air intake required for system	Vot	cfm		**6285**							
Outdoor air per unit floor area	Vot/As	cfm/sf		**1.43**							
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p		**77.6**							
Outdoor air as a % of design primary supply air	Ypd	cfm		**404%**							
Detailed Calculations											
Initial Calculations for the System as a whole											
Primary supply air flow to system at conditioned analyzed	Vps	cfm	= VpdDs =	8820							
UncorrectedOA requirement for system	Vou	cfm	= Rps Ps + Ras As =	845							
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	0.06	0.18	0.06	0.06	0.06
OA rate per person	Rpz	cfm/p			7.50	5.00	5.00	7.50	5.00	5.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm			330	530	430	1710	430	430	430
Unused OA req'd to breathing zone	Vbz	cfm	= Rpz Pz + Raz Az =		317.3	29.7	29.7	222.1	29.7	29.7	80.9
Unused OA requirement for zone	Voz	cfm	= Vbz/Ez =		317	30	30	222	30	30	81
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 =		0.96	0.06	0.07	0.13	0.07	0.07	0.19
Unused OA fraction required in primary air to zone	Zp		= Voz / Vpz =		0.96	0.06	0.07	0.13	0.07	0.07	0.19
System Ventilation Efficiency											
Zone Ventilation Efficiency (App A Method)	Evz		= (Fa + FbXs - FcZ) / Fa =		0.13	1.04	1.03	0.97	1.03	1.03	0.91
System Ventilation Efficiency (App A Method)	Ev		= min (Evz) =	**0.13**							
Ventilation System Efficiency (Table 6.3 Method)	Ev		= Value from Table 6.3 =	n/a							
Minimum outdoor air intake airflow											
Outdoor Air Intake Flow required to System	Vot	cfm	= Vou / Ev =	**6285**							
OA intake req'd as a fraction of primary SA	Y		= Vot / Vps =	**0.71**							
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	= Vou / Ev =	n/a							
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		= Vot / Vps =	n/a							
OA Temp at which Min OA provides all cooling											
OAT below which OA Intake flow is @ minimum		Deg F	= {(Tp-dTsf)-(1-Y)*(Tr+dTrf =	48							

Building:	DE Hospice Building A										
System Tag/Name:	ERU-1										
Operating Condition Description:	Energy Recovery										
Units (select from pull-down list)	IP										
Inputs for System	**Name**	**Units**		**System**							
Floor area served by system	As	sf		4400							
Population of area served by system (including diversity)	Ps	P	100% diversity	81							
Design primary supply fan airflow rate	Vpsd	cfm		1,555							
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		5.0							
Inputs for Potentially Critical zones					**Potentially Critical Zones**						
Zone Name			*Zone title turns purple italic for critical zone(s)*		HP-5	HP-4	HP-3	HP-3	HP-1	HP-2	Hp-4
Zone Tag					8	9	10	11	12	13	14
Space type		Select from pull-down list			Booking/waiting	Bedroom/living room	Bedroom/living room	Bedroom/living room	Libraries	Laundry rooms, central	Bedroom/living room
Floor Area of zone	Az	sf			360	270	270	270	225	300	270
Design population of zone	Pz	P	(default value listed; may be overridden)		18	2.7	2.7	2.7	2.25	3	2.7
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm			710	1150	430	430	260	330	530
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	%		567%	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			**0.13**							
Outdoor air intake required for system	Vot	cfm		**6285**							
Outdoor air per unit floor area	Vot/As	cfm/sf		**1.43**							
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p		**77.6**							
Outdoor air as a % of design primary supply air	Ypd	cfm		**404%**							
Detailed Calculations											
Initial Calculations for the System as a whole											
Primary supply air flow to system at conditioned analyzed	Vps	cfm	= VpdDs =	8820							
UncorrectedOA requirement for system	Vou	cfm	= Rps Ps + Ras As =	845							
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	0.06	0.06	0.12	0.12	0.06
OA rate per person	Rpz	cfm/p			7.50	5.00	5.00	5.00	5.00	5.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm			710	1150	430	430	260	330	530
Unused OA req'd to breathing zone	Vbz	cfm	= Rpz Pz + Raz Az =		156.6	29.7	29.7	29.7	38.3	51.0	29.7
Unused OA requirement for zone	Voz	cfm	= Vbz/Ez =		157	30	30	30	38	51	30
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 =		0.22	0.03	0.07	0.07	0.15	0.15	0.06
Unused OA fraction required in primary air to zone	Zp		= Voz / Vpz =		0.22	0.03	0.07	0.07	0.15	0.15	0.06
System Ventilation Efficiency											
Zone Ventilation Efficiency (App A Method)	Evz		= (Fa + FbXs - FcZ) / Fa =		0.88	1.07	1.03	1.03	0.95	0.94	1.04
System Ventilation Efficiency (App A Method)	Ev		= min (Evz) =	**0.13**							
Ventilation System Efficiency (Table 6.3 Method)	Ev		= Value from Table 6.3 =	n/a							
Minimum outdoor air intake airflow											
Outdoor Air Intake Flow required to System	Vot	cfm	= Vou / Ev =	**6285**							
OA intake req'd as a fraction of primary SA	Y		= Vot / Vps =	**0.71**							
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	= Vou / Ev =	n/a							
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		= Vot / Vps =	n/a							
OA Temp at which Min OA provides all cooling											
OAT below which OA Intake flow is @ minimum		Deg F	= {(Tp-dTsf)-(1-Y)*(Tr+dTrf =	48							

Building:	DE Hospice Building A					
System Tag/Name:	ERU-1					
Operating Condition Description:	Energy Recovery					
Units (select from pull-down list)	IP					
Inputs for System	**Name**	**Units**		**System**		
Floor area served by system	As	sf		4400		
Population of area served by system (including diversity)	Ps	P	100% diversity	81		
Design primary supply fan airflow rate	Vpsd	cfm		1,555		
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		5.0		
Inputs for Potentially Critical zones						
Zone Name	*Zone title turns purple italic for critical zone(s)*				**HP-3**	**HP-1**
Zone Tag					**15**	**16**
Space type		Select from pull-down list			**Office space**	**Office space**
Floor Area of zone	Az	sf			120	165
Design population of zone	Pz	P	(default value listed; may be overridden)		0.6	0.825
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm			430	260
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	%		567%	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			**0.13**		
Outdoor air intake required for system	Vot	cfm		**6285**		
Outdoor air per unit floor area	Vot/As	cfm/sf		**1.43**		
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p		**77.6**		
Outdoor air as a % of design primary supply air	Ypd	cfm		**404%**		
Detailed Calculations						
Initial Calculations for the System as a whole						
Primary supply air flow to system at conditioned analyzed	Vps	cfm	= VpdDs =	8820		
UncorrectedOA requirement for system	Vou	cfm	= Rps Ps + Ras As =	845		
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			430	260
Unused OA req'd to breathing zone	Vbz	cfm	= Rpz Pz + Raz Az =		10.2	14.0
Unused OA requirement for zone	Voz	cfm	= Vbz/Ez =		10	14
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 =		0.02	0.05
Unused OA fraction required in primary air to zone	Zp		= Voz / Vpz =		0.02	0.05
System Ventilation Efficiency						
Zone Ventilation Efficiency (App A Method)	Evz		= (Fa + FbXs - FcZ) / Fa =		1.07	1.04
System Ventilation Efficiency (App A Method)	Ev		= min (Evz) =	**0.13**		
Ventilation System Efficiency (Table 6.3 Method)	Ev		= Value from Table 6.3 =	n/a		
Minimum outdoor air intake airflow						
Outdoor Air Intake Flow required to System	Vot	cfm	= Vou / Ev =	**6285**		
OA intake req'd as a fraction of primary SA	Y		= Vot / Vps =	**0.71**		
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	= Vou / Ev =	n/a		
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		= Vot / Vps =	n/a		
OA Temp at which Min OA provides all cooling						
OAT below which OA Intake flow is @ minimum		Deg F	= {(Tp-dTsf)-(1-Y)*(Tr+dTrf =	48		

ERU-1

Building:	DE Hospice Building A
System Tag/Name:	ERU-2
Operating Condition Description:	Energy Recovery
Units (select from pull-down list)	IP

Inputs for System	Name	Units		System
Floor area served by system	As	sf		5195
Population of area served by system (including diversity)	Ps	P	100% diversity	142
Design primary supply fan airflow rate	Vpsd	cfm		1,555
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		5.0

Inputs for Potentially Critical zones				HP-6	HP-4	HP-3	HP-5	HP-3	HP-3	HP-3
Zone Name				1	2	3	4	5	6	7
Zone Tag				Restaurant dining rooms	Bedroom/living room	Bedroom/living room	Restaurant dining rooms	Bedroom/living room	Bedroom/living room	Reception areas
Space type		Select from pull-down list								
Floor Area of zone	Az	sf		450	270	270	315	270	270	385
Design population of zone	Pz	P	(default value listed; may be overridden)	31.5	2.7	2.7	22.05	2.7	2.7	11.55
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm		330	530	430	1710	430	430	430
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	%		678%	100%	100%	100%	100%	100%	100%
Air distribution type at conditioned analyzed		Select from pull-down list			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
Primary air fraction of supply air at conditioned analyzed	Ep									

Results						
Ventilation System Efficiency	Ev				**0.16**	
Outdoor air intake required for system	Vot	cfm			**7923**	
Outdoor air per unit floor area	VobAs	cfm/sf			**1.53**	
Outdoor air per person served by system (including diversity)	VotPs	cfm/p			**55.8**	
Outdoor air as a % of design primary supply air	Ypd	cfm			**510%**	

Detailed Calculations													
Initial Calculations for the System as a whole													
Primary supply air flow to system at conditioned analyzed	Vps	cfm	=	VpdDs	=	10550							
UncorrectedOA requirement for system	Vou	cfm	=	Rps Ps + Ras As	=	1230							
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					0.18	0.06	0.18	0.06	0.06	0.06	0.06
OA rate per person	Rpz	cfm/p					7.50	5.00	7.50	5.00	5.00	5.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm					330	530	1710	430	430	430	430
Unused OA req'd to breathing zone	Vbz	cfm	=	Rpz Pz + Raz Az	=		317.3	29.7	222.1	29.7	29.7	29.7	80.9
Unused OA requirement for zone	Voz	cfm	=	VbzEz	=		317	30	222	30	30	30	81
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	=		0.96	0.06	0.13	0.07	0.07	0.07	0.19
Unused OA fraction required in primary air to zone	Zp		=	Voz / Vpz	=		0.96	0.06	0.13	0.07	0.07	0.07	0.19
System Ventilation Efficiency													
Zone Ventilation Efficiency (App A Method)	Evz		=	(Fa + FbXs - FcZ) / Fa	=		0.16	1.06	1.05	0.99	1.05	1.05	0.93
System Ventilation Efficiency (App A Method)	Ev		=	min (Evz)	=	**0.16**							
Ventilation System Efficiency (Table 6.3 Method)	Ev		=	Value from Table 6.3	=	n/a							
Minimum outdoor air intake airflow													
Outdoor Air Intake Flow required to System	Vot	cfm	=	Vou / Ev	=	**7923**							
OA intake req'd as a fraction of primary SA	Y		=	Vot / Vps	=	**0.75**							
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	=	Vou / Ev	=	n/a							
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		=	Vot / Vps	=	n/a							
OA Temp at which Min.OA provides all cooling													
OAT below which OA intake flow is @ minimum		Deg F	=	((Tp-dTsf)-(1-Y)*Tr+dTr1	=	49							

Building:	DE Hospice Building A
System Tag/Name:	ERU-2
Operating Condition Description:	Energy Recovery
Units (select from pull-down list)	IP

	Name	Units			System
Inputs for System					
Floor area served by system	As	sf			5195
Population of area served by system (including diversity)	Ps	P	100% diversity		142
Design primary supply fan airflow rate	Vpsd	cfm			1,555
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			5.0

Potentially Critical Zones

Inputs for Potentially Critical zones	Name	Units		HP-5	HP-4	HP-3	HP-3	HP-1	HP-2	Hp-4
Zone Name	*Zone title turns purple italic for critical zone(s)*			HP-5	HP-4	HP-3	HP-3	HP-1	HP-2	Hp-4
Zone Tag				8	9	10	11	12	13	14
Space type		Select from pull-down list		Booking/waiting	Bedroom/living room	Bedroom/living room	Bedroom/living room	Libraries	Laundry rooms, central	Bedroom/living room
Floor Area of zone	Az	sf		360	270	270	270	225	300	270
Design population of zone	Pz	P	(default value listed; may be overridden)	18	2.7	2.7	2.7	2.25	3	2.7
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm		710	1150	430	430	260	330	530
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	HP-5	HP-4	HP-3	HP-3	HP-1	HP-2	Hp-4
Percent of total design airflow rate at conditioned analyzed	Ds	%		678%	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	Name	Units	Value
Ventilation System Efficiency	Ev		0.16
Outdoor air intake required for system	Vot	cfm	7923
Outdoor air per unit floor area	Vot/As	cfm/sf	1.53
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p	55.8
Outdoor air as a % of design primary supply air	Ypd	cfm	510%

Detailed Calculations	Name	Units	Formula	System	HP-5	HP-4	HP-3	HP-3	HP-1	HP-2	Hp-4
Initial Calculations for the System as a whole											
Primary supply air flow to system at conditioned analyzed	Vps	cfm	= VpdDs =	10550							
UncorrectedOA requirement for system	Vou	cfm	= Rps Ps + Ras As =	1230							
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	0.06	0.06	0.06	0.12	0.12	0.06
OA rate per person	Rpz	cfm/p			7.50	5.00	5.00	5.00	5.00	5.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm			710	1150	430	430	260	330	530
Unused OA req'd to breathing zone	Vbz	cfm	= Rpz Pz + Raz Az =		156.6	29.7	29.7	29.7	38.3	51.0	29.7
Unused OA requirement for zone	Voz	cfm	= Vbz/Ez =		157	30	30	30	38	51	30
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 =		0.22	0.03	0.07	0.07	0.15	0.15	0.06
Unused OA fraction required in primary air to zone	Zp		= Voz / Vpz =		0.22	0.03	0.07	0.07	0.15	0.15	0.06
System Ventilation Efficiency											
Zone Ventilation Efficiency (App A Method)	Evz		= (Fa + FbXs - FcZ) / Fa =		0.90	1.09	1.05	1.05	0.97	0.96	1.06
System Ventilation Efficiency (App A Method)	Ev		= min (Evz) =	0.16							
Ventilation System Efficiency (Table 6.3 Method)	Ev		= Value from Table 6.3 =	n/a							
Minimum outdoor air intake airflow											
Outdoor Air Intake Flow required to System	Vot	cfm	= Vou / Ev =	7923							
OA intake req'd as a fraction of primary SA	Y		= Vot / Vps =	0.75							
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	= Vou / Ev =	n/a							
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		= Vot / Vps =	n/a							
OA Temp at which Min OA provides all cooling											
OAT below which OA Intake flow is @ minimum		Deg F	= {(Tp-dTsf)-(1-Y)*(Tr+dTrf =	49							

Building:	DE Hospice Building A					
System Tag/Name:	ERU-2					
Operating Condition Description:	Energy Recovery					
Units (select from pull-down list)	IP					
Inputs for System	**Name**	**Units**		**System**		
Floor area served by system	As	sf		5195		
Population of area served by system (including diversity)	Ps	P	100% diversity	142		
Design primary supply fan airflow rate	Vpsd	cfm		1,555		
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		5.0		
Inputs for Potentially Critical zones						
Zone Name			*Zone title turns purple italic for critical zone(s)*		HP-5	HP-8
Zone Tag					15	16
Space type			Select from pull-down list		Laundry rooms, central	Booking/waiting
Floor Area of zone	Az	sf			450	550
Design population of zone	Pz	P	(default value listed; may be overridden)		4.5	27.5
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm			710	1710
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	%		678%	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			**0.16**		
Outdoor air intake required for system	Vot	cfm		**7923**		
Outdoor air per unit floor area	Vot/As	cfm/sf		**1.53**		
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p		**55.8**		
Outdoor air as a % of design primary supply air	Ypd	cfm		**510%**		
Detailed Calculations						
Initial Calculations for the System as a whole						
Primary supply air flow to system at conditioned analyzed	Vps	cfm	= VpdDs =	10550		
UncorrectedOA requirement for system	Vou	cfm	= Rps Ps + Ras As =	1230		
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			0.12	0.06
OA rate per person	Rpz	cfm/p			5.00	7.50
Total supply air to zone (at condition being analyzed)	Vdz	cfm			710	1710
Unused OA req'd to breathing zone	Vbz	cfm	= Rpz Pz + Raz Az =		76.5	239.3
Unused OA requirement for zone	Voz	cfm	= Vbz/Ez =		77	239
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	0.14
Unused OA fraction required in primary air to zone	Zp		= Voz / Vpz =		0.11	0.14
System Ventilation Efficiency						
Zone Ventilation Efficiency (App A Method)	Evz		= (Fa + FbXs - FcZ) / Fa =		1.01	0.98
System Ventilation Efficiency (App A Method)	Ev		= min (Evz) =	**0.16**		
Ventilation System Efficiency (Table 6.3 Method)	Ev		= Value from Table 6.3 =	n/a		
Minimum outdoor air intake airflow						
Outdoor Air Intake Flow required to System	Vot	cfm	= Vou / Ev =	**7923**		
OA intake req'd as a fraction of primary SA	Y		= Vot / Vps =	**0.75**		
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	= Vou / Ev =	n/a		
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		= Vot / Vps =	n/a		
OA Temp at which Min OA provides all cooling						
OAT below which OA Intake flow is @ minimum		Deg F	= {(Tp-dTsf)-(1-Y)*(Tr+dTrf =	49		