Technical Report 1: ASHRAE Standards 62.1 and 90.1 Analysis

Berks Classroom and Lab Building - Berks Campus Reading, PA

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## **1. EXECUTIVE SUMMARY**

This report was used to analyze the compliance of The Berks Classroom and Lab Building with ASHRAE Standards 62.1 and 90.1.

ASHRAE Standard 62.1 focuses on indoor air quality for buildings; the analysis for the standard was done only on the three roof top units. After analyzing the building it was found that the building is compliant with this standard.

ASHRAE Standard 90.1 sets an energy standard for buildings except low-rise residential buildings. The building is almost completely compliant with this standard the two anomalies being the glazing and the slab on grade.

## **2. INTRODUCTION**

Burks Classroom and Lab Building is located on Penn State's Burks Campus, located near Reading, Pennsylvania in Berks County. Penn State Burks sits among rolling hill and tree-lined pathways. The campus has a rich history, considering it was not always part of the Penn State system. The campus started as Wyomissing Polytechnic Institute (WPI) and became part of the Penn State System in 1958. In 1972 it moved to the Spring Township location and added residence halls in 1990. Even though there is rich history with the campus Penn State did not have to follow any historical requirements.

Burks Classroom and Lab Building is 62,188 square feet with all three levels above ground the occupancy for the building is designated as Group B - Business. The building was started in April 2010 and is scheduled to be completed in either August or September of 2011. The delivery method was design-bid-build. As with the new buildings at Penn State, Burks Classroom and Lab Building is designed using LEED certification and after completion is anticipated to achieve a LEED Silver rating under LEED 2.2.

The design team is as follows:

Owner: The Pennsylvania State University Berks Campus

General Contractor: Alvin H Butz, Inc.

Construction Cost Estimator: Becker & Frondorf

Building Architect: RMJM Hiller

Engineers:

Structural: Greenman-Pedersen, Inc.

MEP: H.F. Lenz Company

Civil: Gannett Fleming Engineers
Lighting Consultant: Illumination Arts, LLC
Acoustical Consultant: Shen Milsom Wilke, Inc.

They used multiple codes in the design of Burks Classroom and Lab Building; the codes are mostly 2006 with one exception being 2003. The code are as follows: International Building Code, International Mechanical Code, International Plumbing Code, International Energy Conservation Code, International Code Council Electrical Code, International Fire Code, and Accessibility Code ICC/ANSI 117.1 2003. There were some zoning requirements which included a Land Development Permit (LDP) from Springs Township and an NPDES permit was required from Burks County Conservation District (BCCD).

The building façade of the first floor is consists of two different types of façade, the first and closest to grade are Architectural precast concrete panels backed with an airspace rigid insulation air space and finally a masonry wall. The second part of the first floor façade has an aluminum curtain wall system in place of the architectural precast concrete panels, the two airspaces and rigid insulation. Above the first floor the façade changes again to have an exterior finish of terracotta rain screen backed by rigid insulation backed by cold formed metal framing (CMFM).

The roof system consists of metal decking covered by rigid composite insulation and a Kee membrane. KEE stands for ketone ethylene ester and is gaining popularity in Southern California because of its great waterproofing protection and lightweight design. The KEE membrane is a single-ply, lightweight vinyl and is extremely easy to install. The install for most types of the KEE membrane requires the contractors to use a simple hot air bonding technique; this creates a seamless molecular bond between each sheet of the membrane. This makes the membrane easy to repair and remains highly flexible with age, making it easy to uncover the substructure for repairs if needed.

Considering the Burks Classroom and Lab Building is designed to achieve a LEED Silver rating at completion. The building utilizes a gray water system; this system is designed to supply the restrooms within the building with water for their water closets and urinals. Other things considered for LEED rating was using materials that are made within a 500 mile radius from the site.

#### System Description

The building utilizes a VAV system that has an air side and hydronic side to it.

#### AIR SIDE:

On the air side there are three roof top air handling units (AHUs) that range from 26 tons to 70 tons.

#### HYDRONIC SIDE:

The water side consists of two gas fired boilers with a 6.2 gallon capacity and an output of 850 MBH. The building utilizes four Split system air conditioning units with rated capacities of either 1 or 1.5 tons. There are supplemental heaters located in two vestibules, two corridors and a stair well to help regulate the temperature of these spaces.

## ZONE CONDITIONING:

The spaces are supplied air from Variable Air Volume Boxes (VAV Boxes). The server room is served by a computer room air conditioning unit (CRAC).

## 3. STANDARD 62.1 ANALYSIS

## 3.1. SECTION 5

#### Section 5.1 - Natural Ventilation

The windows are not operational for this building, therefore this is not a valid means of ventilation.

## Section 5.2 - Ventilation Air Distribution

All spaces are supplied air by ducts. According to documentation the system will be balanced prior to occupation.

#### Section 5.3 - Exhaust Duct Location

Exhaust ducts run up the building through similar spaces. At the exterior, the exhaust is not near any intakes.

#### Section 5.4 - Ventilation System Controls

The HVAC system is controlled by either Automated Logic Corporation or Johnson Controls Inc. control system.

## Section 5.5 - Airstream Surfaces

The mineral-fiber board thermal insulation is designed to comply with ASTM C 612 type IB and the mineral-fiber blanked thermal insulation is designed to comply with ASTM C 553 type III since neither incorporate ASTM C 1338 this is not compliant.,

#### Section 5.6 - Out Door Air Intakes

All intakes are more than the minimum distance from the exhaust fans and exhaust air from the building.

## Section 5.7 - Local Capture of Contaminates

The café and the kitchen lab on the first floor have ducted exhausts to the lower roof above the second floor.

#### Section 5.8 - Combustion Air

The kitchen lab and café have supply ducts that supply air very close to above the cooking surfaces.

#### Section 5.9 - Particulate Matter Removal

The roof top AHUs have two filters, the first filter is a pre-filter with a minimum efficiency reporting value or MERV of 7 and the final filter has a MERV of 13 since both are above the required MERV of 6 the AHUs are compliant. The computer room air conditioner and the split system air conditioning units do not have filter data listed, and therefore is hard to judge the compliance of these systems.

#### Section 5.10 - Dehumidification Systems

The AHU systems are compliant. This is a combination of the excess exhaust is made up by the supplemental systems located in the building and some of the lab spaces are negatively pressured.

#### Section 5.11 - Drain Pans

The roof top units are placed on the roof above slope to roof top drains.

#### Section 5.12 - Finned-Tube Coils and Heat Exchangers

Since only the three roof top units were analyzed in this report, the roof top units are place over roof top drains. this section is compliant.

#### Section 5.13 - Humidifiers and Water-Spray Systems

This section does not apply.

#### Section 5.14 - Access for Inspection, Cleaning and Maintenance

The Roof top AHUs have at minimum 48 inches around them to allow for inspection, cleaning and maintenance work to be done. Equipment located in the ceiling cavity is located above removable acoustic ceiling panels to provide access for any inspection, cleaning or maintenance required.

#### Section 5.15 - Building Envelope and Interior Surfaces

The building has a terra cotta rain screen that protects the exterior vertical surfaces from rain penetration and is backed by an air space to drain any rain that gets through. The roof is comprised of a Kee membrane system that keeps moisture from entering the roof structure.

#### Section 5.16 - Buildings with Attached Parking

This section does not apply to this building.

## Section 5.17 - Air Classification and Recirculation

The air from the kitchen hoods are is not recalculated to the general building spaces.

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

#### Areas

This section does not apply; the building is a smoke-free building.

## 3.2. SECTION 6

For the purpose of section 6 analysis only the three roof top units (RTU) will be used.

#### Section 6.2.2.1 - Breathing Zone Outdoor Airflow (equation 6-1)

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

Where

 $A_z$  = zone floor area: the net occupiable floor area of the zone in m2 (ft2)

 $P_z$  = Zone population: the largest number of people expected to occupy the zone during typical usage. If the number of people expected to occupy the zone fluctuates,  $P_z$  may be estimated based on averaging approaches described in Section 6.2.6.2

R<sub>p</sub> = Outdoor airflow rate required per person as determined from Table 6-1

R<sub>a</sub> = Outdoor airflow rate required per unit area as determined from Table 6-1

Section 6.2.2.2 - Zone Air Distribution Effectiveness (Table 6-2)

E<sub>z</sub> = 1

Section 6.2.2.3 - Zone Outdoor Airflow

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

#### Section 6.2.5.1 - Primary Outdoor Air Fraction

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

Where

 $V_{\text{pz}}$  is the zone primary airflow

#### Section 6.2.5.2 - System Ventilation Efficiency

 $E_{\nu}$  from Table 6-3

#### Section 6.2.5.3 - Uncorrected Outdoor Air Intake

 $V_{ou} = DS_{all \ zones}(R_p * P_z) + S_{all \ zones}(R_a * A_z)$ 

 $D = P_s/S_{all zones}P_z$ 

## Section 6.2.5.4 - Outdoor Air Intake

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

## 4. STANDARD 62.1 FINDINGS

The Berks Classroom and Lab Building is compliant with section 5 of 62.1 per the analysis above. Per the analysis of Section 6 above for the three roof top AHUs the Berks Classroom and Lab Building is compliant with the standard. Please refer to Appendix for the supporting calculations.

# 5. STANDARD 90.1 ANALYSIS

## 5.1. SECTION 5 - BUILDING ENVELOPE

Reading, PA is located in Berks County which by using both ASHRAE Figure B-1 and Table B-1 is in climate zone 5-A. This is consistent with most of the state. Being in climate 5-A there are some requirements that must be followed, see Table 1 for the opaque elements and Table 2 for the fenestration elements, information is from Table 5.5-5 in ASHRAE standard 90.1.

| Opaque Elements                  | Assembly Maximum | Insulation Min R-Value |
|----------------------------------|------------------|------------------------|
| Roof: Insulation above Deck      | U-0.048          | R-20 c.i.              |
| Walls, Above Grade: Steel Framed | U-0.064          | R-13.0 + R-7.5 c.i.    |
| Floors:                          |                  |                        |
| Slab on Grade: Unheated          | F-0.730          | NR                     |
| Slab on Grade: Heated            | F-0.860          | R-15 for 24in          |
| Opaque Doors: Swinging           | U-0.700          | -                      |

TABLE 1. OPAQUE ELEMENTS REQUIREMENTS

| Fenestration  | Assembly Max U | Assembly Max SHGC |
|---|----------------|-------------------|
| Vertical Glazing: Metal Framing<br>(Curtainwall/Storefront) | U-0.45         | 0.40              |
| Vertical Glazing: Metal Framing<br>(Entrance Door)          | U-0.80         | 0.40              |
| Vertical Glazing: Metal Framing (All<br>Other)              | U-0.55         | 0.40              |
| Vertical Glazing: Non-metal Framing<br>(All)                | U-0.34         | 0.40              |

#### TABLE 2 FENESTRATION REQUIREMENTS

Using the tables in appendix A of ASHRAE Standard 90.1 the values in Table 3 were obtained. Some assumptions were made in completing Table 3 and include a slight estimation of the thickness of materials and can affect the R-value for some materials. This was only done when a thickness was not indicated on the drawings and there is a slight difference from paper drawings to electronic pdf drawings.

| Exterior Element | R-Value / max SHGC | U-Value for system  | Compliant          |
|------------------|--------------------|---------------------|--------------------|
| Roof             | R-20 insulation    | U-0.060             | U- Value compliant |
|                  |                    |                     | R-Value compliant  |
| Walls            | R-12.5 Terra Cotta | U-0.147 for walls   | U-Value Walls is   |
|                  |                    |                     | compliant          |
| Glazing          | 0.30 SHGC          | U- 0.19 for glazing | Not compliant      |
| S.O.G.           |                    | U-5                 |                    |
| <u>1</u>         |                    |                     |                    |

TABLE 3 U-VALUES OF EXTERIOR ELEMENTS COMPLIANCE

#### 5.2. SECTION 6 - HEATING, VENTILATING, AND AIR CONDITIONING

According to the specifications the duct work is designed to meet ASHRAE Standard 90.1. The roof top AHRs are in two categories two of the three have a required minimum efficiency of 12.1 EER and the third has a required minimum efficiency of 11.3 EER. The two smaller units have designed EERs of 13.9 and 14.1 the largest unit has a designed EER of 12.5 making the equipment compliant.

## 5.3. SECTION 7 - SERVICE WATER HEATING

The roof top units and VAV boxes are supplied hot water by two gas fired boilers the rest of the domestic hot water is supplied by electric water heaters.

## 5.4. SECTION 8 - POWER

According to the drawings the building's electrical system is designed using the International Code Council Electrical Code 2006 but the specifications are referencing NFPA 70 which is also known as the National Electric Code. Since the NEC it states that feeder conductors should have a maximum voltage drop of 2% and a maximum branch circuits to have a maximum voltage drop of 3% at the design load condition, the building is compliant. In addition to the voltage drop requirements the working drawings should include floor plans as well as single line diagrams, the drawing set includes both and there for is compliant.

#### 5.5. SECTION 9 – LIGHTING

The lighting for the Berks Classroom and Lab Building is controlled by occupancy sensors and therefore is compliant with the first part of this section. The second part of compliance is analyzed by the building area method described in Section 9.5 of Standard 90.1 and is summarized in Table 4. Assuming that the Berks Classroom and Lab Building is primarily offices for faculty members the Watts per square foot should be under 1.0 to see the calculation and the numbers see Table 4 below,.

| Lighting | 1st | 2nd | 3rd | W /     | total   |
|----------|-----|-----|-----|---------|---------|
| Fixture  |     |     |     | fixture | wattage |
| С        | 24  | 13  | 4   | 64      | 2624    |
| D        | 8   |     |     | 64      | 512     |
| E        |     |     | 9   | 64      | 576     |
| LA       | 35  | 284 | 114 | 32      | 13856   |
| LA-1     | 30  |     |     | 64      | 1920    |
| LA-2     | 19  | 65  | 21  | 32      | 3360    |
| LA-4     | 28  |     |     | 32      | 896     |
| LA-6     | 14  |     |     | 32      | 448     |

| LAA  |     | 2  | 13  | 85         | 1275   |
|------|-----|----|-----|------------|--------|
| LB   | 102 |    |     | 32         | 3264   |
| LB-1 | 60  | 59 |     | 32         | 3808   |
| LC   | 12  | 20 |     | 64         | 2048   |
| LC-1 | 6   |    |     | 32         | 192    |
| LCC  | 4   |    |     | 4          | 16     |
| LD   | 51  | 9  | 9   | 64         | 4416   |
| LDD  | 1   |    |     | 32         | 32     |
| LE   | 12  | 12 | 12  | 32         | 1152   |
| LEE  | 2   |    |     | 50         | 100    |
| LFF  | 4   |    |     | 50         | 200    |
| LG   |     | 16 |     | 70         | 1120   |
| LGG  | 3   |    |     |            | 0      |
| IJ   | 2   |    |     | 64         | 128    |
| LJ-3 | 2   |    |     | 64         | 128    |
| LK   | 1   | 1  |     | 96         | 192    |
| LK-1 | 1   | 13 |     | 64         | 896    |
| LK-2 | 6   | 2  | 2   | 96         | 960    |
| LK-3 | 9   | 12 | 4   | 32         | 800    |
| LK-4 |     | 2  |     | 160        | 320    |
| LK-5 | 3   |    |     | 64         | 192    |
| LK-7 | 2   | 3  | 2   | 64         | 448    |
| LK-8 |     | 1  |     | 32         | 32     |
| LM   |     |    | 7   | 70         | 490    |
| LN   | 9   |    |     | 8          | 72     |
| LP   | 5   | 5  | 21  | 32         | 992    |
| LP-1 | 10  |    |     | 64         | 640    |
| LT   | 26  |    |     | 32         | 832    |
|      |     |    |     | Total      | 48937  |
|      |     |    | Bui | lding Area | 62,188 |
|      |     |    |     | W/SF       | 0.79   |

#### TABLE 4 LIGHTING WATTAGE SUMMARY

Since the Wattage per square foot is 0.79 and it is less then both the office number of 1.0 and the school/university of 1.2 the building is compliant.

# 6. STANDARD 90.1 FINDINGS

The Berks Classroom and Lab building is mostly compliant with Standard 90.1. There are two items that are not compliant and the both reside in the building envelope analysis section. The glazing and the slab on grade are not compliant with the standard.

# 7. APPENDIX A

| Duibling  | Dette                          | No.                                      |           | A Dubling                      |               |   |            |               |           |            |                     |                     |
|---|--------------------------------|--|-----------|--------------------------------|---------------|---|------------|---------------|-----------|------------|---------------------|---------------------|
| System Tag Name :<br>Operating Condition Description:<br>Units (select from pull-down list)   | RTU-1<br>Design<br>IP          | Peak co                                  |           |                                |               |   |            |               |           |            |                     |                     |
| Inputs for System<br>Floor area served by system<br>Propulation of uses served by system (including diversity)<br>Daugin primary supply fram artiflow rate<br>Dauged per unit area for system (Weighted searage)<br>OA werd per present are system area. (Weighted searage)<br>Inputs for Potentiath Collicel Inner | As<br>Ps<br>Vpsd<br>Ras        | Units<br>S <sup>d</sup><br>dm<br>dm<br>f |           | 100%, diversity                | Syste<br>3021 | 5.3<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5 |            |               |           |            |                     |                     |
| Ziona Nama  | Zano é                         |  |           | a few mitigand scenarios       |               | Learning Loft   | Department | Classroom     | Classroom | Classroom  | Classroom           | Classroom           |
| Z one Tag   |                                | distant in the                           |           | o an onital standay            |               | Ozos<br>Common  | Common     | 244<br>acture | 245       | 246        | 247<br>Office space | 248<br>Office space |
| Space type  |                                | Select in                                |           | lown list                      |               | corridors   | corridors  | classroom     | classroom | classroom  | ourse shares        | anada anii lo       |
| Floor Areas of zone   | 2                              | 1 101.                                   |           |                                |               | 2406  | 430        | 1149.75       | 1152      | 1638       | 1992-25             | 1003.75             |
| Design population of zone<br>Design total supply to zone (primary plus local regirculated)  | V dad                          | <b>₽</b> "                               | (default) | value listed; may be ove       | mdden)        | 2.000   | 220 4      | 1200          | 1220      | 1600       | 1500                | 920                 |
| Induction Terminal Unit, Dual Fan Dual Duot or Transfer Fan?<br>Local reports air % representative of ave system return air   | Π.                             | Select fr                                | ompulld   | lown list or leave blank       | E N/A         |   | 784        | XSX           | 1914      | 192        | 15%                 | 15%                 |
| Inputs for Operating Condition Analyzed   | 7                              | \$                                       |           |                                |               | 1000  | 1000       |               |           |            |                     |                     |
| Percent or total design amow rate at conducted analyzed<br>Air distribution type at conditioned analyzed  | 5                              | Select fr                                | om pull-d | lown list                      |               | 100%  | 100%       | 100%          | 100%      | 1997<br>28 | 100%                | CS CS               |
| Z one air distribution effectiveness at conditioned analyzed<br>Primary air fraction of supply air at conditioned analyzed  | 5 <b>5</b>                     |  |           |                                |               | 1.00  | 1.00       | 1.00          | 1.00      | 1.00       | 1.00                | 1.00                |
| Results<br>Ventilation System Efficiency  | P.                             |  |           |                                |               | 5   |            |               |           |            |                     |                     |
| Outdoor air intaike required for system<br>Outdoor air per unit floor areas   | Wot/As                         |  |           |                                | - 5           | 9 91  |            |               |           |            |                     |                     |
| Outdoor air per person served by system (including) diversity)<br>Outdoor air as a % of design primary supply: air  | Y <sub>pd</sub> P <sub>p</sub> | ۴ <del>پ</del> ا                         |           |                                | 78            | 9 G   |            |               |           |            |                     |                     |
| Detailed Calculations<br>Initial Calculations for the System as a whole   |                                |  |           |                                |               |   |            |               |           |            |                     |                     |
| Primary supply air flow to system at conditioned analyzed   | , N                            | r Br                                     | -         |                                | 200           | 50  |            |               |           |            |                     |                     |
| Initial Calculations for individual zones   | Xs                             |  | - Vot     | u/ Vps                         |               | 25  |            |               |           |            |                     |                     |
| OA rate per unit area for zone<br>OA rate per conson  |                                |  |           |                                |               | 0.00<br>90.0  | 0.00       | 0.06          | 0.06      | 0.06       | 0.06                | 5,00                |
| Total supply air to zone (at condition being analyzed)<br>Unused CA nor'd to breathing zone   | 2 A A                          | <b>} }</b>                               | -<br>2    | z Piz + Razz Az                | •             | 2000  | 220        | 1200          | 1230      | 1600       | 1500                | 215.2               |
| Unused OA requirement for zone  | Voz                            | ₽  |           |                                | 1             | 150   | i M        | 249           | 302       | 56         | 315                 | 215                 |
| Fraction of zone supply from fully mixed primary air  | 3                              |  | ۍ د<br>د  | + (n-epter                     | • •           | 1.00  | 1.00       | 1.00          | 1.00      | 1.00       | 1.00                | 1.00                |
| Fraction of zone CA not directly reduc, from zone<br>Instant CA traction required in surely air to zone   | 22                             |  |           | 1-Ez)(1-Ep)(1-Er)              |               | 1.00  | 1.00       | 1.00          | 1.00      | 1.00       | 1.00                | 1.00                |
| Unused OA traction required in primary air to zone  | Ζp                             |  | - Vo      | z/ Vpz                         | 1             | 10.0  | 0.11       | 0.21          | 0.25      | 0.35       | 0.21                | 0.23                |
| Z one Ventilation Efficiency (App A Method)   | Evz                            |  | -         | + FbXs - FcZ) / Fa             | 1             | 1.18  | 1.14       | 1.04          | 1.01      | 0.90       | 1.04                | 1.02                |
| System Ventilation Efficiency (App A Method)<br>Ventilation System Efficiency (Table 6.3 Method)  | <b>T T</b>                     |  | <br>∑⊒    | n (Ever)<br>tua from Tabla 6:3 | ••            | 5.8   |            |               |           |            |                     |                     |
| Minimum outdoor air intaks sirflow<br>Outdoor Air Intaks Flaw required to System  | Vot                            | ₽  | - Vo      | u/ Ev                          |               | 2   |            |               |           |            |                     |                     |
| OA intake req'd as a traction of primary SA   | 4                              |  | - Vot     | Vps                            | -             | 69  |            |               |           |            |                     |                     |
| Outdoor Air Intake Flew required to System (Table 6.3 Method)<br>OA intake regid as a traction of primary SA (Table 6.3 Method)   | <b>≺</b> %                     | ľ  | •••<br>88 |                                |               |   |            |               |           |            |                     |                     |
| OA Tamp at which Min OA provides all cooling  |                                |  | 5         | JT-D / WOT- JT-                |               | 5   |            |               |           |            |                     |                     |
| CONTINUED DE LA MONTON CONTINUED DE LA MONTONIA   |                                | L Part                                   | -         | Protocol (1997)                |               | đ   |            |               |           |            |                     |                     |
|   |                                |  |           |                                |               |   |            |               |           |            |                     |                     |

| BunAteg:<br>System Tag Name :<br>Operating Condition Description:<br>Unna: select rom pui-cown issu  | Bunka C<br>RTU-1<br>Design | Roak ooo         | ing L      | dr Building                    |         |  |                                       |                  |                |  |                      |                    |                         |
|--|----------------------------|------------------|------------|--------------------------------|---------|--|---------------------------------------|------------------|----------------|--|----------------------|--------------------|-------------------------|
| Incust for Surban<br>Floor area served by system (including diversity)<br>Design process served to system (including diversity)<br>Design process server that such areas<br>Design process and the system weather areas<br>DArroyd per unit area for system weather diversity)<br>DArroyd per person for system weather diversity)<br>autors for Processing collect across | Red P and                  | dinits<br>dinits |            | 1005, dvanby                   |         | <u>55 10 00 17 15 10</u> |                                       |                  |                | Puler  | rilarity Cr Niccal 2 |                    |                         |
| Zong Name  | Zone H                     | a lans p         | ngala Mal  | o for altical zone(s)          |         | 8  | nactor Graph                          | Tos MM           | Learing Loft   | Classroom  | Classroom            | Seminar            | Bits & Bytes            |
| Zona Tag   |                            |                  |            |                                |         | 9  | 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 | 240<br>Xiter lab | Critics space  | 120  | 121<br>Liotuna       | 122<br>Lecture hal | 123<br>Calationia/fast- |
| Spana type   |                            | Salactin         |            | Sown list                      |         |  |                                       |                  |                | riasunom   | risternom            | (fired south)      | tood dining             |
| Floor Areaof zone  | 12                         | 51               |            |                                |         | Π  |                                       | 1022             | 2456           | 10545  | 774                  | 436                | 640.5                   |
| Design population of z one<br>Resign total superior increase indexes nice local portraciation  | 1                          | 17               | default    | value lated; may be one        | midden) |  | <b>1</b> 20                           | 3 12             | 11             | 1400   | 4700                 | 21                 | 1                       |
| Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?   | 4                          | Salactite        | mpulo      | fown list or leave blank       | INA     | Π  | 2                                     |                  |                |  |                      |                    |                         |
| Inputs for Operating Condition Analyzed  |                            |                  |            |                                | 1       |  |                                       |                  |                |  |                      |                    |                         |
| Persent of total design antixe raiset conditioned analyzed<br>Air distribution type at conditioned analyzed<br>Zone air distribution offectiv energis at conditioned analyzed  | N 8                        | Salaci to        | mpulo      | Sown list                      | 10      | 8  | 100%                                  | ភ័នទី            | 10<br>10<br>10 | 19<br>19<br>19<br>19<br>19<br>19<br>19<br>19<br>19<br>19<br>19<br>19<br>19 | 100%                 | 1005               | 100%                    |
| Results  |                            |                  |            |                                |         |  |                                       |                  |                |  |                      |                    |                         |
| Vertilation By stamEtholency<br>Outdoor at intelse required for system   | s v                        | Ť                |            |                                | 1 e     | ឌ ೫  |                                       |                  |                |  |                      |                    |                         |
| Outdoor all per person served by system (including diversity)  | VOIP5                      | 5                |            |                                | 86      | 5 4  |                                       |                  |                |  |                      |                    |                         |
| Outdoor at as a % of design primity supply air   | Ŕ                          | ł,               |            |                                | 7       | 2  |                                       |                  |                |  |                      |                    |                         |
| Detailed Calculations<br>Initial Calculations for the System as a whole  |                            |                  |            |                                |         |  |                                       |                  |                |  |                      |                    |                         |
| Primary supply air flow to system a conditioned assigned<br>UncorrectedOA requirement for system   | é k                        | 33               | 25         | dDs<br>Pa + Rea Aa             | 2 12    | ā ģ  |                                       |                  |                |  |                      |                    |                         |
| Unconnected OA negici as altraction of primary SA  | ž                          |                  | - 10       | u/ Vpa                         |         | N  |                                       |                  |                |  |                      |                    |                         |
| CALIZING ALL DATE AND TOT TOTAL  | Ā                          |                  |            |                                |         |  | uus                                   | 0.12             | NUN            | U.Ub   | ann a                | aru                | SLN S                   |
| OAnata per parson  | Ħ                          | din b            |            |                                |         |  | 5.00                                  | 10.00            | 5.01           | 7.50   | 7.50                 | 7.30               | 750                     |
| Total suppy air to cone (at condition being analyzied)<br>Unised CR regid to breathing zone  | ส์ล์                       |                  | 27         | z Pz + Raz Az                  | 1       |  | 8                                     | 972.6            | 2091           | 1150<br>2058   | 508.9                | 530<br>186.7       | 140                     |
| Unused OA requirement for zone   | Ā                          | Ì                | .≦         |                                | 1       |  |                                       | 373              | 211            | 20   | 504                  | 117                | 212                     |
| Fraction of zone supply from tutly interest from zone  | 73                         |                  | •••<br>873 | + () () -                      | • •     |  | 1.00                                  |                  | 5              |  | 1.0                  | 5                  | 150                     |
| Fraction of zone CA not directly radire, from zone   | 8                          |                  |            |                                | 1       |  | 1.00                                  | 1.00             | 1.01           | 1.0  | 1.00                 | 1.10               | 100                     |
| Unused Of fraction required in supply air to zone<br>Unused Of fraction required in primary state years  | H N                        |                  | -          | 2/Vdr                          | 1       |  | 0.00                                  |                  | 10.0           | A B  | 0.23                 |                    | 019                     |
| System Ventilation Efficiency  | ł                          |                  |            | and a loss                     | 1       |  |                                       | -                |                |  |                      |                    |                         |
| 2019 Ventilition Enclandy wipp A Memory  | EMZ                        |                  | 1          | 1+H085-H02//H0                 | ļ       | ;  | 1.25                                  | 13KT             | 2011           | U.20   | 80.00                | arn                | 111/                    |
| System Vesteason Entering (App A Method)<br>Vestilation System Efficiency (Table 6.3 Method)   | 2 2                        |                  | 5          | h (evz.)<br>Luo from Tabla 5.3 |         | 2 8  |                                       |                  |                |  |                      |                    |                         |
| Winimum outdoor air intaka airliow   | 1                          |                  |            | and them is allowed a          | ľ       | 1  |                                       |                  |                |  |                      |                    |                         |
| Outdoor Air Intaka Flow required to System   | ģ                          | Ť                | : 5        | U/EV                           | -       | 9 2  |                                       |                  |                |  |                      |                    |                         |
| Outdoor Air Intake Flow required to System (Table 6.3 Mehod)   | a                          | ŧ.               | 5          | u/ By                          |         | 2  |                                       |                  |                |  |                      |                    |                         |
| OA Temp at which Mn OA provides all coding   | 1                          |                  |            |                                | 1       |  |                                       |                  |                |  |                      |                    |                         |
| Contractor which an interview is the internation   |                            | - Per            | - 10       | period (1-1) for the           | •       | 8  |                                       |                  |                |  |                      |                    |                         |

| Super/<br>assistant         Equipment<br>issage         Englow<br>Autom           Citiba space         Strange<br>rooms         Office a<br>rooms           202.75         Strange<br>rooms         Office a<br>rooms           100         100           100         100           100         100           100         100           100         100           100         100           100         100           100         100           1.00         1.00           1.00         1.00           0.15         0.01           0.15         0.01           1.10         0.04  | India generation     Nume     Units     System       India generation     Nume     India generation     System       India generation     Nume     Nume     India generation       India generation     Nume     Nume     Nume     Nume       India generation     System     Stand from System     Stand from System     Stand from System       India generation     Nume     Nume     Nume     Nume     Stand from System       India generation     Stand from System     Stand from System     Stand from System     Stand from System       India generation     Stand from System     Stand from System <td< th=""><th>d supph air al conditioned analyzed Da %. 1074 1074 1074 1074 1074 1074 1074 1074</th><th>Asem CRistency     Ex     0.30       Mails caplined to system     Volk     clm       Mails caplined to system     Volk     clm       r particip sarved by yintem (including devently)     VolPis     dialy       a % of dealigit primuly supply all     Vpd     clm       a % of dealigit primuly supply all     Vpd     clm</th><th>r in System as a whole<br/>pip at flw to system at on rditoned a valyzed V pis cfm = V piCs = 20550<br/>3C4 night an untitor system<br/>C4 night as a function of primuly C4 X = V ou / Vpis = 5161<br/>a whole as not as a function of primuly C4 X = V ou / Vpis = 0.22</th><th>Full availabrization         Fair         Chinh         Chinh         Clinic         &lt;</th><th>Support profile         Your         Your         Fill         Your         Your</th><th>kon mapuheekin suppoy atribuzone Zd = Voor Voor = 0.00 0.10 0.10 0.10 0.15 0.01<br/>kon napuheekin pumpanya laho zone Zp = Voor Voor = 0.89 0.12 0.08 0.15 0.31</th><th>nov<br/>hove a second secon</th><th>na Eriolanov (Augo A Martined) EV – min (Szr) – 136<br/>na Eriolanov (Augo A Martined) EV – min (Szr) – 136</th><th>se Flow required to System Vot ofm - Vou/EV - 14257</th><th>Air manage annown.<br/>Air manage annown.<br/>Air manage Thanton of primary SA. Y – Vol Vitra – (4267)</th><th>Oor Air Trades Baltroom     Vol     Cfm     Vou/Ev     - 14267       barde nords as handror of prinary SA     V     Cfm     Vou/Ev     - 14267       brade nords as handror of prinary SA     V     - Vol/Vp     - 0.60       brade nords as handror of prinary SA     V     - Vol/Vp     - 0.60       brade nords as handror of prinary SA     V     - Vol/Vp     - 0.60       brade nords as handror of prinary SA     V     - Vol/Vp     - 0.60</th></td<> | d supph air al conditioned analyzed Da %. 1074 1074 1074 1074 1074 1074 1074 1074 | Asem CRistency     Ex     0.30       Mails caplined to system     Volk     clm       Mails caplined to system     Volk     clm       r particip sarved by yintem (including devently)     VolPis     dialy       a % of dealigit primuly supply all     Vpd     clm       a % of dealigit primuly supply all     Vpd     clm | r in System as a whole<br>pip at flw to system at on rditoned a valyzed V pis cfm = V piCs = 20550<br>3C4 night an untitor system<br>C4 night as a function of primuly C4 X = V ou / Vpis = 5161<br>a whole as not as a function of primuly C4 X = V ou / Vpis = 0.22 | Full availabrization         Fair         Chinh         Chinh         Clinic         < | Support profile         Your         Your         Fill         Your         Your | kon mapuheekin suppoy atribuzone Zd = Voor Voor = 0.00 0.10 0.10 0.10 0.15 0.01<br>kon napuheekin pumpanya laho zone Zp = Voor Voor = 0.89 0.12 0.08 0.15 0.31 | nov<br>hove a second secon | na Eriolanov (Augo A Martined) EV – min (Szr) – 136<br>na Eriolanov (Augo A Martined) EV – min (Szr) – 136 | se Flow required to System Vot ofm - Vou/EV - 14257 | Air manage annown.<br>Air manage annown.<br>Air manage Thanton of primary SA. Y – Vol Vitra – (4267) | Oor Air Trades Baltroom     Vol     Cfm     Vou/Ev     - 14267       barde nords as handror of prinary SA     V     Cfm     Vou/Ev     - 14267       brade nords as handror of prinary SA     V     - Vol/Vp     - 0.60       brade nords as handror of prinary SA     V     - Vol/Vp     - 0.60       brade nords as handror of prinary SA     V     - Vol/Vp     - 0.60       brade nords as handror of prinary SA     V     - Vol/Vp     - 0.60 |
|--|--|---|--|---|---|--|--|---|--|---|--|--|
| Supervision         Engline           110Ap         Autor           100Ap         Autor           0.34         Autor           0.34         Autor           0.34         Autor             | 1.0<br>1.0<br>1.0<br>1.0<br>1.0<br>1.0<br>1.0<br>1.0   | 1.00  |  |   | 150<br>46.5   | 100  | 0.51   | 0.94  |  |   |  |  |
| Searing<br>Instance         Electroniza<br>Instance           111         110           111         100           111         100           111         100           111         100           111         100           111         100           111         100           111         100           1100         100           1100         100           1100         100           1100         100           1100         100           1100         100           1100         100           1100         100           1100         100           1100         100           1100         100           1100         100           1100         100 | samy Ekonoska<br>space Electronical<br>internation Lib<br>internation Electronical<br>internation Electronical<br>international international<br>international international<br>international international international<br>international international i   | 01. 011<br>0 80<br>01 9001  |  |   | 510<br>510<br>510<br>510<br>510   |  | 020  |   |  |   |  |  |

| Building    |   | Berks    | Classroo   | m an    | d Lab Building                  |          |         |              |           |
|-------------|---|----------|------------|---------|---------------------------------|----------|---------|--------------|-----------|
| System T    | ag Name :   | RTU-1    |            |         |                                 |          | _       | t            |           |
| Ope ratin   | Condition Description:  | Design   | Peak co    | oling   |                                 |          |         | t            |           |
| Units (se   | act from pull-down list)  | IP       |            |         |                                 |          |         |              |           |
| Incuster do | - Bush -  | Marrow   | Unite      |         |                                 |          | Ducinen | r            |           |
| inputs to   | r system  | Name     | unns       |         |                                 | H        | system  | -            |           |
|             | Pilot area served by system   | AS       | 51         |         | 10000                           |          | 30217.5 | -            |           |
|             | Population of allea served by system (including diversity)<br>Design primary supply fan aliffan min | Mond     | -t-        |         | TOUN UNDERY                     |          | 20.500  | -            |           |
|             | Of and participation for purpose Michigan and   | Dee      | of male 1  |         |                                 |          | 20,000  | -            |           |
|             | OA metid per unit alva for system (w eighted average)   | Dre      | cimin      |         |                                 |          | 0.07    | -            |           |
| Inputs to   | r Poin stially Critical zones   | ripe     | cump       |         |                                 |          | 0.0     | L            |           |
| ingrata to  |   |          |            |         |                                 |          |         | Resource     | Seminar   |
|             | Zone Name   | Zone t   | te turns p | wpk     | Italic for critical zone(s)     |          |         | Center       | Classroom |
|             | Zone Tag  |          |            |         |                                 |          |         | 111          | 112       |
|             |   |          |            |         |                                 |          |         | Office space | Lecture   |
|             | Space type  |          | Colord     |         | and shows that                  |          |         |              | classroom |
|             | Energy and a second second  |          | CHINCE     | ion p   | JUE-COWIT IDL                   |          |         |              |           |
|             | Proof Area of 2019  | AZ       | 51         | (state) | and and an interior and the sec | -        | (mark)  | 475          | 589       |
|             | Design population of zone   | PZ Nater | at an      | (061    | aux value issed; may be ov      | umdo     | wit)    | 5            | 1/        |
|             | Lesign total supply to zone (primary plus local recirculated)                                       | Adad     | Colorit    | -       | will down list or lower block   | an Maria | . 8     | 540          | 700       |
|             | Local social air 5/ accessibility of automatical critical air                                       | Ex       | OWNER      | ion b   | ADD-COMPTIBLE OF THAT'S DISTR   | II NO    | •       |              |           |
| inputs fo   | r Operating Condition Analyzed  | EI       |            |         |                                 | 10       |         |              |           |
|             | Percent of total design airflow rate at conditioned analyzed  | Ds       | %          |         |                                 |          | 100%    | 100%         | 100%      |
|             | Air distribution type at conditioned analyzed   |          | Select t   | tom p   | ull-down list                   |          |         | CS           | CS        |
|             | Zone air distribution effectiv eness at conditioned analyzed  | Ez       |            |         |                                 |          |         | 1.00         | 1.00      |
|             | Primary air fraction of supply air at conditioned analyzed  | Ep       |            |         |                                 |          |         |              | 3         |
| Results     |   |          |            |         |                                 |          |         |              |           |
|             | Ventilation System Efficiency   | EV       |            |         |                                 |          | 0.36    |              |           |
|             | Outdoor air intake required for system  | Vat      | ctm        |         |                                 |          | 14267   |              |           |
|             | Outdoor air per unit floor area   | Vot/As   | ctm/st     |         |                                 |          | 0.47    |              |           |
|             | Outdoor air per person served by system (including diversity)                                       | Vot/Ps   | ctm/p      |         |                                 |          | 30.3    |              |           |
|             | Outdoor air as a % of design primary supply air   | Ypd      | ctm        |         |                                 |          | 70%     |              |           |
| Detailed    | Calculations  |          |            | _       |                                 | _        |         |              |           |
| Initial Ca  | culations for the System as a whole   |          |            |         |                                 |          |         |              |           |
|             | Primary supply air flow to system at conditioned analyzed   | Vps      | ctm        | -       | VpdDs                           | -        | 20550   |              |           |
|             | UncorrectedOA requirement for system  | Vou      | ctm        | -       | Ros Ps + Ras As                 | -        | 5161    |              |           |
|             | Uncorrected OA regid as a fraction of primary SA  | Xs       |            | -       | Vou/ Vps                        | -        | 0.25    |              |           |
| Initial Ca  | iculations for individual zones   |          |            |         |                                 |          |         |              |           |
|             | OA rate per unit area for zone  | Rat      | ctm/st     |         |                                 |          |         | 0.06         | 0.06      |
|             | OA rate per person  | Bpz      | ctm/p      |         |                                 |          |         | 5.00         | 7.50      |
|             | Total supply air to zone (at condition being analyzed)  | Vdz      | ctm        |         |                                 |          |         | 540          | 700       |
|             | Unused CA regid to breathing zone   | Vbr      | ctm        | -       | Rpz Pz + Raz Az                 | -        |         | 68.5         | 162.8     |
|             | Unused OA requirement for zone  | Vaz      | ctm        | -       | Vbz/Ez                          | -        |         | 69           | 163       |
|             | 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  | Fo       |            | -       | 1-(1-Ez)(1-Ep)(1-Er)            | -        |         | 1.00         | 1.00      |
|             | Unused OA fraction required in supply air to zone   | Zd       |            | -       | Voz / Vdz                       | -        |         | 0.13         | 0.23      |
|             | Unused OA fraction required in primary air to zone  | Zp       |            | -       | Voz / Vpz                       | -        |         | 0.13         | 0.23      |
| System V    | Ventilation Efficiency  |          |            |         |                                 |          |         |              |           |
|             | Zone Ventilation Efficiency (App A Method)  | Evz      |            | -       | (Fa + FbKs - FcZ) / Fa          | -        |         | 1.12         | 1.02      |
|             | System Ventilation Efficiency (App A Method)  | EV       |            | -       | min (Evz)                       | -        | 0.36    |              |           |
|             | Ventilation System Efficiency (Table 6.3 Method)  | EV       |            | -       | Value from Table 6.3            | -        | n/a     |              |           |
| Minimum     | outdoor air imake airflow   |          |            |         |                                 |          |         |              |           |
|             | Outdoor Air inclike Flow required to System   | Vot      | cim        | -       | VOU/ EV                         | -        | 14267   |              |           |
|             | OA intake regid as a fraction of primary SA   | 1        |            | -       | Vot/ Vps                        | -        | 0.60    |              |           |
|             | Outdoor Air intake How required to system (Table 6.3 Method)  | Vot      | eim        | -       | VOU/ EV                         | -        | n/a     |              |           |
| -           | CA make regid as a fraction of primary SA (Table 6.3 Method)  | 1.       |            | -       | Vot/ Vps                        |          | nva     |              |           |
| OA TEMP     | OAT below which OA Intoke free is O minimum   |          | Dee        |         | ITTO ATTAC IS MORTH ATTA        |          | 1.140   |              |           |
|             | CALL DAVA AND IN THIS IN THE WITH THE   |          | Degr       | -       | (()p-0150+(1-T)-(11+011         |          | 48      |              |           |

| Building:<br>System Tag Name:<br>Operating Condition Description:  | Barks (<br>RTU-2<br>Dvolum | lassroot | t and Lab Building   |                   |                |       |               |   |             |             |        |
|--|----------------------------|----------|--|-------------------|----------------|-------|---------------|---|-------------|-------------|--------|
| Obst (Marcelling III) (1990) (1990)  |                            |          |  |                   |                |       |               |   |             |             |        |
| Inputs for System<br>Fierra and concertive evidem  | Name                       | " Into   |  | System<br>Materia | <u>-</u>       |       |               |   |             |             |        |
| Population of area served by system (including diversity)  | 3                          |          | 10% dversity   | 1                 | deate          |       |               |   |             |             |        |
| OA redd per unit area for system (Weighted average)  | R S                        | 1        |  | 12,0              | No.            |       |               |   |             |             |        |
| INPUTS TO: HORE-TRAINFUTURED ZONKS   | Pps<br>B                   | 8        |  |                   |                |       |               |   |             |             |        |
| Zone Name  | 7000                       |          | ento dallo fre cellost sensitei  |                   | Comp Lab       | Loopy | Comp Lab      | IT Store  | Comp Lab    | Twels Lab   | Compor |
| Zong Tag   |                            |          |  |                   | 200            | F301  | 209           | 207/207A  | 201         | 300         | 0901   |
| Stars Alter  |                            |          | down line  |                   | Contraction of |       | (Dupped party | and the second se | (m)         | of printing |        |
| Floor Area of zone   | A.                         |          | all particular line  |                   | 8              | 877.5 | 962.5         | 431.5   | 1402.25     | 910         | 88     |
| Design population of zone indexervative local region (which  | Ĩ                          | } "      | detault value listed; may be ove   | middan)           | 8 08           |       | 2             | 8.0   | 19          | an 19       |        |
| Induction Lemmina Unit, LUasi Han Uka Ukot or Litarsherhanin   |                            | 2000110  | ULT DIRITORNAL RECO. 1990 N DISTRICT   | NA                |                |       |               |   |             |             |        |
| Incute for Operating Condition Assigned  |                            |          |  |                   | 9              | 0     | 3             |   |             |             | 3      |
| Percent of bial design alflow alle alconditioned analyzed  | 0                          | ¢ *      | on roll down lint  | 100               | 10%            | 100%  | 100%          | 10%   | 100%        | 10%         | 100%   |
| Zons air dshbutiin effectiv enass at conditioned analy zvd   | 1                          |          |  |                   | 1.00           | 100   | 1.00          | 100   | 1.00        | 15          | 1.00   |
| Finally an actual of staticy and containing analysis.  | 8                          |          |  |                   |                |       |               |   |             |             |        |
| Ventilation 3/ sten Efficiency<br>Outhor all intake regularity for system  | a V                        | 1        |  | £8                |                |       |               |   |             |             |        |
| Outdoor air per unit floor area  | Volues                     | 1        |  | 8                 |                |       |               |   |             |             |        |
| Contoor all per person services y system (neuroni) conversity /<br>Outdoor all as a % of dasign primary supply all             | Ŕ                          | 9        |  | 8                 |                |       |               |   |             |             |        |
| Detailed Calculations<br>Initial Calculations for the System as a Whole  |                            |          |  |                   |                |       |               |   |             |             |        |
| Primary supply airflow to system at conditioned analyzed   | R                          | 3        | - VpdDs  | -                 |                |       |               |   |             |             |        |
| Unormated CA replanament of system<br>Unormated CA replate a traction of primay SA   | Xs                         | 8        | <ul> <li>Mos P3 + Mas A3</li> <li>Wou/ Vps</li> </ul>  | 28                | 00             |       |               |   |             |             |        |
| OA rate per unit area for zone   | P                          | S.       |  |                   | 0.12           | 006   | 90.0          | 012   | 0.12        | 66          | 0.05   |
| OA rate per person   | P                          | ł        |  |                   | 10.00          | 510   | 5.00          | 1000  | 10.00       | 5           | 00     |
| Tutat subjer an income (at construction demy analyzed)<br>Unused CA read to breathing cone                                     | <b>R</b> R                 | 8 6      | Rep Pt + Rep Ar  | •                 | 365.5          | 52.7  | 162.8         | 527   | 458.3       | 140.6       | 99 A   |
| Unused CA requirementter zone  | Ŕ                          | ŝ        | - Vitanii 2  | 1                 | 396            | 1     | 163           | 8   | t,          | ŝŝ          |        |
| Franking of cone supply not grady typic, rom zone<br>Franking of cone supply from fully indeed primary sh                      | 72                         |          |  |                   | 1.00           | 5     | 100           | 88  | 8           | ŝ           |        |
| Fraction of none OA not directly redit, from zione   | 2.5                        |          | <ul> <li>1-(1-E)(1-E)(1-E)</li> </ul>  |                   | 1.00           | 5     | 1.00          | 18  | 1.00        | 5           | 1.00   |
| Unused CA traction required is supply air to zone<br>Unused CA traction required is primary air to zone                        | 22                         |          | <ul> <li>Voz /Vpz</li> </ul>   |                   | 0.45           | 0.36  | 0.19          | 016   | 220         | 55          | 0.23   |
| System Ventilation Efficiency  | ŝ                          |          |  | •                 | -              | 1 20  | 1             | 112   | 1<br>2<br>2 | i           | ţ      |
| System Variilation Efficiency (App A Mathod)   | V                          |          | <ul> <li>min (Exz.)</li> </ul>   | -                 |                |       |               |   |             |             |        |
| Ventilation System Efficiency (Fiddle 3.0 Method)  | 2                          |          | <ul> <li>Valuetrom Table CD</li> </ul>   | - 20              | Ĭ              |       |               |   |             |             |        |
| Outprise Air Interest annual annual of the System  |                            | 3        | - Vnu/ Pv  |                   | ~              |       |               |   |             |             |        |
| OA Intake radid as a fraction of primary SA  | 1                          |          | <ul> <li>Vot/ Vps</li> </ul>   | '<br>8            |                |       |               |   |             |             |        |
| Outdon All Intelle Row required to System (Table 6.3 Nathod<br>OA Intelse radid as a fraction of primary SA (Table 6.3 Nathod) | × a                        | 8        | - Vol/ Sv<br>- Vol/ Vps  | <br>20            | NJ 44          |       |               |   |             |             |        |
| OA Temp at which Min OA provides all cooling   |                            |          | ITTO ATTA  |                   | J              |       |               |   |             |             |        |
|  | l                          |          | - Not starting of the second s |                   |                |       |               |   |             |             |        |

| System Tag Name:<br>System Tag Name:<br>Cps wing Condition Description.<br>Units (solidet frompull-down list)                     | Barts (<br>RTU-2<br>Design | That Oc   | m and Lab Building<br>soling                                |          |                       |         |              |                       |                        |                        |                    |
|---|----------------------------|-----------|---|----------|-----------------------|---------|--------------|-----------------------|------------------------|------------------------|--------------------|
| Inputs for System.  | Name                       | Units     |   | Syste    | <u>=</u>              |         |              |                       |                        |                        |                    |
| Ficer ana sawed by system<br>Population of a war sawed by system (Instability Unwrality)<br>Rector where a same to be strikted at | 578                        | 1 - 1     | Viscondo Nation   | 14566    |                       |         |              |                       |                        |                        |                    |
| OA medit per unit area the system (W-alphad swampd)<br>OA medit per person the system area. (W-alphad swampd)                     |                            | ₿₿        |   |          |                       |         |              |                       |                        |                        |                    |
| Zone Name   |                            |           |   |          | Super /<br>Assistance | Lobby P | rolotype Lab | Receiving/<br>Storage | Design Lab             | Projects Lab P         | esearch Lat        |
| Jone Tag  | 2008                       |           | (c)each research and set                                    |          | 101<br>101            | F103    | 108          | 109 / 109A            | 103                    | <b>1</b> 8             | 114                |
| ediț ecede  |                            |           |   |          | areds com a           | 100000  | e0e          | Bundan                | e8a<br>Interviewe      | 999                    | olo united and     |
| Floor Assa of zone  | Az                         | st        | rom pull-down list  |          | 150                   | 456     | aboratories  | 574                   | aborationes<br>938.875 | lacoratorias<br>1226.1 | aboratorias<br>705 |
| Design xopulation of zone<br>Design volation of zone infimery plus boat restructed)   | S R                        | -<br>-    | (dataulivalue listed; may be ov                             | amiddan) | 3 10                  |         | 720          |                       | 8 M                    | 8 14                   | s                  |
| Induction Terminal User, Dual Fan Dual Dect or Transfer Fan?<br>Local ratio: at % representative of ave system whum air           | Ψ                          | Sdoot t   | ron pull-down list or leave blank                           | INA      | 257                   | 784     | 201          | 7.57                  | XXX                    | 792                    | 152                |
| Inputs for Operating Condition Analyzed   |                            | 1         |   |          | -                     |         |              |                       |                        |                        |                    |
| Heroencor total cestigit aintide rate a concritories analysed<br>At utati futbori type at uuristiismed anelysed                   | US                         | Selection | run pull-down Isl   |          | 0% 100%               | 100%    | 83           | 100%                  | 1075                   | 005                    | 201                |
| Acres all distriction electiveness a conditioned analyzed<br>Primary all fraction of supply all all conditioned analyzed          | 7 R                        |           |   |          | ULL                   | 1.00    | 00.1         | 1.00                  | 1.00                   | tur,                   | 1.00               |
| Fesults<br>Ventilaton By dom Eficience  | Đ                          |           |   |          | *                     |         |              |                       |                        |                        |                    |
| Outdoor air intaka negulrad for systam  | No.                        | 1         |   | . *      | : 23                  |         |              |                       |                        |                        |                    |
| Outdoor at the person served by spatem (including diversity)<br>Outdoor at the person served by spatem (including diversity)      |                            | 1         |   | . 2 6    | 8 <b>-</b>            |         |              |                       |                        |                        |                    |
| - fotos famos diama su na control por tran  | i                          |           |   |          |                       |         |              |                       |                        |                        |                    |
| Initial Calculations for the System as a whole<br>Primary supply air flow to system a conditioned analyzed                        |                            | ₽         | - VMDs  | n<br>Di  | 110                   |         |              |                       |                        |                        |                    |
| Uncorrected CA requirement for system<br>Uncorrected CA reads as a fraction of privacy CA   |                            | )<br>III  | - Rps Ps + Ras As   | • 14     | 88                    |         |              |                       |                        |                        |                    |
| Initial Calculations for Individual zones   | i                          | ŧ         | 1   |          | 2                     | 2       | *            | 2                     | 2                      | 5                      |                    |
| OA ratepar parson   | 귀                          | and a     |   |          | 5.00                  | 5.00    | 12.00        | 0.00                  | 1020                   | 10.00                  | 10.00              |
| Unused CA regular to zone (at contains being analytical)<br>Unused CA regular breakhing zone                                      | i i                        | 6 8       | <ul> <li>Plac Piz + Plazz Az</li> </ul>                     | 1        | 0/                    | 200     | 1/50         | 420                   | 429.6                  | 470.7                  | 208.9              |
| Unused CA requirement for zone  | Å                          | ₽         | - Violez  | ľ        | 19                    | . 11    | 362          | . 8                   | 8                      | 471                    | N                  |
| Fraction of zone supply from fully need primary sin   | 7                          |           |   | •        | 1.00                  | 1.00    | 1.00         | 1.00                  | 150                    | 1.00                   | 1.0                |
| Fraction of zone OA not directly redire. from zone<br>Unused CA fraction required in supply air to zone                           | 27                         |           | <ul> <li>1-(1-5z)(1-Ep)(1-Er)</li> <li>Vez / Vez</li> </ul> |          | 1.00                  | 0.14    | 1.00         | 0.16                  | 043                    | 1.8                    | 1.00               |
| Unused CA traction required in prinary all to zone  | Zp                         |           | <ul> <li>Vez / Vpz</li> </ul>                               | 1        | 0.27                  | 0.14    | 131          | 0.16                  | 0.43                   | 0.47                   | 0.30               |
| Cystem Vestilation Efficancy (App A Vathor)   | Evz                        |           | <ul> <li>(Fa + FbKs - FoZ) / Fa</li> </ul>                  | •        | 1.01                  | 1.15    | 198          | 1.12                  | 3610                   | 0.81                   | 660                |
| System Ventilation Eficiency (Aco A Method)<br>Ventilation System Eficiency (Table 6.3 Nethod)                                    | 22                         |           | <ul> <li>mn (Byz)</li> <li>Value from Table 6.3</li> </ul>  | • •      | 8 2                   |         |              |                       |                        |                        |                    |
| Minimum outdoor air Intiska airfiow<br>Outdoor Air Intiska Hew Required to System   | N CI                       | 3         | - YOU/ EV   |          | Ē                     |         |              |                       |                        |                        |                    |
| OA Intaka req16 as a hadion of primary SA   | 4                          | ł         | <ul> <li>Vet/ Vps</li> </ul>                                | 1        | 81                    |         |              |                       |                        |                        |                    |
| OA intake regid as a fraction of primary SA (Table 6.3 Nethod)  | 1                          |           | - Vet/Vps   |          | 15                    |         |              |                       |                        |                        |                    |
| OA temp at which Min GA provides all cooling<br>OAT beaw which GA Infake flow is @ minimum  |                            | Dig F     | <ul> <li>([]pdTs}(I-Y](Tr+d)f</li> </ul>                    | •        | 12                    |         |              |                       |                        |                        |                    |
|   |                            |           |   |          |                       |         |              |                       |                        |                        |                    |

| Buildina:  | Berks  | Classroor                                | m an | d Lab Building                |       |         | 2               |               |
|--|--------|--|------|-------------------------------|-------|---------|-----------------|---------------|
| System Tag/Name :  | RTU-2  |  |      |                               |       |         | t               |               |
| Operating Condition Description:   | Design | Peak Co                                  | olin | 9                             |       |         | 1               |               |
| Units (select from pull-down list)   | IP.    |  |      |                               |       |         | 120             |               |
| Inputs for System  | Name   | Units                                    |      |                               | 1     | System  | Т               |               |
| Floor area served by system  | As     | st                                       |      | 3                             | 1     | 4565.48 | I               |               |
| Population of area served by system (including diversity)  | Ps     | P  |      | 100% dversity                 |       | 212     | I               |               |
| Design primary supply fan airflow rate   | Vpsd   | ctm                                      |      |                               |       | 12,810  | T               |               |
| OA regid per unit area for system (Weighted average)   | Ras    | ctm/st                                   |      |                               |       | 0.12    |                 |               |
| OA regid per person for system area (Weighted average)   | Rps    | cfm/p                                    |      |                               |       | 8.7     | T               |               |
| inputs for Polentially Critical zones  |        |  |      |                               |       |         | -               |               |
| Zono Namo  |        |  |      |                               |       |         | Measurement     | Seminar       |
|  | Zone t | le tirns p                               | urpk | Halic for critical zone(s)    |       |         |                 | Charles Oohin |
| Zone Tag   |        |  |      |                               |       |         | 105             | 308           |
|  |        |  |      |                               |       |         | University/coll | Lecture       |
| Space type   |        |  |      |                               |       |         | ege             | classroom     |
|  |        | Select fr                                | om p | oull-down list                |       |         | laboratories    |               |
| Floor Area of zone   | Az     | st                                       |      |                               |       |         | 1256.25         | 791           |
| Design population of zone  | Pz     | P  | (dat | ault value listed; may be ov  | emidd | en)     | 13              | 25            |
| Design total supply to zone (primary plus local recirculated)  | Voted  | ctm                                      |      |                               |       |         | 1410            | 1500          |
| Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?   |        | Select fr                                | om p | oull-down list or leave blank | II NV |         | 3               |               |
| Local recirc, air % representative of ave system return air  | Er     |  | _    | 66                            |       |         | 75%             | C 7 EK        |
| nouts for Operating Condition Analyzed<br>Research of Intel design aidlaw rate of conditioned analyzed | De     | 97                                       |      |                               |       | 1009    | 1009/           | 1009/         |
| Air distribution have at conditioned analyzed  | US     | To<br>Colorit to                         | -    | tell down list                |       | 100%    | 100%            | 100%          |
| Zone air dairibution offertikenear at conditioned analyzed   | E.e.   | CHINGEN                                  | on , | ALC-SOME TO:                  |       |         | 1.00            | 100           |
| Drimmar air fraction of surply air at conditioned analyzed   | En     |  |      |                               |       |         | 1.00            | 1.00          |
| Printery an inaction of supply an at conditioned analyzing   | - EP   |  |      |                               |       |         |                 |               |
| Vantilation System Efficiency  | Ev     |  |      |                               |       | 0.81    |                 |               |
| Outrinor air intako roquirod for system  | Vot    | cim.                                     |      |                               |       | 4483    |                 |               |
| Outrinor air nar unit finor area   | Vot/As | cimist                                   |      |                               |       | 0.31    |                 |               |
| Outdoor air par parson savad by system (including diversity)   | Vot/Ps | ctmip                                    |      |                               |       | 21.1    |                 |               |
| Outdoor air as a % of design primary supply air  | Ypd    | ctm                                      |      |                               |       | 35%     |                 |               |
|  |        |  |      |                               |       |         |                 |               |
| pitaled Calculations<br>Initial Calculations for the System as a whole                                 |        |  |      |                               |       |         |                 |               |
| Drimay surply air flow in surion at conditioned analyzed   | Mee    | eter.                                    | 122  | VedDe                         | 28    | 10010   |                 |               |
| Linearmented DA manimum for surfam   | Vou    | cim.                                     |      | Des De . Des As               |       | 9660    |                 |               |
| Lincorrected OA registered to system   | Xe     | C. C | -    | Vou/Vos                       |       | 0.28    |                 |               |
| atial Calculations for individual zones  | ~      |  |      |                               |       |         |                 |               |
| OA rate nor unit area for zone   | Bar    | cimist                                   |      |                               |       |         | 0.18            | 0.05          |
| OA rate per person   | Box    | ctmin                                    |      |                               |       |         | 10.00           | 7.50          |
| Total supply air to zone (at condition being analyzod)   | Vdr    | ctm                                      |      |                               |       |         | 1410            | 1500          |
| Linused CA realit in breathing zone  | Vhr    | ctm                                      |      | Bry Pr + Bar Ar               |       |         | 356.1           | 235.0         |
| Linused CA requirement for zone  | Vor    | ctm                                      |      | Vhr/Fr                        |       |         | 355             | 235           |
| Fraction of zone supply not directly regime from zone  | Fa     |  | 12   | En + (1-En/Er                 |       |         | 1.00            | 1.00          |
| Fraction of zone supply from fully mixed orimany air   | Eh     |  |      | En                            |       |         | 1.00            | 1.00          |
| Fraction of zone QA not directly recirc, from zone   | Fo     |  |      | 1-(1-Ez)(1-Ep)(1-Er)          |       |         | 1.00            | 1.00          |
| Unused OA fraction required in supply air to zone  | Zd     |  | 12   | Voz /Vdz                      |       |         | 0.25            | 0.16          |
| Unused CA fraction required in primaw air to zone  | ZD     |  | 12   | Voz /Voz                      |       |         | 0.25            | 0.16          |
| System Ventilation Efficiency  |        |  |      |                               |       |         |                 |               |
| Zone Ventilation Efficiency (App A Method)   | Evz    |  | -    | (Fa + FbKs - FcZ) / Fa        |       |         | 1.03            | 1.13          |
| System Ventilation Efficiency (App A Method)   | EV     |  | -    | min (Evz.)                    | -     | 0.81    |                 |               |
| Ventilation System Efficiency (Table 6.3 Method)   | EV     |  | -    | Value from Table 6.3          | -     | 0.68    |                 |               |
| Animum outdoor air intake airflow  |        |  |      |                               |       |         |                 |               |
| Outdoor Air Intake Flow required to System   | Vat    | ctm                                      | -    | Vou/ Ev                       | -     | 4483    |                 |               |
| OA intake regid as a fraction of primary SA  | Y      |  | -    | Vot/ Vps                      | -     | 0.35    |                 |               |
| Outdoor Air Intake Flow required to System (Table 6.3 Method)  | Vot    | cfm                                      | -    | Vou/ Ev                       | -     | 5374    |                 |               |
| OA intake regid as a fraction of primary SA (Table 6.3 Method)   | Y      |  | -    | Vot/ Vps                      | -     | 0.42    |                 |               |
| DA Temp at which Min OA provides all cooling   |        |  |      |                               |       |         |                 |               |
| OAT below which OA Intake flow is @ minimum  |        | Deg F                                    | -    | hTD+1T)*(Y-1)-(1ETD-qT)       | -     | 23      |                 |               |

| Building:<br>System TagName -<br>Operating Condition Description:<br>Units (select from pull-down its)   | Barks (<br>Pasign<br>P | Classroom a | nd Lab Building<br>ad          |  |                      |                    |                    |                    |               |                    |          |
|--|------------------------|-------------|--------------------------------|--|----------------------|--------------------|--------------------|--------------------|---------------|--------------------|----------|
| Impos for 3ystem<br>Floor susta son wid by system (Including diversity)<br>Deceptorations are served by ystem (Including diversity)<br>Deceptorations supply frameworks<br>Deceptorations supply frameworks<br>Deceptorations are by statem area (Weighted severage)<br>DA need per particular zerves<br>DA need per particular zerves | R S S S S              | damb g      | 100% dvosty                    | System<br>13345.3<br>10,79<br>5,79<br>5,79 |                      |                    |                    |                    |               |                    |          |
| Zona Name  |                        |             |                                |  | Faculity<br>Office / | Faculty<br>Offices | Faculty<br>Offices | Faculity<br>Office | Continence    | Faculty<br>Offices | Corridor |
| Zone Tag   |                        |             |                                |  | 335 / 0304           | 233, 334 &<br>335  | 330, 331 &<br>332  | 319                | 5             | 324, 326 Ł<br>327  | 0303     |
| Space ype  |                        | Salad form  | pul-down ist                   |  | Office space         | Office space 0     | million space      | office space (     | or the second | Office space       | Comidors |
| Floor Area of zono<br>Resident roculation of zono  | ₽ ≧                    | -           | fault using listed; may be our |  | 502                  | 20.5               | 370/2              | . 8                | 183           | , H                | 5        |
| Design total supply to zone (primary plus local recirculated)  | Vitrd                  | •           |                                |  | 蔎,                   | 330                | 330                | 280                | 18            | 33                 | 200      |
| Local recirc. at % representative of ave system return air   | Ψ                      |             |                                |  | 2                    | 3                  | 2                  |                    | 2             | 3                  | 2        |
| Inputs for Deerating Coedition Analyzed<br>Percent of tota design airflow rate at conditioned analyzed   | 8                      | 1           |                                | 1029                                       | 109                  | 100%               | 100%               | 100%               | 100%          | 104%               | 100%     |
| Even an use fuctor whether were a sub-<br>primary air thattion of supply air all conditioned analyzed  | 00                     |             |                                |  | 100                  |                    | 1.00               | 1.00               | 1.00          | 18                 | 00.I     |
| Pesults<br>Ventilation By dam Efficiency   | W                      |             |                                | 0.75                                       |                      |                    |                    |                    |               |                    |          |
| Dutdoor air intaka raquinad tor system<br>Dutdoor air por unit ficor area  | Value V                | Ì           |                                | e 18                                       |                      |                    |                    |                    |               |                    |          |
| Duidoor air po: penson served by system (induding diversity)<br>Duidoor air as a %, of deelgn primary supply air   | Vales<br>Vales         | ۹ ژ         |                                | 21 12                                      |                      |                    |                    |                    |               |                    |          |
| Debiled Calculations<br>Initial Calculations for the Rysitim as a whole  |                        |             |                                |  |                      |                    |                    |                    |               |                    |          |
| Incorned supply air now to system at constantion analysis<br>Uncorned solid. A sequitament for system  | 22                     | •           | Aps Ps - Ras As                | 172  |                      |                    |                    |                    |               |                    |          |
| Initial Calculations for individual zones  | 8                      | din di      | 1                              |  | 105                  | 200                | 0.06               | 0.06               | 0.05          | 075                | 105      |
| DA rate per person   |                        | đ           |                                |  | 500                  | 5.00               | 5.00               | 5.00               | 5.00          | 15                 | 16       |
| Total supply at to zone (at construction being analyzing)<br>Unitated OA trep'd to breakling zone  | N N                    | f 1         | Rue Pa - Read As               | 1  | 40.0<br>40.0         | 52.2               | 32.2               | 197                | 401           | 81 B               | 0.0      |
| Unused CA requirement for zone   | N N                    | 11<br>-     | VIII III                       | 1  | 45                   | 100                | 10                 | 8                  |               | g ⊑2               |          |
| Fraction of zone supply not directly redro, fram zone<br>Fraction of zone supply from fully mixed primary all  | 77                     |             | 中+(1-5)EF                      |  | 100                  | 1.00               | 1.00               | 1.00               | 120           | 100                | 1.00     |
| Fraction of zone CA not directly regim, from zone  | 12                     |             | 1-(1-Ez)(1-Ep)(1-Ep)           | ľ  | 100                  | 1.00               | 1.00               | 1.00               | 1.00          | 150                | 1.00     |
| Unused CA traction required in primary air to zone   | 55                     |             | Voz /Vpz                       | • •  | 59                   | 0.16               | 0.16               | 0.07               | 0.29          | 0.14               | 100      |
| System Ventilation Efficiency<br>Zona Ventilation Efficiency (Ago A Method)  | Eaz                    |             | (Fa + Pb(s - Pd) / Fa          | •  | 105                  | 1.00               | 1.00               | 1.09               | 0.57          | 1122               | 1.16     |
| System Ventilation Efficiency (App A Method)<br>Ventilation System Pfiniancy (Table 3.3 Method)  | 2 2                    |             | Value from Table 5 3           |  |                      |                    |                    |                    |               |                    |          |
| Minimum outdoor air Intake airflow<br>Dutdoor Air Intake Flow required to System   | N.                     | •           | You/ Ev                        | 5  | en.                  |                    |                    |                    |               |                    |          |
| DA tridewineqViso a hadron vi prinery SA<br>Dutdog Air Inteke Flow required to System (Table 53 Method)  | s ×                    | Ĵ           | You/ Yos                       |  | - w                  |                    |                    |                    |               |                    |          |
| DA Intake roof's as a fraction of primary SA (Table 63 Mathod)<br>OA Temp at which Nin OA provides all cooling   | ۲                      |             | Vot/ Vps                       | - 0.2                                      | -                    |                    |                    |                    |               |                    |          |
| DAT below which CA intake fow is @ minimum   |                        | Dag F -     | (Tp-dTs)-(1-Y)(Tr+dTd          |  | 2                    |                    |                    |                    |               |                    |          |
|  |                        |             |                                |  |                      |                    |                    |                    |               |                    |          |

| System Tag Name :<br>Consting Condition Josofistion:<br>Units (select form pul-down list)   | Barks C<br>R1U-3<br>Design<br>IP | Cooling   | Load       | ab Billding                  |  |           |                        |                      |           |                     |              |                    |
|---|----------------------------------|---|------------|------------------------------|--|-----------|------------------------|----------------------|-----------|---------------------|--------------|--------------------|
| Inputs for System<br>Ever zona oovarity ayetan<br>Population it area server by aytan (including Oversity)<br>Deep provide serve to system Weighted average<br>OA edd servers ave to system area (Weighted average)<br>Inpute for Petermiany-Centent zerver. | 광광<br>문문<br>문문                   | daniya |            | 10%, dventy                  | System<br>19945 99<br>10750<br>0.08<br>5.1 |           |                        |                      |           |                     |              |                    |
| Zons Nams   |                                  |   |            | In Freedom Instantin         |  | Lobby     | Dopy/ Fax /<br>Printer | PT Faculty<br>Office | Comtor    | Faculity<br>Offices | Faculity     | Faculty<br>Offices |
| Zone Tag  |                                  |   |            |                              |  | 1064      | 22                     | 319                  | 0301      | 320, 321 &          | 304          | 305 & 306          |
| Sinaka Mina   |                                  |   |            |                              |  | Lobbes    | This space (           | office space         | Corridors | Office space        | Office space | Office space       |
| Floor Area of zons  | A.                               | 10001   |            | down ist                     |  |           |                        |                      |           | 35                  | 130.5        | 8                  |
| Design population of z one  | P                                | -0  | dataut     | value listed; may be over    | rddan)                                     |           |                        | m                    |           |                     | t-a          | *                  |
| Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?  | 100                              | Salacit   | mpul       | down list or leave blank, if | WA   | and and a | ē                      |                      | 8         | 5                   |              | 200                |
| I need name an Autoprocession of averages of the internal<br>Incuts for Oceanting Condition Analyzed  | 4                                |   |            |                              |  | 2         | 3                      |                      |           | 2                   | 3            | 3                  |
| Percent of bital design aliflow rais at conditioned analyzed<br>Air ostnouton type at conditioned analyzed  | P                                | 2000  |            | down list                    | 102%                                       | 100%      | 100%                   | 10%                  | 100%      | 100%                | 100%         | 100%               |
| Zone air dishibution eifediv eness at conditioned analy zed<br>Primary air haction of supply air at conditioned analyzed  | 88                               |   |            |                              |  | 1.00      | 1.0                    | 1.00                 | 1.00      | 1.00                | 1.00         | 1.00               |
| Results<br>Venilation 3ystem Efficiency   | V                                |   |            |                              | 675  |           |                        |                      |           |                     |              |                    |
| Outdoor air intaka required for system  | N.                               | Î   |            |                              | 2296                                       |           |                        |                      |           |                     |              |                    |
| Outdoor all por preven served by system (including diversity)   | Valle                            | t i   |            |                              | 83   |           |                        |                      |           |                     |              |                    |
| Outdoor air as a % of design primary supply air   | ť                                | Ĵ   |            |                              | 13   |           |                        |                      |           |                     |              |                    |
| Initial Calculations for the Systemas a whole   |                                  |   |            |                              |  |           |                        |                      |           |                     |              |                    |
| UncornectedDA requirement for system  | ēi                               | 1   | ।<br>स     | os Ps + Ras As               | 1728                                       |           |                        |                      |           |                     |              |                    |
| Linovnariat cua rugidias a traction of pernary sta<br>Initial Calculations for Individual zones   | ×.                               |   | 1          | uit Wps                      |  |           |                        |                      |           |                     |              |                    |
| OA alle per unit alea for cone  | ΞĨ                               |   |            |                              |  | 0.05      |                        | 800                  | 0.06      | 0.06                | 006          | 1005               |
| Total supply air to zone (at condition being analyzed)  | A.                               | Ť.  | ,          |                              |  | SHO       | : 10                   | 120                  | 290       | 360                 | 110          | 120                |
| Unused CA requirement for zone  | A 3                              | •   | • •<br>54  |                              |  | •         |                        | 30                   |           | 5 S                 | 18           | 36                 |
| Fradion of cone supply not directly reade. from zone  | 727                              |   | •<br>•#7   | )+(1-Ep)Er                   |  | 1.00      | 10                     | 1.00                 | 1.8       | 1.0                 |              | 1.00               |
| Fraction of cone GA not dreatly redire, from zone   | 77                               |   | 1 1<br>2 4 | (1-E2(1-E2)(1-E))            |  | 1.00      | 5                      | 1.00                 | 1.00      | 1.00                | 8            | 1.00               |
| Unuted CA traction required in supply air to z one  | N                                |   | -          | sz /Wdz                      |  | 0.00      | 2                      | 0.36                 | 0.00      | 0.14                | 0.16         | 0.11               |
| Unused CA traction required in primary air to zone  | Zp                               |   | -          | at / Vipe                    |  | 0.00      | 0.00                   | 0.25                 | 0.00      | 0.14                | 0.16         | 0.11               |
| System Ventilation Efficiency (App & Mathod)<br>Zony Ventilation Efficiency (App & Mathod)  | Eve                              |   | D          | a + FBKs - FGZ) / Fa         |  | 1.16      | 1.15                   | 0.91                 | 1.16      | 1.02                | 0.99         | 1.05               |
| System Vartilation Ethciancy (App A Method)   | V                                |   |            | n (Bvz)                      |  |           |                        |                      |           |                     |              |                    |
| Venimun outdoor air Intaka airflov  | 2                                |   | 1          |                              | 5  |           |                        |                      |           |                     |              |                    |
| Outdoor Air Intaka Flow required to System<br>OA Intaka racid as a fraction of primary SA   | < d<br>d                         | Î   | **         |                              | 12106                                      |           |                        |                      |           |                     |              |                    |
| Outborr Air Intaks Row required to System (Table 6.3 Method)  | ď                                | Î   | 1          | W/Br                         |  |           |                        |                      |           |                     |              |                    |
| CA Temp at which Min OA provides all cooling  | 1                                |   | 1          |                              |  |           |                        |                      |           |                     |              |                    |
| OAT holes which "A letiko few is @ ninimum  |                                  | Deg F   | -          | D-STREAT ALL AND A STREAT A  |  |           |                        |                      |           |                     |              |                    |

| Q  | OA Tamp at w                       | 8  | 21  |   | Minimum outs           | 14   | 200  | Zon Zon                                  |   |   |  | 1   | 2  | 21  |                              |                                | Trit   | Q               | Q                           | Initial Calculat          |  |                                    | Pin  | Initia Calculat                  | Dotalod Cake | 9  | 2   | 8                          | g   | Van                          | Post in a   |   | Zon   | Alto                                      | Pan   | Inputs for Ope            | 6   | Ind   |  |                        | Floo            | -           | 1                  | Zon    |      | Zon       |             | Inputs for Pet          | 21   |   | Pap   | MI                      | Inputs for Bys | Units (sole of t     | Operating Con        | NOW WASKE |  |
|--|------------------------------------|--|---|---|------------------------|--|--|--|---|---|--|---|--|---|------------------------------|--------------------------------|--|-----------------|-----------------------------|---------------------------|--|------------------------------------|--|----------------------------------|--------------|--|---|----------------------------|---|------------------------------|---|---|---|---|---|---------------------------|---|---|--|------------------------|-----------------|-------------|--------------------|--------|------|-----------|-------------|-------------------------|--|---|---|-------------------------|----------------|----------------------|----------------------|-----------|--|
| IT below which CA listaxe fow s @ maimum | which Win OA provides all coviling | Intakeredid as a fraction of primary SA (Table 6.3 Method) | tobor Air Intako Flow required to System (Table 6.3 Method) | ideological and the first of the first of the second | door ar intaks airflow | ntistini System Etistenny (Talia 6 3 Method) | stem Vintilation Efficiency (Apr A Method) | ne Ventilation Efficiency (App A Mothod) | used UA traction required in primary at to zona | used On tradition provided in support white provide | TOTAL A TANK ON THE TANK AND A TANK AND | and a second state of the | which it some supply from high mixed missory sin | ction of zone supply net directly regire, from zone | used CA requirement for mine | used CA read to breathing zone | tal supply air to zone (at condition heing analyzed) | rate per person | rate per unit area for sone | tions br individual zones | corrected OA regid as a fraction of primary SA | DOMEGRACIA REQUIREMENTS FOR SISSEM | may sipply allflow to system it conditioned analyzed | ntions for the System as a whole | ulations     | roor ar as a % or oesgn prinary suppy an | topor at per person served by system including diversity) | toor at par unit foor area | marking includes the process of the process | riflation By stam Efficiency | THE WE I HAVE A PRACT OF THE AT A VALUE AND A THE AT AN A PRACT | man at inaction of success air a conditioned analyzed | ne air detribution offied veness at conditioned analy zed | distribution type at conditioned analyzed | mant of total design airline rate at conditionad analyzed | enting Condition Analyzed | cal necto, air % representative of ave system nitum air | luction Terminal Unit, Dual FanDual Duct or Transfer Fan? | sign total supply to zona (primary plus local natioulated) | NUO ZIO NOTZIO NOTZION | or Area of zone | and for any |                    | na Tag |      | na Nama   |             | antially Critical zones | red ber person for system area. (Weighted everage) | and which a state of the state | putation of area served by system (including diversity) | or anas saworthy system |                | from pull-down list) | ndition Description: | NATIO:    |  |
|  |                                    | 1  | a '   | 19  | i                      | 2  | V  | Evz                                      | cþ  | 7 2   | 12   | 7 8   | 7  | 7   |                              | Ā                              | Ş.   | R               | 刀刷                          |                           | ×  | 0                                  | 2  |                                  | l            | Ĩ  | 00175   | VolVes                     | ģ   | 2                            | ł   | 6   | Y   |   | 2   |                           | Ψ   |   |  | 1                      | A.              |             |                    |        |      |           |             | 1                       | in a   |   | 7   | a.                      | Name           | p                    | Design               | RIN'S V   |  |
| - Ben                                    |                                    |  | 8   | 8   | ł                      |  |  |  |   |   |  |   |  |   | ł                            | ł                              | •  | ł               | din si                      |                           |  | 8                                  | ł  |                                  | l            | 1  | 3   |                            | 8   |                              |   |   |   | Salacth                                   | ۴   |                           |   | Salacth   | 3  | ٦                      | 51              | Salactho    |                    |        |      |           |             |                         | Ĵ  | 1   | 7   | 4                       | Units          |                      | Cooling I            | 1001000   |  |
| -  |                                    |  |   |   | f                      | - 18   | 31   | 2  | - 102   |   | -  | 1   | 5 4  |   |                              | इ                              |  |                 |                             |                           |  | -<br>7                             | - Vpd  |                                  | l            |  |   |                            |   |                              |   |   |   | om pul-d                                  |   |                           |   | p-Ind up  |  | A Inteled              |                 | p-Ind uuc   |                    |        |      |           |             |                         |  |   | Г   | 1                       |                |                      | Load                 |           |  |
| Utilitie                                 |                                    | VIII I   | 2   |   | 2                      | in from T                                    | (Ba  | + FbXs-                                  | MAL   |   | 11/1-0   |   |  |   | 1                            | Pr - Re                        |  |                 |                             |                           |  |                                    | 0  |                                  | l            |  |   |                            |   |                              |   |   |   | own ist                                   |   |                           |   | own ist o   |  | GISI BUE               |                 | own ist     |                    |        |      |           |             |                         |  |   | 100% d  |                         |                |                      |                      | D DUNI    |  |
| D+11/17                                  |                                    |  |   |   |                        | ante a se                                    |  | Fei)/ Fa                                 |   |   | Ana-Me   |   |  |   |                              |                                |  |                 |                             |                           |  | SAS .                              |  |                                  | l            |  |   |                            |   |                              |   |   |   |   |   |                           |   | r lowa bi   |  | o; nay bo              |                 |             |                    |        |      |           |             |                         |  |   | venty   |                         |                |                      |                      | 2         |  |
|  |                                    | •  |   |   |                        | ŝ  | •  |  | •   | •   | •  | •   |  |   |                              | •                              |  |                 |                             |                           | •  | •                                  | •  |                                  | l            |  |   |                            |   |                              |   |   |   | 1   |   | 1                         |   | ank II N/A  |  | 00mevo                 |                 |             |                    |        |      |           |             | Г                       | Т  | Т   | Т   | -                       |                |                      |                      |           |  |
| 4  |                                    | 21   | 2   | 2290  |                        | 075  | 075  |  |   |   |  |   |  |   |                              |                                |  |                 |                             |                           | 0.16   | 1/28                               | 11002  |                                  | l            | 215                                      | 13.0  | 0.17                       | 1225  | 0.75                         |   | _   | _   |   | 10290   |                           |   |   |  | ā                      |                 |             | ~                  |        | _    |           | _           |                         | 2  | 10,750  | 176   | 1245                    | metal          |                      |                      |           |  |
|  |                                    |  |   |   |                        |  |  | 0.81                                     | er.n  | 0.00  | T.L.   |   | 8  |   | 1                            | 417                            | 190  | 5.00            | 0.05                        |                           |  |                                    |  |                                  |              |  |   |                            |   |                              |   |   | 1.00  | CS  | 1004  |                           | 3   |   | 120  | ø                      | 195.75          | gating      | Dominia mostrini O | -      | 917  |           | Continance  |                         |  |   |   |                         |                |                      |                      |           |  |
|  |                                    |  |   |   |                        |  |  | 0.75                                     | 0.40  |   |  | i i   | ŝ  | i i   | 6                            | 40.4                           | 5  | 50              | 20.0                        |                           |  |                                    |  |                                  |              |  |   |                            |   |                              |   | i   | i   | 8   | 100%  |                           | 19  |   | 18   | æ                      | 174             |             | Office apace O     | -      | 5    | Office    | PT Faculity |                         |  |   |   |                         |                |                      |                      |           |  |
|  |                                    |  |   |   |                        |  |  | 650                                      | 0.16  |   |  | 4 00  | 10   | 1.00  | \$                           | 181                            | ;;   | 5.00            | 90.0                        |                           |  |                                    |  |                                  |              |  |   |                            |   |                              |   |   | 1.00  | 8   | 100%  |                           | 75%   |   | 1.5  | 2                      | 541             |             | other abace o      | 000    | 802  | Office    | Feculity    |                         |  |   |   |                         |                |                      |                      |           |  |
|  |                                    |  |   |   |                        |  |  | 0.82                                     | MCD.  |   |  |   | 8  |   | -                            | 409                            | 190  | 5.00            | 0.06                        |                           |  |                                    |  |                                  |              |  |   |                            |   |                              |   |   | 1.00  | CS  | 1074  |                           | 191   |   | 120  | σ                      | 182.25          | eating      | ontennoe/m         |        | 244A |           | Conference  |                         |  |   |   |                         |                |                      |                      |           |  |
|  |                                    |  |   |   |                        |  |  | 104                                      | 200   |   | Duri I   |   | 8  | 5   | 10                           | 119                            | 5  | 500             | 90.0                        |                           |  |                                    |  |                                  |              |  |   |                            |   |                              |   |   | 100   | CS  | 100%  |                           |   |   | 081  | N                      | 141.5           |             | Office apage       | 2010   | ALIA | Assistant | Admin       |                         |  |   |   |                         |                |                      |                      |           |  |
|  |                                    |  |   |   |                        |  |  | 101                                      | 05  |   | -  | -   | 3  | 8   | 2                            | 8.7                            | 5  | 500             | 66                          |                           |  |                                    |  |                                  |              |  |   |                            |   |                              |   |   | 100   | CS  | 100%  |                           | 2   |   | 40   |                        | 528             |             | Office space       | 0 100  |      | Office    | Changellors |                         |  |   |   |                         |                |                      |                      |           |  |
|  |                                    |  |   |   |                        |  |  | 1.94                                     | 121   |   |  |   |  |   | 1                            | 47.1                           | 200  | 500             | 1.05                        |                           |  |                                    |  |                                  |              |  |   |                            |   |                              |   |   | :00   | 8   | 10092   |                           | 1   |   | 220  | o                      | 367.5           | aneas       | Te ca ption        | 2      | 202  |           | Reception   | Folds                   |  |   |   |                         |                |                      |                      |           |  |

| Pailding.  | Ponts (              | Issunor   | m and 1 ah Ruildinn                                |                  |                     |                     |                     |                                 |             |                      |         |
|--|----------------------|-----------|--|------------------|---------------------|---------------------|---------------------|---------------------------------|-------------|----------------------|---------|
| System Tag Name :<br>Ope reting Condition Description.<br>Usits (select from pull-down list)   | RTU3<br>Design<br>IP | Ooding    | Lovd   |                  |                     |                     |                     |                                 |             |                      |         |
| injuns tot system<br>Floor area served by system   | As Name              | st unts   | 1000   | 1334E.3          |                     |                     |                     |                                 |             |                      |         |
| Population of use several by system (including diventity)<br>Design primal supply that an after rate<br>CA reach per unit arealtor system (Weighted average)<br>CA reach per prevent the system area. (Weighted average)<br>https://doc.org/ | Par and Para         |           | Aprile ap 1900.                                    | 10,150<br>10,150 | Titaly Critical Zor | *5                  |                     |                                 |             |                      |         |
| Zona Nama  | Zone II              |           | worke Marke for contenal zonae(s)                  |                  | Centerance          | Faculty<br>Officers | Faculty<br>Officers | Faculty                         | Comfoor     | Computer<br>Wurknaum | Storage |
| Zone Tag   |                      |           |  |                  | 311                 | 315 316 & 3         | 10, 312 &<br>314    | 300                             | 0301        | 200A                 | 210A    |
| Space kpps   |                      | Solar to  | nmpullutinan liet                                  |                  | Contain a mailing ( | D eseds equit       | o esta co           | eoeds south                     | Comidons    | Computer lab         | Storige |
| Floor Area of zone   | Az                   | 1 11      |  |                  | 243                 | 351                 | 35                  | 148.5                           | 993         | 133,125              | 258.75  |
| Design total supply to zone (primary plus local rectrouisted)  |                      | 1         | (default value listed; may be over                 | ndden)           | 200 6               | 800                 | 6                   | 1<br>1<br>1<br>1<br>1<br>1<br>1 | 80.         | 150 2                | 220     |
| Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?<br>Local racin. at % recessoriative of ave system roturn air  | ų                    | Salad In  | ompuli-down list or leave blank, if                | WA               |                     | 22                  | 1921                | 192                             |             | 194                  | 192     |
| Incuss 101.009.09100, CONDISION ANALY280   | 2                    | ٩         |  | 1000             | 1000                |                     | ine i               |                                 | 1000        | time                 | 1002    |
| Air distribution type at conditioned analyzed<br>Zone air distribution affortiveness at conditioned analyzed   | W 1                  | Salact to | ompuli-down list                                   |                  | 500                 | 58<br>88            | ŝs                  | 8 G                             | :<br>:<br>: | 100                  | 100     |
| Primar air tradion of supply air al conditioned analyzed   | Ð                    |           |  |                  |                     |                     |                     |                                 |             |                      |         |
| Ventilation By dam Efficiency  | EV                   |           |  | 075              |                     |                     |                     |                                 |             |                      |         |
| Outdoor air intaka required for system   | Va                   | 1         |  | 226              |                     |                     |                     |                                 |             |                      |         |
| Outdoor air per una seor urea<br>Outdoor air per person servedby system (including dhensity)   | VolPs                | Ĵ         |  | 12.5             |                     |                     |                     |                                 |             |                      |         |
| Outdoor air as a %, of design primary supply air   | Ŕ                    | ł         |  | 219              |                     |                     |                     |                                 |             |                      |         |
| oktalied Calculations<br>Initial Calculations for the System as a whole  |                      |           |  |                  |                     |                     |                     |                                 |             |                      |         |
| inningi suppy an now a system at considering analysis.<br>UnconsidedDA requirement for system  |                      | 8         | <ul> <li>Pps Ps + Ras As</li> </ul>                | 1728             |                     |                     |                     |                                 |             |                      |         |
| Uncorrected CA regid as a traction of primary 3A<br>Initial Calculations for Individual zones  | Xe                   |           | - Vou/Vpe  |                  |                     |                     |                     |                                 |             |                      |         |
| OA rate per unit area for zone   |                      | ł         |  |                  | 30.0                | 306                 | 30.0                | 0.06                            | 0.06        | 0.12                 | 0.12    |
| Total supply at to zone (at condition tailing analyzed)  | N.                   | i i       |  |                  | 200                 | 360                 | 8                   | ŝ                               | 290         | 150                  | 12      |
| Unused CA requirement for zone   |                      | <b>-</b>  | <ul> <li>Hpz Pz + Hac Az</li> <li>VbpFz</li> </ul> |                  | 45                  | 513                 | 5                   | 189                             | 500         | 38 A                 | 31.1    |
| Fraction of zone supply not directly redro, from zone  | 27                   |           | · 中+1-42m  | Ì                | 1.00                | 1.00                | 1.00                | 1.00                            | 1.00        | 1.00                 | 1.00    |
| Fraction of zone suboy from twy most primary air<br>Fraction of zone CA not directly redire from zone  | 23                   |           | <ul> <li>1-(1-02)(1-09)(1-09)</li> </ul>           |                  | 1.00                | 1.00                | 1.00                | 1.00                            | 1.00        | 1.00                 | 1.00    |
| Unused OA fraction required is supply air to z ena   | 2                    |           | - Voz Ndz  |                  | 0.22                | 0.14                | 014                 |                                 | 0.21        | 0.26                 | 14      |
| System Vantilation Efficiency  | ×p                   |           | adau zoa   | Ì                | 2010                | 41.14               | 41.W                | 1110                            | 1.00        | -110                 | -10     |
| Zone Ventilation Efficiency (App A Method)   | Evz                  |           | <ul> <li>(Fa + PbKs - PcZ) / Fa</li> </ul>         |                  | 0.93                | 1.02                | 1.02                | 1.04                            | 0.95        | 0.90                 | 1.02    |
| oyseen vulleader Situation y (444 A sector)<br>Vantilation By stem Efficiency (Fable 63 Mathod)  | Q 9                  |           | <ul> <li>Value from Table 6.3</li> </ul>           | 25               |                     |                     |                     |                                 |             |                      |         |
| Minimumoutdoor air intaka aintow<br>Outdoor Air Intaka Row required to System  | Vat                  | ł         | - Vou/Ev   |                  |                     |                     |                     |                                 |             |                      |         |
| OA Intaka raq'é as a fraction d' primair SA  | 1                    | ł         | <ul> <li>Vot/ Vps</li> </ul>                       |                  |                     |                     |                     |                                 |             |                      |         |
| CA Intake rapid as a fraction of primary SA (Table 6.3 Method)   | 1                    |           | <ul> <li>Vot/ Vps</li> </ul>                       | 5                |                     |                     |                     |                                 |             |                      |         |
| OA Tempat which Min GA provides allocoling<br>OAT been which GA telefor live to @retrienum   |                      | Dag F     | <ul> <li>{(Tp-dTaf) (5-Y)/(Tr+dTr)</li> </ul>      |                  |                     |                     |                     |                                 |             |                      |         |
|  |                      |           |  |                  |                     |                     |                     |                                 |             |                      |         |

| System Tag Name:<br>System Tag Name:<br>Cap wing Condition Description.<br>Units (see from pull-down list)   | Bents (<br>RTU-3<br>Design<br>IP   | Ocoling                                 | h and La   | ib Building                      |  |                    |              |                    |                     |                    |                    |                   |
|--|--|---|------------|----------------------------------|--|--------------------|--------------|--------------------|---------------------|--------------------|--------------------|-------------------|
| Inputs for System<br>Foor stats sowned by system<br>Projections of the second by system<br>Design orders supply that and source of<br>Design orders supply that and source of<br>Design of the weather sections area. (Weighted second<br>DA red() per parameter system area. (Weighted second<br>DA red() per parameter system area. (Weighted second<br>DA red) per parameter system area. (Weighted second<br>DA red) per parameter second second | Name<br>A S<br>A S<br>A S<br>A S<br>A S<br>A S<br>A S<br>A S<br>A S<br>A S | dm<br>dm<br>dm<br>dm<br>dm<br>dm        |            | Var an 1000                      | System<br>13345.3<br>10,75<br>10,75<br>5 |                    |              |                    |                     |                    |                    |                   |
| Zone Name  |  |   |            | o for collinat meaning           |  | Admin<br>Assistant | Office       | Faculty<br>Offices | Faculity<br>Offices | Faculty<br>Offices | Faculty<br>Offices | Faculty<br>Office |
| Zona Tag   |  |   |            |                                  |  | 2108               | 210          | 211, 212&          | 214, 215 &          | 217,218 8          | 21, 225 &          | 220               |
| edul ecodo   |  |   |            | fragen liet                      |  | Cittoe spece       | Citico spaca | office space       | office space        | Officia space      | Office space       | office spece      |
| Floor Assa of zone   | Az   | ST COMPANY                              |            |                                  |  | 195.5              | 210          | 371.25             | 371.25              | 3712S              | 371.25             | 135               |
| Design population of zone  | P  | 1                                       | datauty    | value listed; may be over        | fiéden)                                  | 1.2                | 200          | 9                  |                     | 3                  |                    | 100               |
| Induction Terminal Unit, Dual Fan Dual Duct or Translet Fan?   |  | Sdooth                                  | anpullo    | fown list or lwave blank, if     | NA                                       |                    | -            |                    | 5                   |                    |                    |                   |
| Local racim, at % representative of ave system joium air<br>Inputs for Ocerating Condition Analyzed  | Ψ  |   |            |                                  |  | 15%                | 794          | 1991               | 791                 | 764                | 79%                | 75%               |
| Percent of total design at they rate at concitionec analyzed   | Ds   | 8                                       |            |                                  | 102                                      | 100%               | 100%         | 10%                | 100%                | 100%               | 100%               | 1003              |
| Jone all distribution offectiveness at conditioned analyzed<br>Petrova all facilities of surrey, all of surrelivened analyzed  | 7 W  |   |            |                                  |  | 1.00               | 1.00         | 1.00               | 1.00                | 100                | 1.00               | 1.00              |
| Fesults<br>Ventilaton By sam Efficience  | EV   |   |            |                                  | 07                                       |                    |              |                    |                     |                    |                    |                   |
| Outdoor air intaka required for system   | Vot  | 9                                       |            |                                  | 229                                      |                    |              |                    |                     |                    |                    |                   |
| Outdoor air per person served by spatem (including diversity)  | V di V   |   |            |                                  | :25                                      |                    |              |                    |                     |                    |                    |                   |
| Outdoor alf ass a %, of design primary supply all  | Ŕ  | 9                                       |            |                                  |  |                    |              |                    |                     |                    |                    |                   |
| Initial Calculations for the Bystem as a whole<br>Permay supply air flow to sed am a conditioned analyzed  |  | 3                                       |            | \$                               | 1100                                     | 3                  |              |                    |                     |                    |                    |                   |
| UncornactedCA requirement for system   | Vou  | ₿                                       | - 7        | s Ps + Ras As                    | - 172                                    | 1 85               |              |                    |                     |                    |                    |                   |
| Initial Calculations for Individual zones  | 2  |   |            | and a loss                       |  | c                  |              |                    |                     |                    |                    |                   |
| OA rateper unit areafor zone<br>OA rateper person  |  | olan olan olan olan olan olan olan olan |            |                                  |  | 5.00               | 5.00         | 5.00               | 5.00                | 5100               | 5.00               | 5.00              |
| Total supply at to zone (at condition being analyced)  | i i  | 8                                       |            |                                  |  | 220                | 300          | 33                 | 330                 | 1                  | 330                | 120               |
| Unused CA requirement for cone   | R I  | 8                                       | i i<br>≨i  |                                  |  | 12                 | ± 1          | 53                 | KS L                | KS Å               | 13                 | 18                |
| Fraction of more supply and directly racion from more  | 7 27   |   | ,<br>, , , | + (1-Fp)Fr                       | 1  | 100                | 55           |                    | 33                  |                    |                    |                   |
| Fraction of zone outpay more twy moved pressery an   | 7 2  |   | <br>       | 1_Ez)(1_Eo)(1_En)                |  | 100                | 1            |                    |                     | 1                  | 88                 | 1.0               |
| Unused CA fraction required in supply air to zone  | Zd   |   | 11         | z/Wdt                            |  | 0.10               | 0.12         | 1.16               | 0.16                | 0.12               | 0.16               | 0.15              |
| Unused CA traction required in primary all to zone   | Zp   |   | - 10       | z/Vpz                            | Ì  | 0.10               | 0.12         | 1.16               | 0.16                | 0.12               | 0.16               | 0.15              |
| Zone Vertilation Efficiency (App A Vertiloc)   | Evz  |   | 7          | 1+ PbKs- PdZ) / Fa               |  | 1.05               | 1.03         | 1.00               | 1.00                | 113                | 1.00               | 1.0               |
| System Ventilation Efficiency (App A Method)<br>Ventilation By stem Efficiency (Table 6.3 Method)  | 88   |   | • •<br>≦∎  | ue from Table 6.3                | 35                                       |                    |              |                    |                     |                    |                    |                   |
| Minimum outdoor air intaka airfiow<br>outdoor Air maxa Hew Required to system  | VQ   | 8                                       | 1          | U/ EV                            |  | •                  |              |                    |                     |                    |                    |                   |
| OA Intaka req16 as a hadion of primary SA  | 4  | ł                                       |            | 1/ Vpa                           | 10                                       | . =                |              |                    |                     |                    |                    |                   |
| OA Intalia radio as a haction of primary SA (Table 6.3 Method)   | × 8  | 8                                       | • •<br>≤ • | 1/ Vbs                           | <br>64                                   | - <b>-</b> x       |              |                    |                     |                    |                    |                   |
| OA Temp at which Min OA provides all cooling   |  |   | 5          | NATES & WITCH                    |  | Þ                  |              |                    |                     |                    |                    |                   |
| titettiin 🖉 m annannin Les Innin annan 1140  | l  |   | 1          | the second for the second second | ľ  |                    |              |                    |                     |                    |                    |                   |

| System Tag Name :<br>Operating Condition Description :<br>Units (select from put-oown list)  | RTU-3<br>Design       | Claesroom and Lab Building<br>n Cooling Load  |   |   |                       |              |                     |            |              |                    |
|--|-----------------------|---|---|---|-----------------------|--------------|---------------------|------------|--------------|--------------------|
| Inputs for System<br>Filter and served by system<br>Projulation of ana served by yistem (including diversity)<br>Design promovy supply an aution rate<br>CA read pair serves the system (W eighted sevenge)<br>CA read pair secon to system sees. (W eighted sevenge)<br>Inputs for Preventable Critical sources   | As<br>Ps<br>Ps<br>Ras | units<br>P<br>chm<br>thy<br>thy<br>thy<br>thy<br>thy<br>thy<br>thy<br>thy<br>thy<br>thy | Crater<br>2010<br>1010<br>1010<br>1010<br>1010<br>1010<br>1010<br>101 |   |                       |              |                     |            |              |                    |
| znyousa nor in winxaary curacaar zoowa.<br>Zona Nana   |                       |   |   | mail Support  | Panulity P<br>Offices | Con<br>Con   | Parality<br>Offices | Contenents | Family       | Faculty<br>Offices |
|  | Zone t                | tio turns jumple Nafo for ontice  | (acmo(s)  | 22  | 205 205 8             | 201 & U2UZ   | 230, 232 &          | 3          | 2 462, A62   | 231. 229 &         |
| Zona Tag   |                       |   |   | ł   | 228                   | 200 B 200    | 203                 | 5          | 238          | 241                |
| State of the second sec |                       | Salad from pull-down list   |   | Dup!<br>wow,Buildiug  | Office space          | Office space | ottice apace        | ading      | Office space | Office (peak       |
| Fixor Area of zone<br>Design providion of zone   | 22                    | st<br>P (datult value liste   | : may be overridder)  | 210   | 371.25<br>6           | 2103.75      | 971.25              | 210        | 371.25       | 371.25             |
| Design total supply to zone (primary plus local rectinuiated)<br>Induction Terminal Unit, Dual Pan Dual Ductor Transfer Pan?   | Voted                 | ofm<br>Soloot from pull down list or  | lowoblank / N/A   | 10  | 330                   | 440          | 330                 | 140        | 330          | 28                 |
| Local recto, all % representative of are system rotum air  | Ψ.                    |   |   | 75  | 77                    | 100          | 793                 | 2          | 3            | 3                  |
| Incuts for Overation Condition Analyzed<br>Percent d total design sificer rate at conditioned analyzed   | 0                     | 8   | 102%  | 100%  | 109%                  | 100%         | 100%                | 10%        | 100%         | 100%               |
| Air distribution type at conditioned analyzied<br>Zone air distribution effectiv ensas at conditioned analyzed   | R                     | Select from pull-down list  |   | i co  | ន៍ន                   | 50           | :e CS               | 100        | 1.00         | i s                |
| Pesuits<br>Venilation System Ethionov  | 2                     |   | 0.75  |   |                       |              |                     |            |              |                    |
| Outdoor at initials required forsystem   | Vot                   | d and a second  | 2296  |   |                       |              |                     |            |              |                    |
| Outdoor air per person sew adby system (including diversity)   | VolPs                 | dmp   | 13.0  |   |                       |              |                     |            |              |                    |
| Othoor at as a % or design (crimary supply an  | 8                     | 9   | 205   | -   |                       |              |                     |            |              |                    |
| Detailed Cakulations<br>Initial Lacuations for the by stam as a whole  |                       |   |   |   |                       |              |                     |            |              |                    |
| Primary supply dir flow to system at conditioned analyzed<br>Uncorrected/DA requirement for system   | Ĩ                     | ofm - VpdDs<br>ofm - Res Fig. Ras   | A 11002   |   |                       |              |                     |            |              |                    |
| Uncornected OAneq'd as a traction of primary SA  | Xs                    | <ul> <li>Vou/Vps</li> </ul>   | - 0.16  |   |                       |              |                     |            |              |                    |
| OA rate per unit area for zone   | 201                   | dmys  |   | 0.12  | 605                   | 0.06         | 80.0                | 800        | 0.06         | 206                |
| OA rate per person<br>Total supply air to zone (at condition being enalyzed)   |                       | at any  |   | 110   | 500                   | 5.00         | 5.00                | ¥00        | 000          | 202                |
| Unused OA req14 to breathing cone  | ¥.                    | ofm - Rez Pz + Raz  | Az -  | 25.2  | 52.3                  | 161.2        | 52.3                | 42.6       | 52.3         | 52.5               |
| Unused GA requirement for zone<br>Fraction of zone supply not directly regire, from zone   | a A                   | ctm = Vtx/8z  | •••   | 1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1 | i s                   | 1.00         | 1.00                | ī 8 8      | .1<br>18 12  | 10 55              |
| Fraction of zone supply from fully moad primary air  | 7                     | -<br>-  | •   | 1.0   | 1.00                  | 1.00         | 1.00                | 100        | 1.8          | 1.00               |
| Eraction et zone GA not directly recirc. Itomiciona<br>L'isusad GA fraction rocultad is supply all' foir ona   | 1 7                   | - Ver /Ver  |   | 0.23  | 1.00                  | 25.0         | 1.00                | 100        | 0.16         | 1.00               |
| Usused OA traction required is primary air to zone<br>System Ventilation Efficiency  | Σp                    | <ul> <li>Voz /Voz</li> </ul>  | •   | 0.23  | C.16                  | 0.57         | 0.16                | 030        | 0.16         | 0.20               |
| Zone VertilationEfficiency (App A Method)  | Evz                   | = (Fa + PbXs - I  | 62)/Fa -  | 82.0  | 1.000                 | 0.79         | 1.00                | 085        | 1.00         | 360                |
| Oyawan wasaaban Catavanay (quju A wasavq<br>Vantilation By sticm Etholonoy (Table 6.3 Mathod)  | 22                    | <ul> <li>Value from Te</li> </ul>   | bia 63 - 0.75   |   |                       |              |                     |            |              |                    |
| Minimum outdoor at intake airflow.<br>Outdoor Air Intake Flow required to System   | Vat                   | ctm _ Vou/Ev  | - 2296  |   |                       |              |                     |            |              |                    |
| OA intake requires a fraction of primary SA  | 1                     | - Vot/ Vps  | - 0.21  |   |                       |              |                     |            |              |                    |
| OA intake reqid as a fraction of primary SA (Fable E.S Mathod)   | 1                     | - Vol/ /bs  | - 0.21  |   |                       |              |                     |            |              |                    |
| OA Tamp at which Win OA pany/ses all nonling<br>OAT below which OA latake flow is @ minimum  |                       | Dog F = {(Tp-dTst)-(1)  | 97(TridTri =9   |   |                       |              |                     |            |              |                    |
|  |                       |   |   |   |                       |              |                     |            |              |                    |

| Building:  | And the fe   | Berks                                  | Classroo                                   | m ar  | id Lab Building               |        |  | 3            |
|--|--|--|--|-------|-------------------------------|--------|--|--------------|
| System Ta  | ag Name :  | RTU-3                                  |  |       |                               |        |  |              |
| Ope rating   | Condition Description:   | Design                                 | Cooling                                    | Loa   | d                             |        |  |              |
| Units (see   | act nom pan-down risp  | IF.                                    |  |       |                               |        |  |              |
| Inputs for   | System<br>Floor area served by system<br>Population of area served by system (including diversity)<br>Design primary supply fan airflow rate<br>OA reqid per unit area for system (Weighted average)<br>OA reqid per unit area for system (Weighted average)<br>Poin triality Critical zones | Name<br>As<br>Ps<br>Vpsd<br>Ras<br>Rps | Units<br>st<br>p<br>ctm<br>ctm/st<br>ctm/p |       | 100% dversity                 |        | Bystem<br>13346.38<br>176<br>10,750<br>0.06<br>5.1 |              |
| 285  | Tone Name  |  |  |       |                               |        |  | Faculity     |
|  | 2.016 Patrix   | Zone t                                 | te turns p                                 | urph  | a Italic for critical zone(s) |        |  | Umces        |
|  | Zone Tag   |  |  |       |                               |        | [  | 240 & 243    |
| 1  | Space type   |  | Select t                                   | tom r | ull.down list                 |        |  | Office space |
|  | Floor Area of zone   | Az                                     | st   |       |                               |        |  | 249.75       |
|  | Design population of zone  | Pz                                     | P  | (def  | ault value listed; may be ov  | errido | ian)   | 4            |
|  | Design total supply to zone (primary plus local recirculated)<br>Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?  | Votrd                                  | ctm<br>Select t                            | rom ( | pull-down list or leave blank | INV    |  | 220          |
| inputs for   | Operating Condition Analyzed   | E1                                     |  | _     |                               |        |  |              |
| 0.000000   | Percent of total design airflow rate at conditioned analyzed<br>Air distribution type at conditioned analyzed  | Ds                                     | %<br>Select t                              | tom ( | oull-down list                |        | 102%   | 100%<br>CS   |
|  | Zone air distribution effectiveness at conditioned analyzed  | Ez                                     |  |       |                               |        |  | 1.00         |
|  | Primary air fraction of supply air at conditioned analyzed   | Ep                                     |  |       |                               |        |  |              |
| Results  |  |  |  |       |                               |        |  |              |
|  | Ventilation Bystem Efficiency  | EV                                     |  |       |                               |        | 0.75   |              |
|  | Outdoor air make required for system   | Vot                                    | cim/et                                     |       |                               |        | 0.17   |              |
|  | Outdoor air par bin noor anna<br>Outdoor air nor norson sorvori hy system (including diversity)  | Volles                                 | cim/n                                      |       |                               |        | 13.0   |              |
|  | Outdoor air as a % of design primary supply air  | Ypd                                    | ctm  |       |                               |        | 21%  |              |
| Detailed C   | Calculations   |  |  | _     |                               | _      |  | ().<br>      |
| Initial Cald   | culations for the System as a whole  |  |  |       |                               |        |  |              |
| 1000000000   | Primary supply air flow to system at conditioned analyzed  | Vps                                    | ctm  |       | VpdDs                         | -      | 11002  |              |
|  | UncorrectedDA requirement for system   | Vou                                    | ctm  | -     | Rps Ps + Ras As               | -      | 1728   |              |
|  | Uncorrected OA regid as a fraction of primary SA   | Xs                                     |  | -     | Vou/Vps                       | -      | 0.16   |              |
| Initial Cak  | culations for individual zones   | 200                                    | 10000                                      |       |                               |        |  | 1.000        |
|  | OA rate per unit area for zone   | Raz                                    | ctm/st                                     |       |                               |        |  | 0.05         |
|  | OA rate per person   | HIE                                    | cimp                                       |       |                               |        |  | 5.00         |
|  | Linused (A realid to breathing some  | When                                   | cim.                                       |       | Der Dr., Dar & .              |        |  | 220          |
|  | Unused OA requirement for zone   | Vor                                    | de   | -     | Vhr/Fr                        | -      |  | 35           |
|  | Fraction of zone supply not directly recirc, from zone   | Fa                                     | 100  | - 2   | ED + (1-ED/Er                 | -      |  | 1.00         |
|  | Fraction of zone supply from fully mixed primary air   | Fb                                     |  |       | ED                            | -      |  | 1.00         |
|  | Fraction of zone OA not directly recirc. from zone   | Fo                                     |  | -     | 1-(1-Ez)(1-Ep)(1-Er)          | -      |  | 1.00         |
|  | Unused CA fraction required in supply air to zone  | Zd                                     |  | -     | Voz / Vdz                     | -      |  | 0.16         |
|  | Unused CA fraction required in primary air to zone   | Zp                                     |  | -     | Voz / Vpz                     | -      |  | 0.16         |
| System Ve  | antilation Efficiency  | 200                                    |  |       | 1000                          |        |  | 100          |
| and the second sec | Zone Ventilation Efficiency (App A Method)   | Evz                                    |  | -     | (Fa + FbXs - FcZ) / Fa        | -      |  | 1.00         |
|  | System versiedon Etholency (App A Method)  | EV                                     |  | -     | Marking (EVZ.)                | -      | 0.75   |              |
| Minimum  | outdoor air intake airflow   | 2                                      |  | -     | Value nom Lable 6.3           | -      | 0.75   |              |
| and the second life  | Outdoor Air Intake Flow required to System   | Vot                                    | ctm  |       | Vou/ Ev                       | -      | 2206   |              |
|  | OA intake redid as a fraction of primary SA  | Y                                      |  | -     | Vot/ Vos                      | -      | 0.21   |              |
|  | Outdoor Air Intake Flow required to System (Table 6.3 Method)  | Vot                                    | ctm  | -     | Vou/ Ev                       | -      | 2318   |              |
| - warmen   | OA intake regid as a fraction of primary SA (Table 6.3 Method)   | Y                                      | 1000                                       | -     | Vot/ Vps                      | -      | 0.21   |              |
| OA Temp  | at which Min OA provides all cooling   |  |  |       | The second second second      |        |  |              |
| 1  | OAT below which OA Intake flow is @ minimum  |  | Deg F                                      | -     | {(Tp-dTsf)-(1-Y)*(Tr+dTrf     | -      | -9   |              |