Technical Report 1

ASHRAE Standards 62.1 and 90.1 Compliance Evaluation

Delaware County Community College

STEM Center

Media, PA



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Mechanical Option

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Table of Contents

Table of Contents	2
Executive Summary	4
Part 1: ASHRAE Standard 62.1 Section 5 Evaluation	5
Section 5.1 – Natural Ventilation	5
Section 5.2 – Ventilation Air Distribution	5
Section 5.3 – Exhaust Duct Location	
Section 5.4 – Ventilation System Controls	5
Section 5.5 – Airstream Surfaces	5
Section 5.6 – Outdoor Air Intakes	5
Section 5.7 – Local Capture of Contaminants	6
Section 5.8 – Combustion Air	
Section 5.9 – Particulate Matter Removal	
Section 5.10 – Dehumidification Systems	7
Section 5.11 – Drain Pans	7
Section 5.12 – Finned-Tube Coils and Heat Exchangers	
Section 5.13 – Humidifiers and Water-Spray Systems	7
Section 5.14 – Access for Inspection, Cleaning, and Maintenance	7
Section 5.15 – Building Envelope and Interior Surfaces	
Section 5.16 – Buildings with Attached Parking Garages	
Section 5.17 – Air Classification and Recirculation	8
Section 5.18 – Requirements for Buildings Containing ETS Areas and	
ETS-Free Areas	
Part 2: ASHRAE Standard 62.1 Section 6 Evaluation	
Section 6.2 – Ventilation Rate Procedure	
Section 6 Results	
Part 3: ASHRAE Standard 90.1 Evaluation	
Section 5 – Building Envelope	
Section 6 – Heating, Ventilating, and Air Conditioning	
Section 7 – Service Water Heating	14
Section 8 – Power	
Section 9 – Lighting	
Standard 90.1 Summary	
Appendix A – Ventilation Rate Calculations	
Appendix B – Lighting Power Density Calculations and Schedule	28

3

List of Figures

Figure 1 – Roof Plan of Outdoor Air Intakes	6
Figure 2 – Exhaust Air Riser Diagram	6
Figure 3 – Excerpt from LEED Review	8
Figure 4 – ASHRAE Standard 90.1 Climate Zones	11
<u>List of Tables</u>	
Table 1 – Particulate Matter Filters Compliance	6
Table 2 – Outside Air – Exhaust Air Comparison	7
Table 3 – Outdoor Air Intake Requirement	
Table 4 – Total Building Glazing Area	11
Table 5 – Total Roof Skylight Area	11
Table 6 – Building Envelope Properties	
Table 7 – Unitary Air Conditioners and Condensing Units	13
Table 8 – Fan Power Limitation	

Table 9 – Duct Insulation Properties...... 14

Executive Summary



The Delaware County Community College Science, Technology, Engineering, and Mathematics (STEM) Center is a new addition to their Marple Campus, and is part of the two-building STEM Complex. At 105,000 square feet and four stories it is a focal point for the campus, and stands out with both architectural and sustainable features.

The purpose of this report is to evaluate the compliance of the building against American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standards 62.1 and 90.1.

A section-by-section analysis of Standard 62.1 Section 5 (Systems and Equipment) showed full perceivable compliance. This section considered a variety of criteria, including natural ventilation, airstream surfaces, particulate matter removal, and air distribution. The building specifications indicate a high standard for system quality in all areas considered.

ASHRAE Standard 62.1 Section 6 (Procedures) led to a detailed calculation of ventilation rate for the building. The mechanical system for the STEM Center includes (2) 80,000-cfm rated rooftop air handling units and a substantial amount of outdoor air intake requirements due to the presence of laboratory and other educational spaces. In Section 6, it was determined that the building system is well beyond compliance with the calculated requirements according to ASHRAE. Largely due to the high need for fresh air and air exhaustion within the spaces, as well as the meeting of pressurization requirements, the STEM Center is found to be fully compliant with Standard 62.1 Section 6.

Finally, for ASHRAE Standard 90.1, many systems were considered in a much broader building analysis. Compliance was checked across the building envelope, HVAC systems, service water heating, power, and lighting. In this standard, a few areas of non-compliance were discovered, including building envelope properties and equipment efficiencies. For the most part, compliance was achieved, including a significant difference between the maximum lighting power density and the much lower calculated power density.

Overall, the STEM Center is found to be mostly compliant, faltering in a few sections of the ASHRAE Standards 62.1 and 90.1. It is not surprising to see these limit pushed, however, as Delaware County Community College and the design team have put great efforts into developing a quality and sustainable LEED® certified building.

PART 1 – ASHRAE Standard 62.1, Section 5 Analysis

5

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5.1 Natural Ventilation.

Mechanical ventilation is utilized in the STEM Center, and therefore the natural ventilation requirements do not apply.

5.2 Ventilation Air Distribution.

The ventilation system has the means to achieve the minimum ventilation airflow calculated in ASHRAE Standard 62.1 Section 6. This is made possible by the significant amount of outside air taken in by the two rooftop 80,000 cfm capacity air handlers, which is necessary to assure high air quality in such spaces as laboratories and classrooms.

5.3 Exhaust Duct Location.

Ductwork that contains potentially harmful contaminants comes from the numerous lab spaces and preparation rooms on the second and third floors. This ductwork is appropriately pressurized in accordance with Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) standards using a space pressurization monitoring system. This directs exhaust air to the roof top exhaust fan units.

5.4 Ventilation System Controls.

Direct Digital Controls (DDC) are used on a peer-to-peer Carrier Sense Multiple Access/Collision Detect (CSMA/CD) Ethernet Local Area Network. The control language is both LonTalkTM and BACnet. Spaces are automatically controlled to maintain minimum ventilation and airflow balance. Passive infrared occupancy sensors are used to activate fan system.

5.5 Airstream Surfaces.

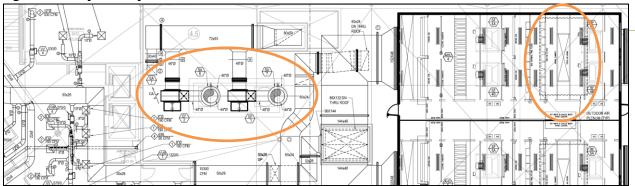
PVC-Coated Galvanized Steel ductwork is in accordance with UL 181 and ASTM A 653/A 653 M. Sheet metal surfaces and metal fasteners are used otherwise.

5.6 Outdoor Air Intakes.

Rooftop outdoor air intakes are located sufficiently far away from all exhaust, including the exhaust air coming from laboratory spaces. The roof plan is shown below (Figure 1: Roof Plan of Outdoor Air Intakes), illustrating that ASHRAE Standard 62.1 Table 5-1 for minimum separation distances required are all satisfied.

Outdoor air intake is "Louvered Penthouse" type, drawing air from four sides, and is designed to prevent snow or rain entrainment. Also, appropriate screening is included on the inside of the louvers.

Figure 1: Roof Plan of Outdoor Air Intakes



5.7 Local Capture of Contaminants.

All potentially contaminated air from equipment or otherwise is ducted to rooftop exhaust fan units. Two main Greenheck exhaust fans discharge air upward at 34,000 cfm, and they are

shown in Figure 2 taken from the Exhaust Air Riser Diagram (Drawing M-504). Additional exhaust fans also exhaust air to the roof top.

5.8 Combustion Air.

The flue gas system for the STEM Center is designed and installed to prevent leakage of combustion products, using high temperature silicone sealant to be gastight. Sufficient air is provided for combustion, and an integral draft diverter is utilized to "assure precise air and flue gas mixture for efficient venting" according to Specification 236330 for Water Boilers.

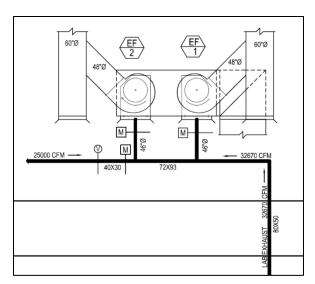


Figure 2: Exhaust Air Riser Diagram

5.9 Particulate Matter Removal.

Particulate filters are tested and rated in accordance with ASHRAE Standard 52.1 and 52.2 and are UL Class I or II rated. Table 1 shows compliance with necessary MERV ratings for filters.

Table 1: Particulate Matter Filters Compliance

Filters Used:	MERV Rating	Required MERV Rating	Compliance? (Y/N)
Camil Farr 30/30	8	6	Υ
Viledon MV85	13	6	Y

5.10 Dehumidification Systems.

Each AHU is designed to bring in a maximum of 66,000 cfm of outdoor air (132,000 cfm total) and the maximum exhaust air cfm for all exhaust fans combined in 81,060 cfm, thus complying with the 5.10.2 standard for exfiltration. Breakdown of maximum exhaust air cfm for each exhaust fan and the comparison to maximum outdoor air cfm is shown below in Table 2.

Table 2: Outdoor Air – Exhaust Air Comparison

	Maximum	Maximum	
	Outdoor Air (cfm)	Exhaust Air (cfm)	
AHU-4	66,000	34,000	EF-1
AHU-5	66,000	34,000	EF-2
		260	EF-3
		1,480	EF-4
		3,390	EF-5
		830	EF-6
		4,600	EF-7
		1,500	EF-8
		1,000	EF-9
Total	132,000	81,060	Total

<u>5.11 Drain Pans.</u>

Hot water and chilled water coil drain pans are sloped in two directions appropriately (greater than 1/8" per foot) and encompass the full width of the coils. Piping for coil drain pans is 80 CPVC. Condensate recessed floor drain is continuously welded for a watertight seal.

5.12 Finned-Tube Coils and Heat Exchangers.

As previously mentioned, adequate number and sizing of drain pans are provided and addressed in specifications.

5.13 Humidifiers and Water-Spray Systems.

The STEM Center does not use humidifiers or water-spray systems; therefore this part of ASHRAE Standard 62.1 Section 5 does not apply.

5.14 Access for Inspection, Cleaning, Maintenance.

Full access has been required for all common HVAC work as per Specification 230500. This includes sufficient sizing of shafts, chases, clearances, access doors, as well as proper location of all equipment to ensure full accessibility.

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<u>5.15 Building Envelope and Interior Surfaces.</u>

The STEM Center uses composite-HDPE/bentonite membrane waterproofing, as well as single-component, modified polyurethane waterproofing for perimeter foundation walls. Vapor seal is placed on concealed side of metal wall panels. Metal wall panel assembly includes components necessary for a weathertight system. Air infiltration is no more than 0.06 cfm/sq. ft. of wall area, tested according to ASTM E 283. Composite wall panels are fabricated in a manner that eliminates condensation on the interior side of panel.

<u>5.16 Buildings with Attached Parking Garages.</u>

There is no attached Parking Garage for the STEM Center; therefore this section of Standard 62.1 does not apply.

5.17 Air Classification and Recirculation.

All spaces in the STEM Center are Class 1 air class according to Standard 62.1 Table 6-1, with the exception of all laboratory spaces. For such rooms (Classes 2 and 4), air is exhausted straight to the rooftop exhaust fans and is not recirculated.

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

As a requirement for LEED® Certification, the STEM Center is a smoke-free building and therefore the requirements for ETS and ETS-Free areas in Standard 62.1 do not apply. Excerpt from the LEED® review is shown below with item "EQp 2 Envionmental Tobacco Smoke Control" highlighted.

	MICO.Z Regional Malenais 2070					2070 malenais extracted, processed and mandactored w/1 000 miles
	MR 6 Rapidly Renewable Materials	1			1	2.5% of materials from rapidly renewable resources
	MR 7 Certified Wood	1	1			50% of wood based materials from FSC certified sources
>	EQp 1 Minimum IAQ Performance		R			Most meet ASTRAC 02-2004
Quality	EQp 2 Environmental Tobacco Smoke Control		R			Prohibit smoking in the building
9	EQ 1 Outdoor Air Delivery Monitoring		-			Permanent CO2 monitoring w/ operation adjositients
Ø	EQ 2 Increased Ventilation	1		1		\$ Outdoor Air delivery 30% over ASHRAE 62-2004
Indoor Environmental	EQ 3.1 Construction IAQ- During Construction	− i	1	<u> </u>		comply with SMACNA standards, MERV 8 filters during construction
t	EQ 3.2 Construction IAQ- Before Occupancy	1	1			employ building flush out or do indoor air quality testing
Ĕ	EQ 4.1 Low-Emitting Materials- Adhesives/Sealants	- 	1			Low VOC adhesives and sealants
Ē		1	1			
.2	EQ 4.2 Low-Emitting Materials- Paints and Coatings					Low VOC paints, primers, anti-rust paints, anti-corrosives, sealers, stains
2	EQ 4.3 Low-Emitting Materials- Carpet	1	1			CRI Green Labeled Plus carpet, Green Labeled cushion, low VOC adhesive
ū	EQ 4.4 Low-Emitting Materials- Composite wood/agrifiber	1	1			No-added-urea-formaldehyde composite wood or agrifiber products only
ō	EQ 5 Indoor Chemical Pollution Source Control	1	1			entryway systems, isolation of chemical pollutants, and MERV 13 filters
용	EQ 6.1 Controllability of Systems- Lighting	1	1			Individual lighting controls for 90% of occupants
	EQ 6.2 Controllability of Systems-Thermal Comfort	1		1		Thermal controls as per ASHRAE 55-2004 for 50% of occupants
9	EQ 7.1 Thermal Comfort- Design	1	1			HVAC and envelope design must meet ASHRAE 55-2004
nhano	EQ 7.2 Thermal Comfort- Verification	1	1			Agreement for post-occupancy survey and remediation
Ę	EQ 8.1 Daylighting	1	1			minimum 2% daylighting factor in 75% of regularly occupied spaces
ŭ	EQ 8.2 Views	li	1			views from 90% of regularly occupied spaces
						nem nem repeating eccepted abdoor

Figure 3: Excerpt from LEED® Review

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PART 2 – ASHRAE Standard 62.1, Section 6 Analysis

6.2 Ventilation Rate Procedure.

Ventilation rate calculations were conducted to determine the minimum outdoor air requirements for ventilation. This analysis was done for nearly all the spaces in the STEM Center (neglecting such spaces as toilet and mechanical rooms), and was based on floor area (A_z) , number of occupants (P_z) , design supply air cfm (V_{dzd}) , and the space type. The rooms analyzed were those selected as potentially critical zones, and these included classrooms, offices, conference rooms, laboratories, preparation rooms, fitness rooms, and locker rooms.

6.2.2 Zone calculations:

The following equations and methods are provided by ASHRAE Standard 62.1 Section 6 for determining outdoor air ventilation rate. These equations, used in an Excel spreadsheet were used to for ventilation rate analysis.

Eqn. 6-1:
$$V_{bz} = R_p * P_z + R_a * A_z$$

 A_z = Zone floor area (ft^2)

 P_z = Zone population (people)

 R_p = Outdoor air flow rate $(\frac{cfm}{person})$

 R_a = Outdoor airflow rate $(\frac{cfm}{ft^2})$

Zone Air Distribution Effectiveness:

 E_z = 1.0 (As defined by Table 6-2)

Zone Outdoor Airflow:

Eqn. 6-2:
$$V_{oz} = \frac{V_{bz}}{E_z}$$

Primary Outdoor Air Fraction:

Eqn. 6-5:
$$Z_p = \frac{V_{oz}}{V_{pz}}$$

Occupant Diversity:

Eqn. 6-7:
$$D = \frac{Ps}{\sum all\ zonesPz}$$

 P_s = System Population

Uncorrected Outdoor Air Intake:

Eqn. 6-6:
$$V_{ou} = D\sum_{all\ zones} (R_p * P_z) + \sum_{all\ zones} (R_a * A_z)$$

Outdoor Air Intake:

Eqn. 6-7:
$$V_{ot} = \frac{Vot}{Ev}$$

10

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Section 6 Results:

Excel spreadsheets of calculations can be found in Appendix A, showing analysis for the building's two air handlers, AHU-4 and AHU-5. All four floors were analyzed, and the total outdoor air intake required was determined to be 43,738 cfm. This compared to the minimum outdoor air cfm of each air handler (66,000 cfm) shows that the STEM Center design exceeds the ASHRAE standard for outdoor air by a significant amount. Because of the amount of air needed for adequate exhausting of laboratory spaces and supplying of numerous classrooms, a substantial amount of outdoor air is required to maintain indoor air quality for the building occupants. This analysis, shown in Table 3 below, concludes that the building design more than accounts for that need.

Table 3: Outdoor Air Intake Requirement

	Outdoor Air
	Intake Required (cfm)
First Floor	18,349
Second Floor	10,007
Third Floor	10,462
Fourth Floor	4,930
Total	43,748
Design Maximum	132,000
Outdoor Air cfm	

Because the air handling units greatly exceed the requirements, V_{oz} (unused outdoor air requirement for zone) totaled for all four floors is 22,978 cfm. This value is significant and gives a point of potential improvement for the air handling system.

PART 3 – ASHRAE Standard 90.1

Section 5: Building Envelope

The STEM Center, and the rest of the Delaware County Community College (Marple Campus), lies in **Climate Zone 4A** according to map seen below in Figure 3.

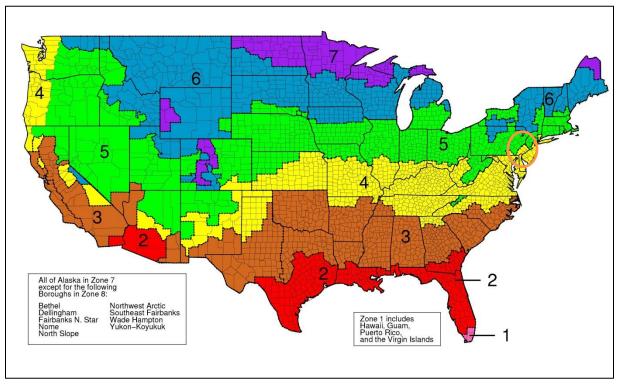


Figure 4: ASHRAE Standard 90.1 Climate Zones

Due mainly to a substantial glass curtain wall system on the south façade of the building, the STEM Center does not comply with the ASHRAE Standard 90.1 maximum allowable vertical fenestration area percentage of 40%. With 2,583 ft² of exterior windows and 19,558 ft² of glass curtain wall, the vertical glazing percentage is 46.61% as tallied in Table 4.

Table 4: Total Building Glazing Area

	Exterior Windows	Glass Curtain Wall	Exterior Walls (Gross)	Percentage Glazing	Max. Percent Allowed	Compliance? (Y/N)
Total Area (SF)	2,583.28	19,558.47	47,501.20	46.61%	40%	N

There is only one skylight, which is circular with an 8' diameter. This is not nearly enough to exceed the maximum percent allowable as shown below in Table 5.

Table 5: Total Roof Skylight Area

	Dome Skylight	Roof Area (Gross)	Percentage Skylight	Max. Percent Allowed	Compliance? (Y/N)
Total Area (SF)	50.27	28,430.11	0.18%	5%	Y

Requirements for building envelope sealing as per section 5.4.3.1 of Standard 90.1 are met with elastomeric joint sealants. These sealants maintain watertight and airtight continuous joint seals for fenestration, wall systems, building assemblies, etc.

In regards to fenestration air leakage, glazed aluminum curtain-wall systems and all aluminum-framed systems have a maximum air leakage of 0.06 cfm/ft², and skylights have a maximum of 0.3 cfm/ft² according to ASTM E 283 testing. This justifies the standard of 0.4 cfm/ft².

There is a minimum distance between doors for vestibules in section 5.4.3.4. For the STEM Center, vestibules such as the main south side entrance have a distance between interior and exterior doors greater than 7 ft, satisfying the requirement.

Using the Prescriptive Building Envelope Option as per ASHRAE Standard 90.1 Section 5.5 for non-residential building type, and using Tables 5.5-1 through 5.5-8, the building's thermal properties is analyzed. Also used for calculation of thermal properties is Appendix A of ASHRAE Standard 90.1. Displayed below in Table 6 is the summary of that analysis, showing that according to the calculated U-Values and R-Values, all building envelope materials comply, except the floor properties do not satisfy the standard.

U-Value | Max Std. U-Value R-Value Min Std. R-Value Compliance? (Y/N) 0.048 28 Roof 0.03446 20 Υ Walls 0.05052 0.113 26 13 Floors 0.06733 0.038 30 30 Ν Doors 0.2 0.7 Υ SHGC Min Std. SHGC Glass 0.29 0.5 0.41 0.4 Υ Skylight 1.2 1.3 0.68 0.65 Υ

Table 6: Building Envelope Properties

Section 6: Heating, Ventilating, and Air Conditioning

In this section of ASHRAE Standard 90.1, different equipment is analyzed for compliance in such criteria as efficiency and capacity. Tables 6.8.1A-6.8.1J provides the minimum efficiency requirements. Additionally, evaluation of compliance is performed for several other components of the HVAC system as well, and those are as follows:

Standard 6.4.4: All metal ducts have a class C seal level, meeting the requirements of Table 6.4.4.2A.

Standard 6.5.1: No economizer requirement for Climate Zone 4A according to ASHRAE Standard 90.1 Table.

Standard 6.5.6: Due to exhaust rate greater than 15,000 cfm, the STEM Center complies with ASHRAE Standard 90.1 section on fume hoods by using a heat recovery system in accordance with Section 6.5.6.1

Section 6.8 – Minimum Equipment Efficiency:

Unitary Air Conditioners and Condensing Units

Shown below in Table 7 is the evaluation of compliance for the split system condensing units, for which each unit has a Seasonal Energy Efficiency Ratio (SEER) or 13.5.

Table 7: Unitary Air Conditioners and Condensing Units

Mark	Service	MBH	SEER	Minimum SEER	Compliance? (Y/N)
ACC-1A	AH-1A	24,000	13.5	9.5	Υ
ACC-1E	AH-1E	24,000	13.5	9.5	Y
ACC-2A	AH-2A	24,000	13.5	9.5	Y
ACC-2E	AH-2E	24,000	13.5	9.5	Y
ACC-3A	AH-3A	24,000	13.5	9.5	Y
ACC-4A	AH-4A	24,000	13.5	9.5	Y

Table 8 shows a comparison of fan horsepower and maximum horsepower required. The maximum horsepower is determined based on the equation is Table 6.5.3.1.1A. For several of the supply and return fans, maximum horsepower is exceeded and does not comply.

Table 8: Fan Power Limitation

	CFM	НР	Factor	Max HP	Compliance? (Y/N)
EF-1	34,000	50	0.0011	37.4	N
EF-2	34,000	50	0.0011	37.4	N
EF-3	260	0.167	0.0011	0.286	Υ
EF-4	1,480	0.5	0.0011	1.628	Y
EF-5	3,390	1.5	0.0011	3.729	Y
EF-6	830	0.25	0.0011	0.913	Y
EF-7	4,600	2	0.0011	5.06	Y
EF-8	1,500	0.333	0.0011	1.65	Y
EF-9	1,000	0.333	0.0011	1.1	Y
SF-4A	44,750	60	0.0011	49.225	N
SF-4B	44,750	60	0.0011	49.225	N
RF-4A	21,500	30	0.0011	23.65	N
RF-4B	21,500	30	0.0011	23.65	N
SF-5A	44,750	60	0.0011	49.225	N
SF-5B	44,750	60	0.0011	49.225	N
RF-5A	21,500	30	0.0011	23.65	N
RF-5B	21,500	30	0.0011	23.65	N
SF-1	3,600	1.5	0.0011	3.96	Υ

14

Water-cooled chillers are specified as meeting ASHRAE Standard 90.1 requirements for capacity, energy efficiency, IPLV, and NPLV for centrifugal chillers greater than 300 tons, according to ARI 550/590 rating and testing.

Compliance for duct insulation is checked through calculating R-Values from known insulation type (and subsequent k-values) and minimum thickness. Shown below in Table 9 is the evaluation of this comparison.

Insulation Type | Min Thickness | R-Value Standard R-Value | Compliance? (Y/N) Supply - Concealed I-3 2 5.6 6 Ν Supply - Outdoors I-2 2 8.7 6 Υ **Return - Outdoors I-2** 2 8.7 3.5 Υ Return - Within 50 ft. of AHU 1-2 2 8.7 3.5 Υ

Table 9: Duct Insulation Properties

The ASHRAE Standard 90.1 for pipe insulation is satisfied for the STEM Center, as piping insulation thickness is specified at 1" for piping 2" or smaller, and 1.5" for bigger than 2".

<u>Section 7 – Service Water Heating</u>

Two Bryan Model DR-350WT-FDG gas fired domestic water heaters are used for heating. Each has a capacity of 336 GPH, and complies with the minimum efficiency of 80 percent required for water heaters above 100,000 BTU/hr.

Section 8 – Power

ASHRAE Standard 90.1 Section 8 requires a maximum voltage drop of 2% for feeders and 3% for branch circuits. Specifications for wiring indicate a maximum voltage drop of 6%, which is higher than the standard, and therefore deemed not necessarily compliant with this section.

<u>Section 9 – Lighting</u>

9.4.1 Lighting Control

Automatic shutoff for lighting exists for the STEM Center using an internal scheduler that takes into account days of the week, holidays, daylight savings time, etc. This design feature satisfies requirements for Standard 90.1 9.4.1.1 for automatic lighting shutoff. For individual spaces, ceiling mount PIR occupancy sensors account for lighting shutoff when spaces are vacant.

9.5 Building Area Method Compliance Path

According to Standard 90.1 Table 9.5.1, the Lighting Power Densities (LPD) for School/University building area type is 1.2 W/ft². This value is multiplied by the gross lighted floor areas to give an interior lighting power allowance of 126 kW. Found in Appendix B is a breakdown of the building's lighting wattage per fixture in actual watts, totaling 89 kW. This is well under the allowable lighting power, a difference of 1.2 W/ft² to approximately 0.84 W/ft².

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ASHRAE Standard 90.1 Summary:

15

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Through evaluation of Standard 90.1, several instances were found in which the building design does not comply with the standard, as well as a handful of instances in which the building design greatly exceeds the requirements.

In the case of the building glazing area, the non-compliance is a result of a bold architectural feature in which one side of the building is colorful brick façade while the other is a four-story glass curtain wall. It is possible that a tradeoff occurred with the upgrade of the mechanical system in the way of ventilation. As previously discussed, the total maximum outdoor air intake for the two roof top air handling units is over 100,000 cfm, which is substantially higher than the calculated minimum required outdoor air (see Appendix A for breakdown). So whereas the excess of glazing may produce higher solar heat gain, it can be conceived that the increase in air ventilation will improve circulation and comfort as well as air quality.

The other main area of non-compliance is found with the air fans excessive horsepower. This limit may be pushed because of the large need for air exhaust due to the building occupancy types. Several laboratory spaces and preparation rooms make for a high requirement for exhaust air. This increases the need for fan power and raises the maximum horsepower. The number of fans may need to be reconsidered and recalculated.

Appendix A: Outside Air Ventilation Calculations

Building: System Tag/Name: Overtein Condition Departments.	Delaware	County	Delaware County Community College STEM Center	enter							
Units (select from pull-down list)	A.										
Inputs for System Floor area served by system Population of area served by system (including diversity) Design primary supply fan airflow rate OA redd per unit area for system (Weighted average) OA redd per person for system area (Weighted average) Inputs for Potentially Critical zones	Name LAS St PS Vpsd off Rps off	Units sf P cfm cfm/sf cfm/p	100% diversity	System 13774 283 20,100 0.06 9.1						Potentially Critical Zones	ritical Zones
Zone Name					S118 Computer Lab	S119 Large Meeting Room	S101 Aerobics	S110A Men's Locker Room	S111A Women's Locker Room	S113 Fitness Center	S112 Snack Bar
Zone Tag	Zone title t	turns purp	Zone title turns purple italic for critical zone(s)		1st Floor Computer lab	1st Floor Conference/m	1st Floor Health	1st Floor Health	1st Floor Health	1st Floor Health	1st Floor Cafeteria fast-
Space type Floor Area of zone		elect from	Select from pull-down list sf		1 007	eeting	club/aerobics room	club/weight rooms	club/weight rooms	club/weight rooms	food dining
Design population of zone Design population of zone Design total supply to zone (primary plus local recirculated) Induction Terminal Unit, Dual Fam Dual Duct or Transfer Fan?	PZ P Vdzd cfr	lect fr	(default value listed; may be overridden) cfm Select from pull-down list or leave blank if N/A	srridden) if N/A	1,200	1200	3370	160	170	2100	150
Inputs for Operating Condition Analyzed Percent of total design airflow rate at conditioned analyzed Air distribution type at conditioned analyzed Zone air distribution effectiveness at conditioned analyzed Primary air fraction of supply air at conditioned analyzed	W2007 GL09 THE	elect from	% Select from pull-down list	100%	100% CS 1.00	100% CS 1.00	100% CS 1.00	100% CS 1.00	100% CS 1.00	100% CS 1.00	100% CS 1.00
Results Ventilation System Efficiency Outdoor air intake required for system Outdoor air per unit floor area Outdoor air per person served by system (including diversity) Outdoor air se a % of design primary supply air	Ev Vot Vot/As of Vot/Ps of Ypd of	ofm cfm/sf cfm/p ofm		0.24 18349 1.33 47.9 91%							
Detailed Calculations Initial Calculations for the System as a whole Primary supply air flow to system at conditioned analyzed Uncornected OA requirement for system Uncorrected OA requirement for system Initial Calculations for individual zones			= VpdDs = Rps Ps + Ras As = Vou / Vps	20100 = 4370							
OA rate per unit area for zone OA rate per person Total supply arr to zone (at condition being analyzed)		± 0			00.01	0.08 120 2.08 3.08 3.08	0.06 20.00 3370	20.08		20.00	
Unused OA red'd to breathing Zone Unused OA requirement for zone Fraction of zone supply not directly recirc. from zone		# # # ##		11 11 11	420.8 421 1.00	560.3 560 1.00	962.1 962 1.00	156.7 157 1.00		830.5 831 1.00	
Fraction of zone supply from fully mixed primary air Fraction of zone OA not directly recire. from zone Unused OA fraction required in supply air to zone Unused OA fraction required in supply air to zone	72 72 75 76	1 11 11 11	= Ep = 1-(1-Ez)(1-Ep)(1-Er) = Voz / Vdz = Voz / Vpz	и и и и	1.00	1.00	1.00 1.00 0.29 0.29	1.00	1.00 0.93 0.93	1.00	1.00
System Veritiation Efficiency (App A Nethod) System Veritiation Efficiency (App A Method) Veritiation System Efficiency (Table 6.3 Method) Minimum printed or it intelled in the system of the system	Evz Evz	ar ur ir	= (Fa + FbXs - FcZ) / Fa = min (Evz) = Value from Table 6.3	= 0.24 = n/a	0.87	0.75	0.93	0.24	0.29	0.82	1.11
Outdoor Air Intake Flow required to System OA intake red'd as a fraction of primary SA Outdoor Air Intake Flow required to System (Table 6.3 Method) OA intake red'd as a fraction of primary SA (Table 6.3 Method)	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	cfm cfm	= Vou/Ev = Vot/Vps = Vou/Ev = Vot/Vps	= 18349 = 0.91 = n/8							
UA Temp at which min UA broyldes all cooling OAT below which OA Intake flow is @ minimum	Q	Deg F =	= {(Tp-dIsf)-(1-Y)*(Tr+dIrl	= 53	526						

building: System Tag/Name:	Delawa	re Count	Delaware County Community College S I EM Center	EM Center						
Operating Condition Description: Units (select from pull-down list)	₫									
Inputs for System Floor area served by system Population of area served by system Population of area served by system (including diversity) Design primary supply fan airflow rate OA redd ber person for system area (Weighted average) OA redd ber person for system area (Weighted average)	As As Ps Vpsd Ras Rps	Units sf P cfm cfm/sf cfm/b	100% diversity	(6 <mark> </mark>	System 13774 20,100 0.06 9.1					
Zone Name					81218	S121B Office	S100C Lower Lounge	S100E Upper Lounge	S100D Computer Lounge	S120 Auditorium
Zone Tag	Zone tit	le turns p	Zone tifle turns purple italic for critical zone(s)	(8)	1st		1st Floor		1st Floor	1st Floor
Space type		0 5 5	Colort from mull-down list		5	Office space	assembly	assembly	assembly	seating area
Floor Area of zone Design nonulation of zone	A2 P7	sf T	on pantaown ist default value listed may be overridden)	he overridder	Ш	80	1206	2975	1782	1475
Design total supply to zone (primary plus local recirculated) Design total supply to zone (primary plus local recirculated) Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	Vdzd	ofm Select fr	ofm Select from pull-down list or leave blank if N/A	blank if N/A		120	3820	4130	1500	2180
Inputs for Operating Condition Analyzed	j									
Percent of total design airflow rate at conditioned analyzed Air distribution type at conditioned analyzed Zone air distribution effectiveness at conditioned analyzed Primary air fraction of surply air air conditioned analyzed	8 E 8	% Select fr	% Select from pull-down list		100%	100%	100% CS 1.00	100% CS 1.00	100% CS 1.00	100% CS 1.00
Results										
Ventilation System Efficiency Outdoor air intake required for system Outdoor air per unit floor area Outdoor air per person served by system (including diversity) Outdoor air as a % of design primary supply air	Ev Vot Vot/As Vot/Ps Ypd	cfm cfm/sf cfm/p cfm			0.24 18349 1.33 47.9 91%					
Detailed Calculations Initial Calculations for the System as a whole										
Primary supply air flow to system at conditioned analyzed UncorrectedOA requirement for system	Nps Vou	E E	= VpdDs = Rps Ps + Ras As	11 11	20100					
Uncorrected OA regid as a fraction of primary SA Initial Calculations for individual zones	×		= Vou / Vps	11	0.22					
OA rate per unit area for zone	Raz Rnz	cfm/sf				0.06	0.06	0.06	0,06	0.06
Total supply proton (at condition being analyzed)	L 49 1	. ₩		1		120	3820		1500	2180
Unused OA requirement for zone	ZO/	∃ ₩		1 11		9,0	172		327	359
Fraction of zone supply not directly recirc, from zone Fraction of zone supply from fully mixed primary air	B 5		= Ep + (1-Ep)Er = Ep	11 11		8.6	1.90	1.00	8.5	9.7
Fraction of zone OA not directly recirc, from zone	Fc 44			11 1		1.00	1.00		1.00	1.00
Unused OA fraction required in primary air to zone	P 27			11 11		0.08	0.05	0.10	0.22	0.16
System ventilation Efficiency (App A Method) Zone Ventilation Efficiency (App A Method)	Evz					1.14	1.17	1.12	1,00	1,05
System Ventilation Efficiency (App A Method) Ventilation System Efficiency (Table 6.3 Method)	ش ش		= min (Evz) = Value from Table 6.3	11 11	0.24 n/a					
Minimum outdoor air intake airflow Outdoor Air Intake Flow required to System	Vot	cţ	= Vou/Ev	11	18349					
OA intake red'd as a fraction of primary SA				11	0.91					
Outdoor Arr Intake Flow required to System (Table 6.3 Method) Outdoor Intake redd as a fraction of primary SA (Table 6.3 Method) Od Term at which Min Od provides all control	_ < <	Ę.	= Vou/Ev = Vot/Vps	н н	B/L B/L					
OAT below which OA Intake flow is @ minimum		Deg F	= {(Tp-dTsf)-(1-Y)*(Tr+dTrI	-dTr1 =	53					
										_

Building: System Tag/Name:	Delawar	e County	Community College STEM C	enter							
Operating Condition Description: Units (select from pull-down list)	Ы										
Inputs for System Floor area served by system Population of area served by system Population of area served by system (including diversity) Design primary supply fan airflow rate OA redd ber until area for system (Weighted average) OA redd per person for system area (Weighted average)	Name As As Ps Vpsd Ras Rps	Units sf P cfm cfm/sf cfm/sf	100% diversity	System 18400 46 46 29,110 0.13							
Zone Name	Zone title	e furns pu	Zone title turns pume italic for critical zone(s)		S209 Classroom	S210 Classroom	S211 Classroom	S219 Blueprint Reading	S222 Classroom	S202 Anatomy/Phy siology	S206 Anatomy/Phy siology
Zone Tag Shace twe					2nd Floor Classrooms	2nd Floor Classrooms	2nd Floor Classrooms	2nd Floor Classrooms	2nd Floor Classrooms	2nd Floor Science	2nd Floor Science
Floor Area of zone		Select fro sf	om pull-down list		(age 9 plus)	(age 9 plus) 972	(age 9 plus) 754	(age 9 plus) 1052	(age 9 plus) 693	laboratories 1502	laboratories 1653
Design population of zone Design total supply to zone (primary plus local recirculated) Induction Terminal Unit, Dual Fau Dual Duct or Transfer Fan?	p	P cfm Select fro	P (default value listed; may be overridden) ofm ofm Select from pull-down list or leave blank if N/A	erndden) if N/A	1,300	1090	1200	32 1250	1840	3090	3090
Inputs for Operating Condition Analyzed		ě			1000	10000	10000	10000	2000	10000	20004
Percent citical design arritow rate at conditioned analyzed Air distribution type at conditioned analyzed Zone air distribution effectiveness at conditioned analyzed	EZ CS	% Select fro	% Select from pull-down list	100	7100 1.00	100% CS 1.00	100%	100% CS 1.00	100% CS 1.00	100% CS 1.00	100% CS 1.00
Primary air fraction of supply air at conditioned analyzed	d L										ħ
Ventilation System Efficiency Outdoor air intake required for system Outdoor are por unit floor area Outdoor are per per son served by system (including diversity) Outdoor air as a % of design primary supply air	Ev Vot Vot/As Vot/Ps Ypd	cfm cfm/sf cfm/p cfm		0.68 10007 0.54 21.7 34%	8 × 4 × %						
Detailed Calculations											
Initial Calculations for the System as a whole Primary supply air flow to system at conditioned analyzed	Sd/	₩,			0 (
Uncorrected OA requirement for system Uncorrected OA requires a fraction of primary SA	™ × ×	E	= Kps Fs + Kds As = Vou / Vps	= 6/62	7 E						
On A rate per unit are a for zone		cfm/sf cfm/p			10.00	0.12	0.12	0.12	0.12	0.18	0.18
lotal supply air to zone (at condition being analyzed) Unused OA reg'd to breathing zone		E E E		п	1300 543.4			1250		3090 590.4	3090 637.5
Unused OA requirement for zone Fraction of zone supply not directly recirc. from zone		E#J		11 11	543 1.00			1.00		1.00	1.00
Fraction of zone supply from fully mixed primary air Fraction of zone OA not directly recirc, from zone	e 2		= Ep $=$ 1-(1-Ez)(1-Ep)(1-Er)	н н	1.00			1.00		1.00	1.00
Unused OA fraction required in supply air to zone Unused OA fraction required in primary air to zone	pZ pZ			11 11	0.42			0.36		0.19	0.21
System Ventilation Efficiency / App & Mathada	t ú		3 1155	1				000			1 03
System Verillation Efficiency (App A Method) Verillation Street Efficiency (Table & Method)	ָ ֓֞֞֞֞֞֞֞֞֞֞֞֞֞֝֞֝֞֝֞֝֞֝֞֝֓֓֞֝֜֝֓֓֓֓֜֝֜֝֡֜֝֜֝֜֝֜֜֝֜֡֜֝֜֡֜֝֜֡֜֝֡֜֜֝֡֜֝֜֡֡֜֝֜֡֡֡֡֜֝֡֡֡֡֡֡		= min (Evz) = Value from Table 6.3	= 0.68			t S	S S	2	<u> </u>	-
Minimum outdoor air intake airflow	à				ō						
Outdoor Air Intake Flow required to System OA intake red'd as a fraction of primary SA	≺ vot	cfm		= 10007	⊵ 4						
Outdoor Air Intake Flow required to System (Table 6.3 Method) Od intake recit as a fraction of primary SA (Table 6.3 Method)	≺ <ot< td=""><td>ofm</td><td>= Vou/Ev = Vot/Vns</td><td> </td><td>2/2</td><td></td><td></td><td></td><td></td><td></td><td></td></ot<>	ofm	= Vou/Ev = Vot/Vns		2/2						
OA Temp at which Min OA portages all opinions by Countries of Min OA portages all opinions of AT below which OA private flow is @ minimum		Ded F			23						
Derow when or means (2) infillinging	ı	- - - - - - - - - - -				l	l				

Building:	Delaware	County (Delaware County Community College STEM Center	nter							
Operating Control Description: Operating Control Operating Contr	<u>a</u>										
Inputs for System Floor area served by system Floor area served by system Population of area served by system (including diversity) Design primary supply fan airflow rate OA req do per unit area for system area (Weighted average) OA req do perperson for system area (Weighted average)	Name U As sf Ps Ps V Vpsd cf Ras cf	Units st P cfm cfm/sf cfm/p	100% diversity	System 18409 29,110 0.13						O contribution	Potantially Critical Zonas
Zone Name	7000 4460		To continue to the first first to the continue of the first		S212 Biology	S212 Biology S215 Biology	S216 CAD	S217 Architectural	S218 CAD	S203A Anatomy	S213A Biology
Zone Tag	Tone me	und suun	ne nanc for crincal zone(s)		2nd Floor	2nd Floor	2nd Floor	2nd Floor	_	Storage 2nd Floor	Storage 2nd Floor
Space type	Ø	elect fron	n pull-down list		Science	Science laboratories	Computer lab	Computer lab	Computer lab	Storage	Storage
Floor Area of zone Design population of zone		Đ	sf (default value listed; may be overridden)	rridden)	1421	1410	1083	568	1072	476	418
e (primary plu: Jal Fan Dual I	pz	cfm Select fron	ofm Select from pull-down list or leave blank if N/A	f N/A	2980	2980	1240	530	1180	009	400
Local rectro, air % representative of ave system return air Inputs for Operating Condition Analyzed	Ė										
	% SQ		%	100%	100%	100%	100%	100%	100%	100%	100%
An distribution type at conditioned analyzed Zone air distribution effectiveness at conditioned analyzed			i puil-down list		1.00	1.00	1.00	1.00	T .	1.00	1.00
Primary air fraction of supply air at conditioned analyzed Results	d H										
				0.68							
Outdoor air intake required for system Outdoor air per unit floor area	Vot Vot/As of	ofm cfm/sf		10007							
Outdoor air per person served by system (including diversity)		cfm/p		21.7							
Outdoor air as a % of design primary supply air	Ypd	J J		34%							
Detailed Calculations Initial Calculations for the System as a whole Demonstrate and the system as a whole				- 20440							
Uncorrected OA requirement for system Uncorrected OA requirement for system Uncorrected OA read as a fraction of nimary SA	ς Ω γ α Σ	E E	= Kps Ps + Ras As = Vou / Vns	= 6762 = 6762 = 0.23							
Initial Calculations for individual zones							Š				
OA rate per unit area for zone OA rate per person		ctm/st cfm/b			10.00		10.00				
Total supply air to zone (at condition being analyzed)					2980		1240				400
Unused OA req'd to breathing zone Unused OA requirement for zone	Vbz cf Voz cf	 Д Д	= Rpz Pz + Raz Az = Vbz/Ez	11 11	575.8	573.8	450.0	208.2	448.6	57.1	
Fraction of zone supply not directly redire from zone				11 1	00.1		1.00				1.00
Fraction of zone supply from fully mixed primary air Fraction of zone OA not directly recirc, from zone	0 Y			11 31	1 8		108				
Unused OA fraction required in supply air to zone	pΖ			11	0.19		0.36				
Unused OA fraction required in primary air to zone System Ventilation Efficiency	d7		= Voz / Vpz	П	0.19		0.36				
Zone Ventilation Efficiency (App A Method)	Evz				1.04	1.04	0.87	0.84	0,85	1.14	111
System Ventilation Efficiency (App A Method) Ventilation System Efficiency (Table 6.3 Method)	ش ش		= min (Evz) = Value from Table 6.3	= 0.68 = n/a							
Minimum outdoor air intake airflow											
Outdoor Air Intake Flow required to System OA intake ren'd as a fraction of primary SA	Vot ≺	c t		= 10007							
Outdoor Air Intake Flow required to System (Table 6.3 Method)	ŏ	off miles	= Vou/Ev	= n/a							
OA intake req'd as a fraction of primary SA (Table 6.3 Method) OA Temp at which Min OA provides all cooling	>		= Vot/Vps	= n/a							
OAT below which OA Intake flow is @ minimum	۵	Deg F	= {(Tp-dTsf)-(1-Y)*(Tr+dTrl	= 23							

Building:	Delaware	County	Delaware County Community College STEM Center	enter							
System ragination: Operating Condition Description: Units (select from pull-down list)	<u>a</u>										2
Inputs for System Floor area served by system Population of area served by system Population of area served by system (including diversity) Design primary supply fan airflow rate OA req'd per unit area for system (Weighted average) OA req'd per person for system area (Weighted average)	Name Language Ps S S S S S S S S S S S S S S S S S S	Units st st P cfm cfm/sf cfm/b	100% diversity	System 18409 29,110 0.13 9.4	- 80 20 10 11 4						
Inputs for Potentially Critical Zones Zone Name Zone Tag	Zone title	turns pu	Zone title turns purpte fialic for critical zone(s)		S200A Team Area 2nd Floor		S203B Preparation Room 2nd Floor	S213B Preparation Room 2nd Floor	S221 Administrativ e Assistant 2nd Floor	S220 Medium Meeting 2nd Floor	S221A Assistant Dean 2nd Floor
Space type Floor Area of zone Design population of zone Design total supply to zone (primary plus local redrculated) Induction - Terminal Unit, Dual Fand or Transfer Fan? Local Feoric are With representative of awas system return are	Az Az S	Select fro sf P (cfm Select fro	Select from pull-down list sf (default value listed; may be overndden) cfm Select from pull-down list or leave blank if N/A.	erridden) if N/A	Corridors 276 6 6 6 200	O	Science laboratories 514 2 2 750	Science laboratories 589 3	Office space 409 409 700	Conference/m eeting 1135 15 15 15 15	Office space
Inputs for Operating Condition Analyzed Percent of fotal design airflow rate at conditioned analyzed Air distribution type at conditioned analyzed Zone air distribution (effectiveness at conditioned analyzed Primary air fraction of supply air at conditioned analyzed	Ds 9 Ez S	% Select fro	% Select from pull-down list	100%	% 100% CS CS 1.00	5 100% CS CS	100% CS 1.00	100% CS 1.00	100% CS 1.00	100% CS 1.00	100% CS 1.00
Results Ventilation System Efficiency Outdoor air intake required for system Outdoor air per unit floor area Outdoor air per person served by system (including diversity) Outdoor air se a % of design primary supply air	Ev Vot Vot/Ps c Ypd c	cfm cfm/sf cfm/p cfm		0.68 10007 0.54 21.7 34%	8						
Detailed Calculations Initial Calculations for the System as a whole Primary supply air flow to system at conditioned analyzed Uncorrected OA requirement for system Uncorrected OA requirement for system Uncorrected OA requirement for system Uncorrected OA require as a fraction of primary SA.		₩.	= VpdDs = Rps Ps + Ras As = Vou / Vps	= 29110 = 6762 = 0.23							
OA rate per unit area for zone OA rate per person OA rate per person Total supply airt o zone (at condition being analyzed) Unused OA requirement for zone Unused OA requirement for zone 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 Unused OA fraction required in supply air to zone Unused OA fraction required in primary air	R R R R R R R R R R R R R R R R R R R	cfm/st cfm/p cfm cfm cfm	= Rpz Pz + Raz Az = Vbz/Ez = Ep + (1-Ep)Er = Ep = 1-(1-Ez)(1-Er) = Voz V/dz = Voz V/dz		000 000 000 000 000 000 000 000 000 00	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0.00 7.55 7.55 7.50 7.50 7.50 7.50 7.50	0010 8 8 30 13 8 30 10 00 11 10 00 11 10 00 11 10 00 11 10 10	0.00 0.00 44 0.00 0.00 0.00 0.00 0.00 0	0.06 0.07	5,00 4,00 19,8 1,00 1,00 1,00 1,00 1,00 1,00 1,00 1,
System Vertilation Efficiency Zone Ventilation Efficiency (App A Method) System Ventilation Efficiency (App A Method) System Ventilation Efficiency (App A Method) Wentilation System Efficiency (Table 6.3 Method) Minimum outdoor air Intake Tiow required to System Outdoor Air Intake Flow required to System OA intake red'd as a fraction of primary SA outdoor Air Intake Flow required to System (Table 6.3 Method) OA intake red'd as a fraction of primary SA OAT below which OA Intake flow required to System (Table 6.3 Method) OA Temp at which Min OA brovides all cooling OAT below which OA Intake flow is @ minimum		cff		0 60			2 8		} 	2 - 6	2 7

	Delemen	,	The state of the s	a open					
Building. System Tag/Name:	Delawa	e courts	Community Conege STEM C	allel					
Operating Condition Description: Units (select from pull-down list)	<u>a</u>								
Inputs for System Floor area served by system Population of area served by system Population of area served by system (including diversity) Design primary supply fan airflow rate OA red ber unit area for system (Weighted average) OA red ber perpension for system area (Weighted average)	Name As Ps Vpsd Ras Rps	Units st P P Cfm/sf cfm/sf cfm/p	100% diversity	System 18409 461 29,110 0.13					
Inputs for Foreitrally Crucal 201165					S221B Dean	S223 Office -	S	S225 Office -	S226 Office -
Zono Too	Zone tit	e furns pu	Zone title turns purple italic for critical zone(s)	·	2nd Floor			2nd Eloor	4 Person
Space type			1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		Office space	Office space	Office space	Office space	Office space
Floor Area of zone	Az	Sf sf	sf sf	9	232	249	249	252	249
Design population of zone Design total supply to zone (primary plus local recirculated) Induction Temrinal Unit, Dual Fan Dual Duct or Transfer Fan?	Pz Vdzd	cfm Select fic	P (default value listed; may be overndden) cfm Select from pull-down list or leave blank if N/A	rndden) f N/A	560	340	340	340	340
Local redro, air % representative of ave system return air Inputs for Operating Condition Analyzed	Ш								
Percent of total design airflow rate at conditioned analyzed	Ds	%		100%	100%	100%	100%	100%	100%
Air distribution type at conditioned analyzed Zone air distribution effectiveness at conditioned analyzed	Ez	Select from	Select from pull-down list		1.00 CS	1.00	1.00	CS 1.00	1.00
	ф								
Kesuits Ventilation System Efficiency	À			0.68					
Outdoor air intake required for system	vot Vot	cfm		10007					
Outdoor air per unit floor area	VotAs	cfm/sf		0.54					
Outdoor air per person served by system (including diversity). Outdoor air as a % of design primary supply air	Vpd Ypd	cfm		34%					
Detailed Calculations									
Initial Calculations for the System as a whole	1	ļ		00440					
FTITIBITY SUPPLY BIT INOW TO SYSTEM BIT COTTUINGTHEU BITBITYZEU THOOMREGEGODA FROM INOW TO SYSTEM	s do	E #5	= vpuUs = Rps Ps + Ras As	6762					
Uncorrected OA red'd as a fraction of primary SA	×s×								
Initial Calculations for individual zones	to G	ofmolef			900	90 0	900	900	90.0
OA rate per person	RDZ	cfm/b			5.00			5.00	5.00
Total supply air to zone (at condition being analyzed)	Zp/	cfm c			260		340	340	
Unused OA red'd to breathing zone	Vbz Voz	# #	= Rpz Pz + Raz Az = Vhz/Fz	11 11	28.9			35.1	
Fraction of zone supply not directly recirc, from zone	Fa			-11	1 9 7	1.00	1.90	1.00	1.00
Fraction of zone supply from fully mixed primary air	Ep			н	1.00			1.00	1.00
Fraction of zone OA not directly recirc. from zone) FC		= 1-(1-Ez)(1-Ep)(1-Er) = 7/67 / 7/4	11 1	7.00	1.00		8.5	1.00
Unused OA fraction required in primary air to zone	r d			1 11	0.05		0.10	0.10	0.10
System Ventilation Efficiency									8
Suppose Ventilation Efficiency (App A Method)	EVZ D.C.		$= (Fa + FbXs - FcZ)/Fa$ $= \min_{(E/x)}$	1 1	1.18	1.13	1.13	1.13	1.13
Ventilation System Efficiency (Table 6.3 Method)	<u>ن</u> ز								
Minimum outdoor air intake airflow									
Outdoor Air Intake Flow required to System	< < ot	E C		10007					
OA III.ake Fed d as a Iradion of primary SA Outdoor Air Intake Flow required to System (Table 6.3 Method)		cfm	= Vol./vps = Vou/Ev	1.34 					
OA intake req'd as a fraction of primary SA (Table 6.3 Method)									
OA Temp at which Min OA provides all cooling OAT helow which OA Intake flow is @ minimim		Ded F	= {(Tp-dTsf)-(1-Y)*(Tr+dTrl	= 23					
	ı								

Building:	Delaware	County	Delaware County Community College STEM Center	enter							
Operating Condition Description: Units (select from pull-down list)	<u>a</u>										
Inputs for System Ploor area served by system Ploor area served by system Poorgluidnon of area served by system (including diversity) Design primary supply fan airflow rate OA req do per person for system area (Weighted average) OA red de per person for system area (Weighted average)	Name U As S Ps P Vpsd c Ras c Rps c	Units st st P cfm cfm/sf cfm/b	100% diversity	System 19283 491 36,410 0.14							
Inputs for Forendally Chucal Zones Zone Name					S308 Classroom	S309 Classroom	S310 Classroom	S317 Large Classroom	S318 Classroom	S321 Classroom	S301 Physics
مر ۲ مرم 7	Zone title	turns pur	Zone title turns purple italic for critical zone(s)		and El Page		Ond Flags	Park I	ond III	Sud Flags	0 ml
Space type	U.	select fro	m pill-down list		Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Classrooms (age 9 plus)	Science
Floor Area of zone Design population of zone	Az Pz s		sf (default value listed: may be overridden)	erridden)	851	968	754	961	689 689	698	1968
Design total supply to zone (primary plus local recirculated) induction Terminal Unit, Dual Fau Dual Duct or Transfer Fan?	ъ	ifm Select fro	ofm Select from pull-down list or leave blank if N/A	ifN/A	1,100	1240	1200	1500	1300	2800	3240
Ana				100%	100%	100%	100%	100%	100%	100%	100%
	S Ep S	select fro	Select from pull-down list		00'1	1.00	1.00	CS 1.00	00.1	CS 1.00	CS 1.00
Results Ventilation System Efficiency Outdoor air intake required for system Outdoor air per unit floor area Outdoor air per person served by system (including diversity) Outdoor air as a % of design primary supply air	Ev C Vot C Vot/Ps C Ypd C	cfm cfm/sf cfm/p cfm		0.72 10452 0.54 21.3 29%							
Detailed Calculations Initial Calculations for the System as a whole Primary enrolly air flow to exetem at conditioned analyzed	200	Ę	= School								
Thingly supply all now 0.9 seem at conditioned analyzed. Uncorrected OA requirement for system Uncorrected OA redd as a fraction of primary SA		J. J.	= Rps Ps + Ras As = Vou / Vps	= 7493 = 0.21							
OA rate per unit area for zone OA rate per person		fm/sf fm/p			0.12	0.12	0.12	0.12		0.12	0.18
Total supply air to zone (at condition being analyzed) Unused ON head to breathing zone Unused ON requirement for analyzed	7d7	₩ ₩ ₩	= Rpz Pz + Raz Az - Vh-nE-1	11 1	1100 532.1 533	1240 606.2 606	1200 470.5	1500 605.3 605.4	1300 432.7	2800 433.8 434	3240 754.2 754.2
Fraction of zone supply not classification cone Fraction of zone supply not classification of zone supply not classification of zone control forms and zone control to zone control to zone classification of		1		1 11 1	1.00	36.5	50.5	36.5		100	, t 4 8 8
Fraction of zone OA not directly recit. from zone	L D T		= Cp = 1-(1-Ez)(1-Ep)(1-Er) = Vgz (Vdt	1 11 1	9:10		9.00			00.1	
	nZ dz			1 11	0.48	0.49	0.39	0.40		0.15	0.23
System ventilation Emidency (App A Method) Sonator Ventilation Efficiency (App A Method)	Evz		= (Fa + FbXs - FcZ) / Fa	1 1	0.72	0.72	0.81	0.80	18.0	1.05	0.97
System Vertification Efficiency (Table 6.3 Method) Minimum Anthon in Proteste Efficiency (Table 6.3 Method)	شد		= Value from Table 6.3	990 =							
Outdoor Air Intake Flow required to System	-	cfm		= 10452							
OA intake red'd as a fraction of primary SA Outdoor Air Intake Flow required to System (Table 6.3 Method)	+	cfm	= Vot/Vps = Vou/Ev	= 0.29							
OA nitake reqid as a fraction of primary SA (Table 6.3 Method) OA Temp at which Min OA provides all cooling	≻	4		S)							
OAT below which OA Intake flow is @ minimum		Deg F	= {(Tp-dTsf)-(1-Y)*(Tr+dTri	= 13							

The state of the s		1000		2000							
Building: System Tag/Name:	Delawar	e County	Delaware County Community College STEM Center	enter							
Operating Condition Description: Units (select from pull-down list)	Ы										0
Inputs for System Floor area served by system Population of area served by system Population of area served by system (including diversity) Design primary supply fan airflow rate OA redd per unit area for system (Weighted average) OA redd per person for system area (Weighted average)	As As Ps Vpsd Ras Rps	Units st P cfm cfm/sf cfm/b	100% diversity	System 19283 19283 491 36,410 0.14	0 = 0 = 0					Poter	rtially Critical Z
Zone Name	Zono title	out of	file towns ourselv Halin to a within at monodo.)		S305 Physics	S305 Physics S311 Organic Chemistry Lab	S314 General Chemistry Lab	S315 Earth and Space Lab	S316 Earth and Space Lab	S302A Physics Storage	S313B Storage
Zone Tag	2010	nd sums h	ipre rianc for critical zonals)		3rd Floor	3rd Floor	3rd Floor	3rd Floor	3rd Floor	3rd Floor	3rd Floor
Space type		Select fro	om pull-down list		laboratories	laboratories	laboratories	laboratories	laboratories	rooms	rooms
Floor Area of zone Design population of zone		P Sf	(default value listed; may be overridden)	erridden)	1654	1474	1425	1436	1672	450	81
Design total supply to zone (primary plus local recirculated) induction Taminal Unit, Dual Fan Dual Dud or Transfer Ear?	VďZď	ofm Select fro	ofm Select from pull-down list or leave blank if N/A	if N/A	1600	8050	2770	2450	2860	620	180
Inputs for Operating Condition Analyzed		1									
Percent of total design airflow rate at conditioned analyzed Air distribution type at conditioned analyzed	S	% Select fro	% Select from bull-down list	%00L	700% CS	300L	100%	100%	100%	100%	100%
Zone arr distribution effectiveness at conditioned analyzed Primary air fraction of supply air at conditioned analyzed	EZ				1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ventilation System Efficiency Outdoor air intake required for system Outdoor air per unit floor area	Ev Vot Vot/As	cfm cfm/sf		0.72 10452 0.54	0 2 4						
Outdoor air per person served by system (including diversity) Outdoor air as a % of design primary supply air		cfm/p cfm		29.	3 %						
Detailed Calculations Initial Calculations for the System as a whole											
Primary supply air flow to system at conditioned analyzed UncorrectedOA requirement for system	=	E E	= VpdDs = RpsPs+RasAs	= 36410 = 7493	0 13						
Uncorrected OA req'd as a fraction of primary SA Initial Calculations for individual zones	s S										
OA rate per unit area for zone OA rate per person	Raz	cfm/sf cfm/b			0.18	10.00	0.18	0.18	0.18	0.12	0.12
Total supply air to zone (at condition being analyzed)		ctt.			1600	8050	2770	2450		620	180
Unused UA red'd to breathing zone Unused OA requirement for zone		E E		11 11	638	585	576.5	57875 578		2 4 2 24 24 25 25 25 25 25 25 25 25 25 25 25 25 25	100
Fraction of zone supply not directly recirc, from zone Fraction of zone supply from fully mixed brimary air	E E		= Ep + (1-Ep)Er = Fn	п п	1:00	1.00	9.1.	9:1		8. 8	8.5
Fraction of zone OA not directly recirc. from zone	Fc		= 1-(1-Ez)(1-Ep)(1-Er)	11 1	1.00	1.00	1.8	1.00		1.00	1.00
	7 4			1 11	0.40	0.07	0.21	0.24		0.09	0.05
System Ventilation Efficiency (App A Method) Zone Ventilation Efficiency (App A Method)	Evz				0.81	1.13	1.00	0.97	0.98	1.12	1.15
System Ventilation Efficiency (App A Method) Ventilation System Efficiency (Table 6.3 Method)	شش		= min (Evz) = Value from Table 6.3	= 0.72 = 0.66	2 50						
Minimum outdoor air intake airflow Outdoor Air Intake Flow required to System	, toy	Ę	= Vol./Fv		2						
OA intake red'd as a fraction of primary SA			= Vot/Vps	= 0.29	. g						
Outdoor Air Intake Flow required to System (Table 6.3 Method) OA intake red'd as a fraction of primary SA (Table 6.3 Method)	- > ≻	E			4 12						
OA Temp at which Min OA provides all cooling OAT below which OA Intake flow is @ minimum		Ded F	= {(Tp-dTsf)-(1-Y)*(Tr+dTri	U	<u>6</u>						
CALL DOLON WHITELE CANTILLING HOW IS OF BRITISHING		- 80		- CALLES	>				l		

1000	Dolows	are Com	orein Contract Contract of STEM Contex	ontor							
building. System Tag/Name:	Cerawa	unon au	y community conege at Em C	eller							
Operating Condition Description: Units (select from pull-down list)	d										
Inputs for System Floor area served by system Floor area served by system Population of area served by system (including diversity) Design primary supply fan airflow rate OA red'd per unit area for system (Weighted average) OA red'd per person for system area (Weighted average) Inputs for Potentially Critical zones	Name As As Ps Vpsd Ras Rps	Units st st P cfm cfm/sf cfm/sf	100% diversity	System 19283 491 491 36,410 0.14 0.14	0 0 0 0						
Zone Name	Zone ti	he turns p	ittle turns purple Italic for critical zone(s)		S313C Hazardous Storage	S316A Storage	S300B Team Area	S300C Team Area	S319 Collaboration	S302B Preparation Room	S312 Instrumentati on
Zone Tag Space type		to 0	البيع هجما المحادث		3rd Floor Storage	3rd Floor Storage	3rd Floor Corridors	3rd Floor Corridors	3rd Floor Conference/m	3rd Floor Science	3rd Floor Storage
Floor Area of zone Design population of zone	Az Pz	P Sf (sf (default value listed; may be overridden)	erridden)	167	800	265	265	477	488	318
Design rotal supply to zone (primary blus local redroulated) Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan? I noal regins air 9, representative of size extern return air	V dzd Pr	Select f	rom pull-down list or leave blank	if N/A	OB.	100	200	200	480	nng	400
Inputs for Operating Condition Analyzed Percent of fotal design airflow rate at conditioned analyzed Air distribution type at conditioned analyzed Zone air distribution effectiveness at conditioned analyzed	Ds Ez	% Select f	% Select from pull-down list	100%	100% CS 1.00	100% CS 1.00	100% CS 1.00	100% CS 1.00	100% CS 1.00	100% CS 1.00	100% CS 1.00
Results Ventilation System Efficiency Ventilation System Efficiency Outdoor air per unit floor area Outdoor air per unit floor area Outdoor air per son served by system Outdoor air per son served by system Outdoor air per son served by system (including diversity) Outdoor air as a % of design primary supply air	50000 00000 00000	cfm cfm/sf cfm/p		0.72 10452 0.54 21.3 29%							
Detailed Calculations Initial Calculations for the System as a whole Primary supply air flow to system at conditioned analyzed UncorrectedOA requirement for system Uncorrected OA redu sa fraction of primary SA. Initial Calculations for individual zones	sd / S×	₩.	= VpdDs = Rps Ps + Ras As = Vou / Vps	= 36410 = 7493 = 0.21							
OA rate per unit area forzone OA rate per person Total supply air to zone (at condition being analyzed) Unused OA requirement for zone Unused OA requirement for zone Fraction of zone supply not directly recirc, from zone Fraction of zone supply from fully mixed primary air 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 supply air to zone	R R R R R R R R R R R R R R R R R R R	cfm/sf cfm/p cfm cfm	= Rpz Pz + Raz Az = Vbz/Ez = Ep + (1-Ep)Er = Ep = 1-(1-Ez)(1-Ep)(1-Er) = voz / voz = voz / voz		200000000000000000000000000000000000000	200000000000000000000000000000000000000	0.06 200 200 15.9 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.	2 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	00.0 00.0 00.0 00.0 00.1 00.1 00.1 00.1 00.1	0.18 600 10.78 100 1.00 1.00 1.00 1.00 1.00 1.00 1.00	0010 0000
System Ventilation Efficiency Zone Ventilation Efficiency (App A Method) System Ventilation Efficiency (App A Method) Ventilation System Efficiency (Table 6.3 Method)	E E E			= 0.72 = 0.66	1.10	£	1.13	1.13	1.10	1.03	1.1
Minimum outdoof at make almow Outdoor Ar intake Flow required to System OA intake req'd as a fraction of primary SA Outdoor Air intake Flow required to System (Table 6.3 Method) OA intake req'd as a fraction of primary SA (Table 6.3 Method) OA intake req'd as all cooling OAT below which OA intake flow is @ minimum	Vot Y d) Vot J) Y	cfm cfm Deg F	= Vou/Ev = Vot/Vps = Vot/Vps = Vot/Vps = {Tp-drsh-(d-Y)*Tr+dTrl	= 10452 = 0.29 = 11334 = 0.31 = 13	20 o V						

Building:	Delaware	County C	Delaware County Community College STEM Center	enter						
System Tag/Name:										
Operating Condition Description: Units (select from pull-down list)	<u>d</u>									
Inputs for System Floor area served by system Population of area served by system Population of area served by system (including diversity) Design primary supply fan airflow rate OA redd per unit area for system (Weighted average) OA redd per person for system area (Weighted average)	Name As As Ps Vpsd CRas CRps	Units sf P cfm cfm/sf cfm/p	100% diversity	System 1928 49 49 0.1	1 2 3 3 3 4 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9					
Zone Name					S313 Preparation Room	S320 Office - Adjunct Faculty	S322 Office - 4 Person	S323 Office - 4 Person	S324 Office - 4 Person	S325 Office - 4 Person
F	Zone title	turns purp	Zone title turns purple italic for critical zone(s)		į		i	i	i	i
Zone lag					Science	3rd Floor Office space	Office space	3rd Floor Office space	Office space	Office space
Space type		elect from	Select from pull-down list		laboratories			\rightarrow		
Floor Area of zone Design population of zone	P2 9	D of (d	(default value listed: may be overridden)	erridden)	387	746	249	249	262	249
a (primary plus local recirco Jal Fan Dual Duct or Trans		n lect fr	ofm Select from pull-down list or leave blank if N/A	if N/A	570	2000	190	190	190	190
Local rectro. air % representative of ave system return air Inputs for Operating Condition Analyzed	ii ii									
Percent of total design airflow rate at conditioned analyzed	Ds 6	۰	%	100%	10	100%	100%	101	100%	100%
Air distribution type at conditioned analyzed		elect from	ı pull-down list		CS CS	S	8 8	CS	CS	S
zorie air distribution ellectiveriess at conditioned analyzed Primary air fraction of supply air at conditioned analyzed	Ep				no.i		00.1			1.00
Results										
Ventilation System Efficiency Outdoor air intake required for system		cfm		0.72 10452	2 2					
Outdoor air per unit floor area	Vot/Pe	cfm/sf		0.5	4 6					
Outdoor air as a % of design primary supply air		cfm		8	. %					
Detailed Calculations Initial Calculations for the System as a whole										
Primary supply air flow to system at conditioned analyzed		cfm			01					
UncorrectedOA requirement for system	_		= Rps Ps + Ras As	= 7493	93					
Uncorrected OA redd as a fraction of primary SA Initial Calculations for individual zones	×		sdy/uoy =		Σī.					
OA rate per unit area for zone		cfm/sf			0.18					
OA fate perperson Total supply air to zone (at condition being analyzed)	Vdt Vdt	ctm/p			10,00 570	2000	190			
Unused OA req'd to breathing zone				11	7.68					
Unused OA requirement for zone Eraction of zone cumply not directly regire from zone	Voz Fa	cfm ::	= Vbz/Ez = Fn + (1-Fn)Fr	11 11	90					
Fraction of zone supply from fully mixed primary air	2 @			п	00.1					
Fraction of zone OA not directly recirc. from zone	FC 44		= 1-(1-Ez)(1-Ep)(1-Er)	10 -	1.00	1.00	1.00	1.00	1.00	1.00
Unused OA fraction required in supply air to zone Unused OA fraction required in primary air to zone	oZ DZ		= Voz/Vpz	11 11	0.16					
System Ventilation Efficiency	ì									
Zone Ventilation Efficiency (App A Method)	Evz				1.05	1.16	1.02	1.02	1.02	1.02
System Vertillation Emidency (App. A. Method) Ventilation System Efficiency (Table 6.3 Method)	ش ۵		= rmin(Evz) = Value from Table 6.3	= 0.66	Q. V.					
Minimum outdoor air intake airflow										
Outdoor Air Intake Flow required to System OA intake regid as a fraction of primary SA		u u	= Vou/Ev = Vot/Vns	= 10452	ପ୍ର ହ					
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm		= 11334	: ₹					
OA Town of unitable Min OA applied all populary SA (Table 6.3 Method)	>		= Vot /Vps		Σ					
OAT below which OA Intake flow is @ minimum		Ded F :	= {(Tp-dTsf)-(1-Y)*(Tr+dTri	п	13					
	l			l						

					-						
Building: System Tag/Name:	Delawar	e County	Community College STEM C	enter							
Operating Condition Description: Units (select from pull-down list)	<u>a</u>										9
Inputs for System Floor area served by system Population of area served by system Population of area served by system (including diversity) Design primary supply fan airflow rate OA redd ber unit area for system (Weighted average) OA redd per person for system area (Weighted average) Inputs for Potentially Critical zones	Name As Ps Vpsd Rps Rps	Units sf sf cfm cfm/sf cfm/p	100% diversity	System 774 774 12,470 0.12, 9.9.9					Poter	Potentially Critical Zones	nes Tes
Zone Name	Zone title	turns pur	title turns purple italic for critical zone(s)		S401 Classroom	S402 Classroom	S403 Classroom	S406 Classroom	S407 Classroom	S411 Classroom	S412 Classroom
9 7	pz	Select fror sf P (c cfm Select fror	Select from pull-down list sf F (default value listed; may be overridden) cfm Select from pull-down list or leave blank if N/A	erridden) if N/A	Classrooms (age 9 plus) (1,430	4th Floor Classrooms (age 9 plus) 1000 50	4th Floor Classrooms (age 9 plus) 638 32 1000	4th Floor Classrooms (age 9 plus) 74 74 714	4th Floor Classrooms (age 9 plus) 860 44 1200	4th Floor Classrooms (age 9 plus) 777 39	4th Floor Classrooms (age 9 plus) 966 49 1300
Inputs for Deersting Condition Analyzed Inputs for Deersting Condition Analyzed Percent of total design airflow rate at conditioned analyzed Air distribution type at conditioned analyzed Zone air distribution effectiveness at conditioned analyzed Primary air fraction of supply air all conditioned analyzed	Ds E	% Select fron	% Select from pull-down list	100%	6 100% CS CS	100% CS 1.00	100% CS 1.00	100% CS 1.00	100%	100% CS 1.00	100% CS 1.00
Results Vanilation System Efficiency Outdoor air intake required for system Outdoor air per unit floor area Outdoor air per unit floor area Outdoor air per person served by system (including diversity) Outdoor air as a % of design primary supply air	Ev Vot Vot/Ps Ypd	cfm cfm/sf cfm/p cfm		0.88 4930 0.64 14.2 40%							
Initial Calculations Initial Calculations for the System as a whole Primary supply air flow to system at conditioned analyzed UncorrectedOA requirement for system Uncorrected OA requirement for system Uncorrected OA requirement as a fraction of primary SA	sd/v Xs	JJ JJ	= VpdDs = Rps Ps + Ras As = Vou / Vps	= 12470 = 4353 = 0.35	0 77 9						f.
A rate per unit area for zone OA rate per unit area for zone OA rate per person Total supply air to zone (at condition being analyzed) Unused OA red't to breathing zone Unused OA red'to breathing zone Fraction of zone supply not directly redire. from zone Fraction of zone supply from fully mixed primary air Fraction of zone OA not directly recire. from zone Unused OA fraction required in supply air to zone Unused OA fraction required in pirmary air to zone Unused OA fraction required in pirmary air to zone	Razz Rpz V Vbz V vbz V vbz F F b Z d Z d	cfm/sf cfm/p cfm cfm cfm	= Rpz Pz + Raz Az = Vpz/Ez = Ep + (1-Ep)Er = Ep = 1-(1-Ez)(1-Er) = Voz / Vpz = Voz / Vpz		0.12 1430 1430 393.3 393.3 100 100 100 100 100 100 100 100 100 10	0.12 10.00 1900 620 620 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.	0.12 10.00 10.00 396.6 397 1.00 1.00 1.00 0.40 0.40	0.12 10.00 1120 482.9 483.1 1.00 1.00 1.00 1.00 1.00 1.00	0.12 10.00 1200 543.2 543.2 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.	0.12 10.00 1140 483.2 483.2 1.00 1.00 1.00 1.00 1.00 1.00	0.12 13.00 605.9 606.9 1.00 1.00 1.00 0.47
System Ventilation Efficiency Zone Ventilation Efficiency (App A Method) System Ventilation Efficiency (App A Method) Ventilation System Efficiency (Table 6.3 Method) Minimum outdoor air intake all find outdoor air intake all find outdoor air intake allow required to System	Evz Ev K	Ę	= (Fa + FbXs - FcZ) / Fa = min (Evz) = Value from Table 6.3 = Valu / Ev	0.88	1.07	1.02	0.95	0,92	06'0	0.93	888
Outdoor Air interest inwequere to system OA intake red'd as a fraction of primary SA Outdoor Air Intake Flow required to System (Table 6.3 Method) OA intake red'd as a fraction of primary SA (Table 6.3 Method) OA Temp at which Min OA provides all cooling OAT below which OA Intake flow is @ minimum	√ √ √ ×	cfm Deg F	= vot /vps = vot /vps = vot /vps = vot /vps = (Tp-dTst)-(1-Y)*(Tr+dTr1	0.40 = 6364 = 0.51 = 29	29 44 45 52 52 52 52 52 52 52 52 52 52 52 52 52						

Building: System Tag/Name:	Delaware	County C	Delaware County Community College STEM Center	nter				
Operating Condition Description: Units (select from pull-down list)	Ы							
Inputs for System Floor area served by system Population of area served by system (including diversity) Design primary supply fan airflow rate OA red'd per unit area for system (Weighted average) OA red'd per person for system area (Weighted average)	Name Language Ps	Units sf P cfm cfm/sf cfm/p	100% diversity	System 7741 347 12,470 0.12				
Zone Name Zone Taq	Zone title	turns purp	Zone title turns purple italic for critical zone(s)		S413 Classroom 4th Floor	S408 Conference 4th Floor	S415 Conference 4th Floor	S416 Astronomy Lab 4th Floor
Space type Space type Floor Area of zone Design population of zone Design total supply to zone (primary plus local recirculated) Induction Terminal Unit, Joual Fan Doub Duck or Transfer Fan? Local recirculation representative of everystem return and	Az Az S	Select from sf P (de cfm Select from	Select from pull-down list Sf (default value listed; may be overridden) cfm Select from pull-down list or leave blank if N/A	ridden) 'N/A	2000 200	Conference/m eeting 297 297 360	Conference/m eeting 417 5	Science laboratories 692 177
Inputs for Operating Condition Analyzed Percent of total design arrilow rate at conditioned analyzed And distribution type at conditioned analyzed Zone arr distribution effectiveness at conditioned analyzed Primary air fraction of supply air at conditioned analyzed	Ds Tag	6 Select from	% Select from pull-down list	100%	100% CS 1.00	100% CS CS 1.00	100% CS 1.00	100% CS 1.00
Nentilation System Efficiency Outdoor air intake required for system Outdoor air per unit floor area Outdoor air per person served by system (including diversity) Outdoor air as a % of design primary supply air	Ev Vot Vot/Ps Ypd	cfm cfm/sf cfm/p cfm		0.88 4930 0.64 14.2 40%				
Detailed Calculations Initial Calculations for the System as a whole Primary supply air flow to system at conditioned analyzed Uncorrected A requirement for system Uncorrected OA requirement for system Uncorrected OA requirement for system	sd/ Nov Xs	m my	= VpdDs = Rps Ps + Ras As = Vou / Vps	= 12470 = 4353 = 0.35				
OA rate per unit area for zone OA rate per person Total supply air to zone (at condition being analyzed) Unused OA requit to breathing zone Unitsed OA reminiment for zone	Raz Rpz Vdz Vbz	cfm/sf cfm/p	Rpz Pz + Raz Az Vizz Fz	11 31	0.12 10.00 1150 445.1	0.06 5.00 360 37.8	0.06 5.00 600 50.0	0.18 10.00 1270 294.6
Fraction of zone supply from directly recirc. from zone 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			-Ep)Er)(1-Ep)(1-Er) dz pz		100000000000000000000000000000000000000	00	00	1.00
System Vertitation Efficiency System Vertitation Efficiency (App A Method) System Ventilation Efficiency (App A Method) Ventilation System Efficiency (Table 6:3 Method) Minimum outdoor air Intake airflow	Evz Ev		= (Fa + FbXs - FcZ) / Fa = min (Evz) = Value from Table 6.3	0.88	96.0	1.24	1.27	1.12
Outdoor Air Intake Flow required to System OA intake redd as a fraction of primary SA Outdoor Fred Trake Flow required to System (Table 6.3 Method) OA intake redd as a fraction of primary SA (Table 6.3 Method) OA intake redd as a fraction of primary SA (Table 6.3 Method) OA Temp at which Min OA provides all cooling			Vou / Ev Vot / Vps Vou / Ev Vot / Vps	6 0 % 0				
OAT below which OA Intake flow is @ minimum		Deg F =	= {(Ip-dISt)-(1-7)*(Ir+dIH	53				

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Advisor: Dr. Stephen Treado

Appendix B: Lighting Power Schedule and Calculations

	COURT							
LUMINAIRE		COMMEDICAL EVARADIE-	VOLTAGE	LABARC	ACTUAL IMATTS	INSTANCES	MATTACE DED	MOUNTING
FIX TURE TYPE	FIXTURE DESCRIPTION	COMMERCIAL EXAMPLE: MANUFACTURER & CATALOG NUMBER	VOLTAGE	LAMPS	ACTUAL WATTS	INSTANCES	WATTAGE PER FIXTURE TYPE	MOUNTING
TTPE	DESCRIPTION	LEDALITE VECTRA 9714D1STT232-S-7-2-E					PIATURE TIPE	
А	1' X 4' RECESSED HIGH EFFICIENCY ACRYLIC	FOCAL POINT FEQ	277	(2) 32W 830 T8	65	606	39390	RECESSED
^	LENSED LUMINAIRE WITH DIMMING BALLAST	ZUMTOBEL ML4		(2) 3244 030 10	03	000	33330	(ILCCOCCO)
		LEDALITE VECTRA 9714D1STT1 32-S-1-2-E					-	
A1	1' X 4' RECESSED HIGH EFFICIENCY ACRYLIC	FOCAL POINT FEQ	277	(1) 32W 830 T8	33	79	2607	RECESSED
7.1	LENSED LUMINAIRE	ZUMTOBEL ML4		(1) 5211 656 16	33	, ,	2007	
		LEDALITE VECTRA 9714D1CRT232-S-1-2-E						
A2	1' X 4' RECESSED HIGH EFFICIENCY ACRYLIC	FOCAL POINT FEQ.	277	(2) 32W 830 T8	65	71	4615	RECESSED
	LENSED LUMINAIRE	ZUMTOBEL ML4	75 AMI	(-)				32.430.88324
		COOPER METALUX 2GC85-332A125-277V-EB81						
В	2' X4' RECESSED AO.125" ACRYLIC LENSED LUMINAIRE	LITHONIA	277	(3) 32W 830 T8	94	17	1598	RECESSED
	LOWINVAIRE	LIGHTOLIER						
4		COOPER METALUX 2GC-317A125-277V-EB81		k				
B2	2' X 2' RECESSED AO.125" ACRYLIC LENSED LUMINAIRE	LITHONIA	277	(3) 17W 830 T8	61	9	549	RECESSED
		LIGHTOLIER	10					
		COOPER PORTFOLIO C6226E-6251LI-WF		(consent				
C	6" OPEN DOWNLIGHT	LITHONIA	277	(2) 26W TTT	58	148	8584	RECESSED
		LIGHTOLIER						
		COOPER PORTFOLIO C62182D-6251LI-WF						V712-4774479 1-21
D	6" DIMMABLE OPEN DOWNLIGHT	LITHONIA	277	(2) 18W TTT	43	125	5375	RECESSED
		LIGHTOLIER						
		COOPER PORTFOLIO 0622620-6251LI-WF		(4)				
E	5" DIMMABLE OPEN DOWNLIGHT	LITHONIA	277	(2) 26W TTT	58	88	5104	RECESSED
		LIGHTOLIER						
_		PRUDENTIAL P-8990(4)T8CWATMWSC277X1		(4) 2511:	u e u	2.7		Meser
F	3' ROUND RECESSED ACRYLICLENSED LUMINAIRE	The Control of the Co	277	(4) 25W 830 T8	101	22	2222	RECESSED
		OR APPROVED EQUAL						
_		PRUDENTIAL P-8960(8)T8CWATMWSC277X1		(a) 2211/ 22 5 To				0.105.105
G	6' ROUND RECESSED ACRYLIC LENSED LUMINAIRE		277	(8) 32W 830 T8	282	9	2538	SURFACE
		OR APPROVED EQUAL						
	DECORATIVE OF DECESSED DOMANUCUE	LIGHTOLIER D6A01-8051CL-6218HU	277	(2) 1000 0	20	40	1072	DECESSED
н	DECORATIVE 6" RECESSED DOWNLIGHT	CO ADDROGUED FOUND	277	(2) 18W Q	39	48	1872	RECESSED
		OR APPROVED EQUAL			-			
J	RECESSED PERIMETER OPEN WALL WASH LUMINAIRE WITH SLIDING SLEEVE AS REQUIRED.	FOCAL POINT MARK LIGHTING MP1-T8EBEBB-2	277	(1) 32W 830 T8	33	81	2673	RECESSED
100	LENGTH AS INDICATED ON PLAN.	OR APPROVED EQUAL	2//	PER 4'	33	91	2073	HECESSED
		FOCAL POINT FAVA-NS-1T5-1C-UNV-S-X-WH-4						
К	4' RECESSED WALL WASH LUMINAIRE	Total of the state	277	(1) 28W 830 T5	33	12	396	RECESSED
				(1) 2011 000 10	33	12	330	112020020
		COOPER PORTFOLIO C16032EP-LI						
L	5" SURFACE MOUNTED DOWNLOAD	LITHONIA	277	(2) 26 W TTT	59	5	295	COLUMN
		LIGONIER						190-10-600-00-70-049
		COOPER PORTFOLIO C62182D-6211LI-WF		C				
М	6" OPEN WALL WASH DIMMABLE DOWNLIGHT	LITHONIA	277	(2) 18W TTT	43	44	1892	RECESSED
		LIGHTOLIER						
		PRISMA DISCUS 28 072457						
N	CEILING SURFACE MOUNTED WET LOCATION		277	(1) 26W TTT	29	19	551	SURFACE
		OR APPROVED EQUAL		I MACTORE S				
	ENTERIOR CLILL CLIP OFF CAMPAGE CALL	BEGA #8309MH						
P	EXTERIOR FULL CUT OFF FIXTURE ON 12' POLE		208	150W MH	166	0*	0	POLE
		OR APPROVED EQUAL				*SITE LIGHTING		
		COOPER \$\$232277VEB81					10020-01	
Q	4' STRIP FIXTURE WITH CAGE	LITHONIA	277	(2) 32W 830 T8	65	24	1560	PENDANT
		LIGHTOLIER						
0.2711		COOPER 8755232277VEB81	Lymna	A STATE OF THE STA	100	.gov.		A STATE OF THE STA
Q2	8' STRIP FIXTURE WITH CAGE	LITHONIA	277	(2) 32W 830 T8	65	22	1430	PENDANT
		LIGHTOLIER	1					
_	LED STAIR TREAD FIXTURE	PROLUME RIA-XX"- WWF	120	INCLUSES	2=	22	05-	
R	LENGTH AS INDICATED ON PLAN	WITH PSX24-100/O AS REQUIRED	120	INCLUDED	27	32	864	STAIR
100000000000000000000000000000000000000		OR APPROVED EQUAL						
	CAMALL MOUBLIED HIS CONTACTOR	NATIONAL LIGHTING S66-ID/D-W-4T8-A	277	(A)221A/ 920 TO	1.64	1.0	2256	STIDEACE MAN
S	8' WALL MOUNTED UP/DOWN FIXTURE	OR APPROVED EQUAL	277	(4)32W 830 T8	141	16	2256	SURFACE WALL
		ON APPROVED EQUAL						
т	WALL MOUNTED INTERIOR DIRECT FLOOD LIGHT		277	(1) 26W	29	4	116	SURFACE WALL
	IN SKYLIGHT	OR APPROVED FOLIAL	2//	(1) 2000	29	4	110	JUNEAUE WALL
		OR APPROVED EQUAL COOPER VT2-232-DR-120-EB						
U	ELEVATOR PIT LIGHT	0001 EN 412 232 DR 120 CB	120	(1) 26W TTT	29	3	87	WALL
U	ELEVATOREN LIGHT		120	(1) 2000 111	29	3	0/	WALL
		COOPER PORTFOLIO C6226E-6280LI4G						
U2	RECESSED VAPOR TIGHT FIXTURE	LITHONIA	277	(2) 26W TTT	58	4	∂?35 41313\sner	svite_BABOXISSED
- 52	200720000 CTC-CCC - T-CCC - CCC - CC	LIGHTOLIER	l	1-/ 111	50	-		
				-			A STATE OF THE STATE OF	Constitution of the second

29

Advisor: Dr. Stephen Treado

V	12" 120° LED STRIPS TO BE CONTINUOUSLY MOUNTED IN COVE, LENGTH AS INDICATED ON PLAN	PHILIPS EW 523-000004-00 / 999-000284-00 OR APPROVED EQUAL	120	INCLU DED	0	0	0	COVE
W	MINI 3W LEDS POT FOR SIGNAGE WITH DRIVER	VISUAL LIGHTING BLUX-0401-080-W-NX WITH 901-006-700-U PER (2) SPOTS OR APPROVED EQUAL	120	INCLUDED	4	6	24	SURFACE
х	EXTERIOR RECESSED LENSED DOWNLIGHT	COOPER PORTFOLIO CL9142E-10002P LITHONIA LIGHTOLIER	277	(1) 26W TTT	29	52	1508	RECESSED
Y	RECESSED CHROME XENON DISPLAY CASE FIXTURE	PEGASUS PALPX-CH-PHD60 AMERICAN LIGHTING LVPX80CH OR APPROVED EQUAL	120	INCLUDED	0	10	0	RECESSED
z	DECORATIVE PENDANT	TECH LIGHTING 700FJSDAFC OR APPROVED EQUAL	120	50W BIPIN HALOGEN	55	2	110	PENDANT
EXIT	EDGE LIT LED EXIT SIGN WITH RED LETTERS AND SILVER BACKING	COOPER LITHONIA LIGHTOLIER	277	INCLUDED	0	0 Negligible	0	MOUNTING, SIDES CHEVRONS AS INDICATED ON PLANS
NERAL N	OTES:					TOTAL:	88448	_

GENERAL NOTES:

1 PROVIDE ALL LAMPS WITH 3000K COLOR TEMPERATURE.

PROVIDE ALL LAMPS WITH 80+ CRI.

3 PROVIDE ALL FIXTURES WITH LINEAR FLUORESCENT LAMPS WITH AN INTEGRAL DISCONNECTING MEANS PER NEC ARTICLE 410-73 (G).

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