

TECHNICAL REPORT 1

Brice Ohl

Mechanical Option

Advisor Professor Stephen Treado

Submitted 9.17.2012

*The New Offices for
RLPS Architects*

Lancaster, PA

Table of Contents	1
Executive Summary	2
Building Overview	3
Building Description	3
Mechanical System Overview	3
Occupant and Project Team	3
ASHRAE Standard 62.1 – 2007 Analysis	4
Section 5 Systems and Equipment	4
Section 6 Calculation Procedure	8
Summary	9
ASHRAE Standard 90.1 – 2007 Analysis	10
Section 5 Building Envelope	10
Section 6 Heating, Ventilation, and Air Conditioning	11
Section 7 Service Water Heater	11
Section 8 Power	11
Section 9 Lights	12
Section 10 Other Equipment	12
Summary	13
References	13
Appendix A	14
Table 1: ASHRAE 62.1 Table 5-1	14
Table 2: Minimum OA Requirements Calculations	15
Table 3: ASHRAE 62.1 Table 6-1	16
Appendix B	18
Table 1: Climate Zone Map	18
Table 2: ASHRAE Standard 90.1 Table 5.5-5	19
Table 3: Typical Wall Detail	20
Table 4: Window Area Calculations	21
Table 5: Voltage drop Calculations	21

Executive Summary

The objective of this report is to analyze the new Office Building for RLPS Architects for its compliance with ASHRAE Standard 62.1-2007 and ASHRAE Standard 90.1-2007.

The analysis of Standard 62.1 ultimately yielded compliance to sections 5 and 6. There were several sections that did not apply or were found non-compliant. However, it is the view of this report that non-compliance was determined due to lack of exact language or some items being left to the submittal or construction administration phases of the project for which not all information was available.

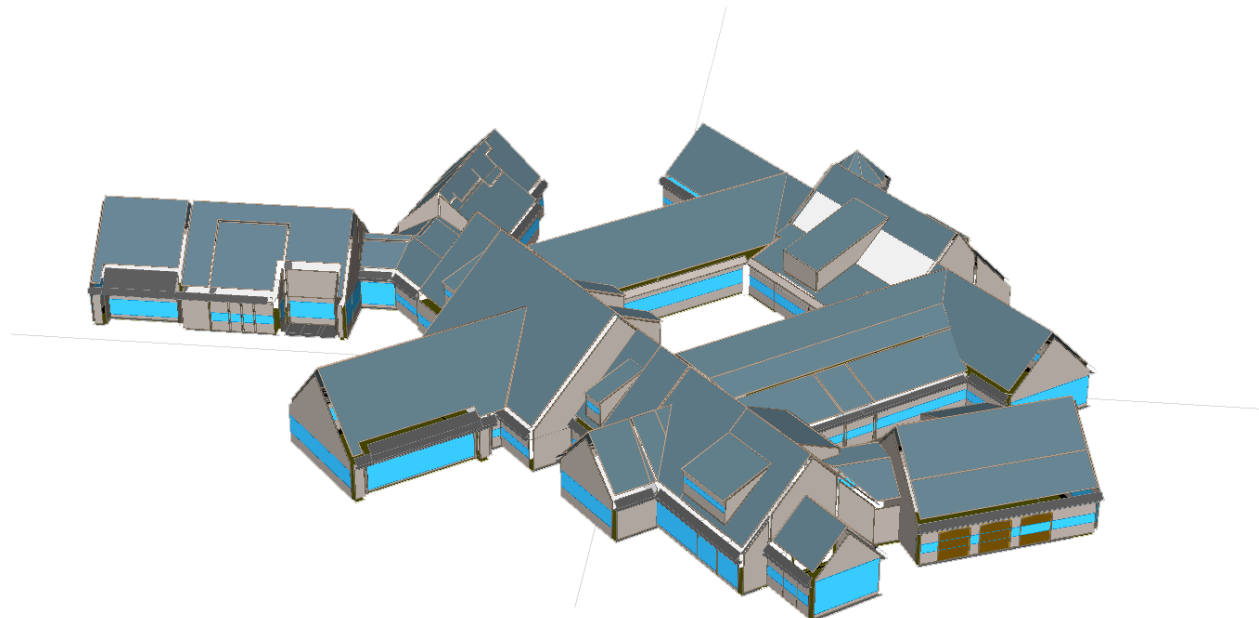
Let it be noted that all minimum ventilation rates were met for each space.

As with Standard 62.1, Standard 90.1 was found in compliance with only minor hesitation caused by some small items found noncompliant. Though a final decision has not been made, the owners wish to leave the option of LEED certification open, thus most systems are designed to current energy standards. However, some omissions do exist. For example, some terminal units do not call for required economizers. It is the belief of this report that this is a byproduct of the geothermal well system being used. Special considerations were made for the system and it is assumed an economizer option will be utilized before system unit selection/installation is complete.

In summation, the New Office Building for RLPS Architects was found compliant with ASHRAE Standards 62.1 and 90.1 with minimum reservations given the provided information to the report.

Building Overview

Building Description



The New Office Building for RLPS Architects is a new construction office building located in Lancaster County, PA. It totals 22,500 square feet which is split between one full ground level and a small mezzanine area. The use of this building is primarily office spaces, studio space, or group work areas. However there are two bistro or kitchen areas as well as an interior courtyard. Overall, the building is classified as Business and can be occupied by just short of 230 people. The expected completion date is January 2013.

Mechanical System Overview

The new office building will be utilizing a geothermal wellfield consisting of eight closed loops. A large capacity pump will feed the twenty-nine water source heat pump terminal units designed individually for each zone. Ventilation will be provided by four large ventilation units located.

Occupant and Project Team

Owner & Architects: RLPS Architects Ltd.

General Contractor: Warfel Construction

Mechanical & Electrical Engineers: Reese Engineering Inc.

Structural Engineers: Zug & Associates, Ltd. Structural Engineers.

Civil Engineers; Harbor Engineering

Surveyor: Herbert, Rowland, & Grubic, Inc.

Landscaping: RLPS Architects Ltd.

ASHRAE Standard 62.1 – 2007 Analysis

Section 5 Systems and Equipment

5.1 Natural Ventilation

There exists a number of operable windows that allow for natural ventilation. Additionally, a hybrid system was considered, but ultimately not selected. However, there are some provisions for a possible future adaptation of this hybrid system.

Section 5.1 does not apply to the new office building.

5.2 Ventilation Air Distribution

5.2.1 Designing for Air Balancing

The mechanical schedules and specifications call for balancing of all supply air diffusers. Section 23 05 93 describes the means of balancing to be used by the mechanical contractor.

5.2.2 Plenum Systems

Linear bar diffuser plenums are used in the new office building. The diffusers call for a volume damper in the mechanical schedules and the design calls for staging the size of the diffusers to maintain proper ventilation rates.

5.2.3 Documentation

Calculations were performed by the mechanical engineers for the minimum requirements of ventilation air and the design specifications reflect the calculations and procedures for testing.

The new office building is in compliance with section 5.2.

5.3 Exhaust Duct Location

Exhaust ductwork is extended above the ceiling to louver plenums. Both the duct lengths and plenums are specified for insulation and negative pressurization of -1" w.g. Compliance is to be tested to ASHRAE 90.1-2004.

The new office building is in compliance with section 5.3.

5.4 Ventilation System Controls

The new office building shall include a Building Automation System (BAS). Information is limited on the system, but it is known that carbon dioxide sensors are tied to the BAS to maintain a minimum outdoor flow rate.

The new office building is in compliance with section 5.4.

5.5 Airstream surfaces

The ductwork is composed of sheet metal and flexible tubing. Specifications in Division 23 call for compliance to ASHRAE 62.1. Submittals were unavailable for review of selected airstream surfaces.

The new office building is in compliance with section 5.5.

5.6 Outdoor Air Intakes

5.6.1 Location

The location of all of the outdoor air intakes were found compliant to ASHRAE Standard 62.1 Table 5-1.

A form of Table 5-1 can be found at Table 1 in Appendix A.

5.6.2 Rain Entrapment

Both intake and exhaust diffusers call for weather seals and drain ability. The specifications go on to describe exact installation and compliance.

5.6.3 Rain Intrusion

No outdoor mounted equipment exists.

5.6.4 Snow Entrainment

No outdoor mounted equipment exists.

5.6.5 Bird Screens

No specifications for the use of bird screens could be located nor were they in detailed drawings. Due to lack of information compliance could not be found with this section.

The new office building is not in compliance with section 5.6.

5.7 Local Capture of Contaminants

All non-combustion mechanical equipment with contaminant capture ability is isolated and the space is ducted directly outside.

The new office building is in compliance with section 5.7.

5.8 Combustion Air

No fuel burning appliances exist in the new office building.

Section 5.8 does not apply to the new office building.

5.9 Particulate Matter Removal

Section 23 81 146 of the Division 23 specifications calls for all water source heat pumps to comply with ASHRAE 62.1 Section 5. Additionally, sizes and efficiencies of pre-filters and secondary filters are specified. However, no MERV 6 or higher filters were explicitly named in the detailed drawings or specifications. Due to lack on information the new office building does not comply with this section.

The new office building is not in compliance with section 5.9.

5.10 Dehumidification System

5.10.1 Relative Humidity

The Water Source Heat Pump terminal units are set to control the humidity in accordance with the %65 relative humidity.

5.10.2 Exfiltration

The minimum outdoor air intake is set higher than the maximum exhaust flow rate for all spaces except for the zone neutral or negatively pressurized. However, the building's net intake is higher than its net exhaust.

The new office building is in compliance with section 5.10.

5.11 Drain Pans

The detailed drawings call for drain pans/traps to be installed to the manufacturer's decree.

5.12 Finned-Tube coils and Heat Exchangers

5.12.1 Drain Pans

All Water Source Heat pumps that can produce condensate are scheduled for a condensate drain trap and condensate overflow switches to the manufacturers standard.

5.12.2 Finned-Tube Coils and Heat Exchangers

Fin tubed coils in series do not exist in the new office building.

The new office building is in compliance with section 5.12.

5.13 Humidifiers and Water-Spray Systems

The new office building does not employ water-spray systems.

Section 5.13 does not apply to the new office building.

5.14 Access for Inspection, Cleaning, and Maintenance

5.14.1 Equipment Clearance

Current layout for the ventilation system suggests clearances are adequate for inspection and maintenance.

5.14.2 Ventilation Equipment

Access doors have been specified to the manufacturers' design of the equipment. The submitted equipment data is lacking.

5.14.3 Air Distribution System

Most all duct work and plenum spaces are above an acoustical ceiling or exposed allowing for ease of maintenance and inspection. The below grade ductwork was engineered to not need the maintenance of standard ductwork.

The new office building is in compliance with section 5.14.

5.15 Building Envelope and Interior Surfaces

5.15.1 Building Envelope

The exterior building envelope calls for a typical metal lath on rain screen with control joints and weep holes for condensation that may occur within the envelope. Additionally, penetrations are required to be sealed to different standards or manufacturer's specifications.

5.15.2 Condensation on Interior Surfaces

Proper installation of insulation of all HVAC pipes including those at risk of causing condensation is specified in 23 07 03. Several options of insulating barriers are afforded to the contractor to be submitted.

The new office building is in compliance with section 5.15.

5.16 Buildings with Attached Parking Garages

There are no attached parking garages to the new office building.

Section 5.16 does not apply to the new office building.

5.17 Re-designation

All of the studio, office, and work spaces are classified as Air Class 1 and therefore can be recirculated freely. The spaces of lesser air classes (Bistro, restrooms) are appropriately pressurized, exhausted, and ducted to not recirculate with the surrounding spaces.

The new office building is in compliance with section 5.17.

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

RLPS Architects (owner) are contemplating a LEED certification for the new office building and will arrange for a smoke free office building.

Section 5.18 does not apply to the new office building.

Section 6 Calculation Procedure

Section 6 of ASHRAE 62.1 is the outline of the procedure for calculating the minimum outdoor air rates in a space by space analysis. The first major obstacle is calculating the breathing zone outdoor airflow which is calculated as follows:

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

Where:

V_{bz} is the breathing zone outdoor airflow.

R_p is the outdoor airflow rate required per person as defined by Table 6-1 from ASHRAE 62.1-2007.

P_z is the zone population or expected highest occupancy in the zone.

R_a is the outdoor airflow rate required per unit area as defined by Table 6-1 from ASHRAE 62.1-2007

A_z is the zone floor area.

The next obstacle is the calculation of the zone outdoor airflow (V_{oz}). The equation for calculation is as follows:

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

The values for P_z , A_z , and E_z were provided by the mechanical engineer. The values for R_p and R_a were derived from Table 6-1.

Table 2 in Appendix A shows the calculations as well as a comparison to the outdoor airflow rate to be provided to each zone from its terminal unit. You will find that all analyzed met or exceeded the minimum outdoor air flow rate. Let it be noted that some spaces were omitted as they were marked for future expansion or design data was incomplete at the time.

Additional tables in Appendix A will provide background information used as a basis for the calculations.

Summary

The analysis of ASHRAE 62.1-2007 would show that the New Offices for RLPS Architects was adequately designed by its systems and equipment as well as its ventilation rates. Though this report reflects some non-compliance for a number of sections it is believed that this is due to a lack of specific language or the developing nature of this under construction building. For example, Section 5.9 was found not in compliance due to the exact calling for a MERV 6 or higher filter to be missing. Several instances of a non-specific filter were called for as well as compliance with ASHRAE standards and manufacturer's standards. It is thought that this section will be in compliance after the submittal process and construction administration is complete. With that in mind for this instances and several others, let this report reflect compliance with ASHRAE 62.1-2007 Sections 5 and 6.

ASHRAE Standard 90.1 – 2007 Analysis

Before this analysis begins let it be noted that some subsections do not apply to the new office building and have been omitted.

Section 5 Building Envelope

5.1.4 Climate

The new office building is located in Lancaster, PA which places it in climate zone 5a. Table 1 displays the climate map and the new office location.

5.2 Compliance Path

Compliance to this section is conditional on meeting the requirements of sections 5.4, 5.7, 5.8. Additionally, requirements in either section 5.5 or 5.6 shall be met.

5.4 Mandatory Provisions

Table 3 of Appendix B is a detailed wall construction typical of the new office building. It is a good example to show what sealant components are called for in most fenestrations. Additional detail drawings call for the proper installation and sealing of all fenestrations. Furthermore, specification divisions 23 and 26 have sections calling for the proper sealing of mechanical and electrical wall penetrations.

5.5 Prescriptive Building Envelope Option

The primary concerns of this section are the minimum provided insulation for roofs, walls, and floors as well as the percent vertical glazing. Table 3 in Appendix B is a typical wall section which confirms the minimum insulation requirements set by ASHRAE 90.1 Table 5.5-5. Table 2 in Appendix B highlights the requirements for the new office building.

Calculations were also performed to confirm that the area of glazing was in appropriate proportions defined by ASHARE Standard 90.1 Table 5.5-5. Table 4 shows these calculations with data derived from an energy model provided by the project engineer.

Currently, the average wall U-values are higher than the maximum prescribed, but the vertical glazing is within prescribed amounts.

5.7 Submittals

Local code authority has approved the provided design documents and construction is underway.

5.8 Product Information and Installation Requirements

Current designs and specification documents meet the subsections of 5.8. Notably the identification of equipment and the proper installation of insulation in various configurations.

Section 6 Heating, Ventilating, and Air Conditioning

6.2 Compliance Path

Compliance to section 6 is conditional on meeting the requirements of sections 6.4. Additionally, requirements in either section 6.3 or 6.4 shall be met.

6.3 Simplified Approach Option for HVAC Systems

6.3.2.b All packed terminal heat pumps exceed the required 12.3 EER for new construction found in Table 6.8.1D in ASHRAE 90.1-2007.

6.3.2.c Per Table 6.5.1 of ASHRAE 90.1-2007 economizers are required in climate zone 5a for minimum capacities of 135,000 BTU/hr. The currently selected heat pumps are not scheduled for economizers, nor do the specifications require them.

The new office building is not in compliance with section 6 of ASHRAE 90.1-2007.

Section 7 Service Water Heating

7.2 Compliance Path

Compliance to section 7 is conditional on meeting the requirements of sections 7.4, 7.5, 7.7, 7.8.

7.4 Mandatory Provisions

Division 22 specifications call for all necessary equipment and accessories. Additionally, load calculations were performed by the mechanical engineers and appear to be in check.

7.7 Submittals

The submittal process and local authority approval are well underway, but not completed at the time information was gathered.

7.8 Product Information

Scheduled equipment complies with the performance requirements set by Table 7.8 of ASHRAE 90.1-2007.

The new office building is in compliance with section 7 of ASHRAE 90.1-2007.

Section 8 Power

8.2 Compliance Path

Compliance to section 8 is conditional on meeting the requirements of sections 8.4 and 8.7.

8.4 Mandatory Provisions

Design document indicate that 1.67% is the greatest voltage drop for a feeder design load. This is within the 2% prescribed by ASHRAE 90.1-2007.

A table of calculations was provided by the project engineer. An excerpt can be found on Table 3 in Appendix B.

8.7 Submittals

Requirements for as-built drawings and further documentation are in Division 26 Specifications.

The new office building is in compliance with section 8 of ASHRAE 90.1-2007.

Section 9 Lighting

9.2 Compliance Path

Compliance to section 9 is conditional on meeting the requirements of sections 9.4 and 9.5 or 9.6.

9.4 Mandatory Provisions

Section 26 09 23 of the specifications calls for the use of indoor occupancy sensors and time switches. Further division 26 specifications call for compliance to remaining subsections.

9.6 Alternate Compliance Path: Space-by-Space Method

The design engineers performed a Comcheck and were found in compliance for interior lighting and power calculations. Comcheck uses a space by space calculation method.

The new office building is in compliance with section 9 of ASHRAE 90.1-2007.

Section 10 Other Equipment

10.2 Compliance Path

Compliance to section 10 is conditional on meeting the requirements of sections 10.4 and 10.8

10.4 Mandatory Provisions

Compliance with the Energy Policy Act of 1992 could not be confirmed.

10.8 Product Information

Minimum nominal full load efficiency could not be confirmed.

The new office building is not in compliance with section 10 of ASHRAE 90.1-2007.

Summary

As it was with ASHRAE 62.1-2007 this report reflects that there is some noncompliance with ASHRAE 90.1-2007. However, it is believed that these issues were due to lack of documentations, the nature of the under construction building, and some cases of exemption. For example, the water source heat pumps did not call for economizers which caused non-compliance with section 6. It is believed that this may be a non-issue due to manufactures only making models with economizers or an exemption may have been made due to the use of a geothermal well. Let it be noted that Comcheck reports were run and the new office building was found in compliance with local regulations.

References

Reese Engineering Inc. "Electrical Construction Documents". State College, PA.

Reese Engineering Inc. "Mechanical Construction Documents". State College, PA.

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

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

Appendix A

Table 1

ASHRAE 62.1 Table 5-1, used to confirm minimum separation distance of air intake locations from possible contamination sources.

TABLE 5-1 Air Intake Minimum Separation Distance

Object	Minimum Distance, ft (m)
Significantly contaminated exhaust (Note 1)	15 (5)
Noxious or dangerous exhaust (Notes 2 and 3)	30 (10)
Vents, chimneys, and flues from combustion appliances and equipment (Note 4)	15 (5)
Garage entry, automobile loading area, or drive-in queue (Note 5)	15 (5)
Truck loading area or dock, bus parking/idling area (Note 5)	25 (7.5)
Driveway, street, or parking place (Note 5)	5 (1.5)
Thoroughfare with high traffic volume	25 (7.5)
Roof, landscaped grade, or other surface directly below intake (Notes 6 and 7)	1 (0.30)
Garbage storage/pick-up area, dumpsters	15 (5)
Cooling tower intake or basin	15 (5)
Cooling tower exhaust	25 (7.5)

Note 1: Significantly contaminated exhaust is exhaust air with significant contaminant concentration, significant sensory-irritation intensity, or offensive odor.

Note 2: Laboratory fume hood exhaust air outlets shall be in compliance with NFPA 45-1991³ and ANSI/AIHA Z9.5-1992.⁴

Note 3: Noxious or dangerous exhaust is exhaust air with highly objectionable fumes or gases and/or exhaust air with potentially dangerous particles, bioaerosols, or gases at concentrations high enough to be considered harmful. Information on separation criteria for industrial environments can be found in the ACGIH Industrial Ventilation Manual⁵ and in the ASHRAE Handbook—HVAC Applications.⁶

Note 4: Shorter separation distances are permitted when determined in accordance with (a) Chapter 7 of ANSI Z223.1/NFPA 54-2002⁷ for fuel gas burning appliances and equipment, (b) Chapter 6 of NFPA 31-2001⁸ for oil burning appliances and equipment, or (c) Chapter 7 of NFPA 211-2003⁹ for other combustion appliances and equipment.

Note 5: Distance measured to closest place that vehicle exhaust is likely to be located.

Note 6: No minimum separation distance applies to surfaces that are sloped more than 45 degrees from horizontal or that are less than 1 in. (3 cm) wide.

Note 7: Where snow accumulation is expected, distance listed shall be increased by the expected average snow depth.

ANSI/ASHRAE Standard 62.1-2007

Table 2

Calculations of required minimum outdoor air for each space.

Zone	Rp cfm/person	Pz # of people	Ra cfm/SF	Az SF	Vbz CFM	Ez	Voz CFM	Scheduled OA CFM	Deviation from Minimum Requirements %
Conference	5	30	0.06	575	185	0.7	264	350	133
Conference	5	15	0.06	248	90	0.8	112	150	134
Lobby+eatery*	7.5	13	0.18	1137	302	0.8	378	140	37
Small Meeting	5	4	0.06	100	26	1.0	26	30	115
Admin.	5	2	0.06	265	26	0.8	32	70	216
Accounting	5	2	0.06	242	25	1.0	25	60	245
Gregg's Office	5	1	0.06	204	17	0.8	22	30	139
Jim's Office	5	1	0.06	205	17	0.8	22	25	116
Mike's Office	5	1	0.06	163	15	0.8	18	30	162
Future Conference	5	19	0.06	370	117	0.7	167	N/A	N/A
Office/Conf./Copier	5	2	0.06	440	36	1.0	36	65	179
Great Hall/Bistro	7.5	125	0.18	1655	1235	0.7	1765	Varies	NA
East / West Living Room	5	40	0.06	4260	456	0.8	570	580	102
Marketing	5	2	0.06	294	28	0.8	35	45	130
Printing	5	6	0.06	504	60	0.8	75	200	266
Server	5	0	0.06	90	5	0.8	7	20	296
Corridor/Workstations	0	3	0.06	965	58	0.8	72	95	131
Vestibule	0	0	0.06	145	9	0.8	11	0	0
IT Office	5	1	0.06	117	12	0.8	15	20	133
Workroom	5	5	0.06	1430	111	0.8	139	360	260
Conference	5	8	0.06	195	52	1	65	85	132
Future Offices	5	16	0.06	1700	182	1	228	N/A	N/A
South Studio	5	10	0.06	1665	150	0.8	187.375	245	131
North Studio	5	10	0.06	1665	150	0.8	187.375	245	131
Octagon Conference	5	10	0.06	196	62	0.8	77.2	100	130
Southwest Studio	5	10	0.06	1875	163	0.8	203.125	265	130
Northwest Studio	5	10	0.06	1750	155	0.8	193.75	255	132

Table 3

ASHRAE Table 6-1, used to perform minimum outdoor air calculations in Table 2. Highlighted are the occupancy categories that applied to the new office building.

TABLE 6-1 MINIMUM VENTILATION RATES IN BREATHING ZONE
(This table is not valid in isolation; it must be used in conjunction with the accompanying notes.)

Occupancy Category	People Outdoor Air Rate		Area Outdoor Air Rate		Notes	Default Values			Air Class
	R_p		R_a			Occupant Density (see Note 4)	Combined Outdoor Air Rate (see Note 5)		
	cfm/person	L/s-person	cfm/ft ²	L/s-m ²		#/1000 ft ² or #/100 m ²	cfm/person	L/s-person	
Correctional Facilities									
Cell	5	2.5	0.12	0.6		25	10	4.9	2
Dayroom	5	2.5	0.06	0.3		30	7	3.5	1
Guard stations	5	2.5	0.06	0.3		15	9	4.5	1
Booking/waiting	7.5	3.8	0.06	0.3		50	9	4.4	2
Educational Facilities									
Daycare (through age 4)	10	5	0.18	0.9		25	17	8.6	2
Daycare sickroom	10	5	0.18	0.9		25	17	8.6	3
Classrooms (ages 5–8)	10	5	0.12	0.6		25	15	7.4	1
Classrooms (age 9 plus)	10	5	0.12	0.6		35	13	6.7	1
Lecture classroom	7.5	3.8	0.06	0.3		65	8	4.3	1
Lecture hall (fixed seats)	7.5	3.8	0.06	0.3		150	8	4.0	1
Art classroom	10	5	0.18	0.9		20	19	9.5	2
Science laboratories	10	5	0.18	0.9		25	17	8.6	2
University/college laboratories	10	5	0.18	0.9		25	17	8.6	2
Wood/metal shop	10	5	0.18	0.9		20	19	9.5	2
Computer lab	10	5	0.12	0.6		25	15	7.4	1
Media center	10	5	0.12	0.6	A	25	15	7.4	1
Music/theater/dance	10	5	0.06	0.3		35	12	5.9	1
Multi-use assembly	7.5	3.8	0.06	0.3		100	8	4.1	1
Food and Beverage Service									
Restaurant dining rooms	7.5	3.8	0.18	0.9		70	10	5.1	2
Cafeteria/fast-food dining	7.5	3.8	0.18	0.9		100	9	4.7	2
Bars, cocktail lounges	7.5	3.8	0.18	0.9		100	9	4.7	2
General									
Break rooms	5	2.5	0.06	0.3		25	10	5.1	1
Coffee stations	5	2.5	0.06	0.3		20	11	5.5	1
Conference/meeting	5	2.5	0.06	0.3		50	6	3.1	1
Corridors	–	–	0.06	0.3		–			1
Storage rooms	–	–	0.12	0.6	B	–			1
Hotels, Motels, Resorts, Dormitories									
Bedroom/living room	5	2.5	0.06	0.3		10	11	5.5	1
Barracks sleeping areas	5	2.5	0.06	0.3		20	8	4.0	1
Laundry rooms, central	5	2.5	0.12	0.6		10	17	8.5	2
Laundry rooms within dwelling units	5	2.5	0.12	0.6		10	17	8.5	1
Lobbies/prefunction	7.5	3.8	0.06	0.3		30	10	4.8	1
Multipurpose assembly	5	2.5	0.06	0.3		120	6	2.8	1

ANSI/ASHRAE Standard 62.1-2007

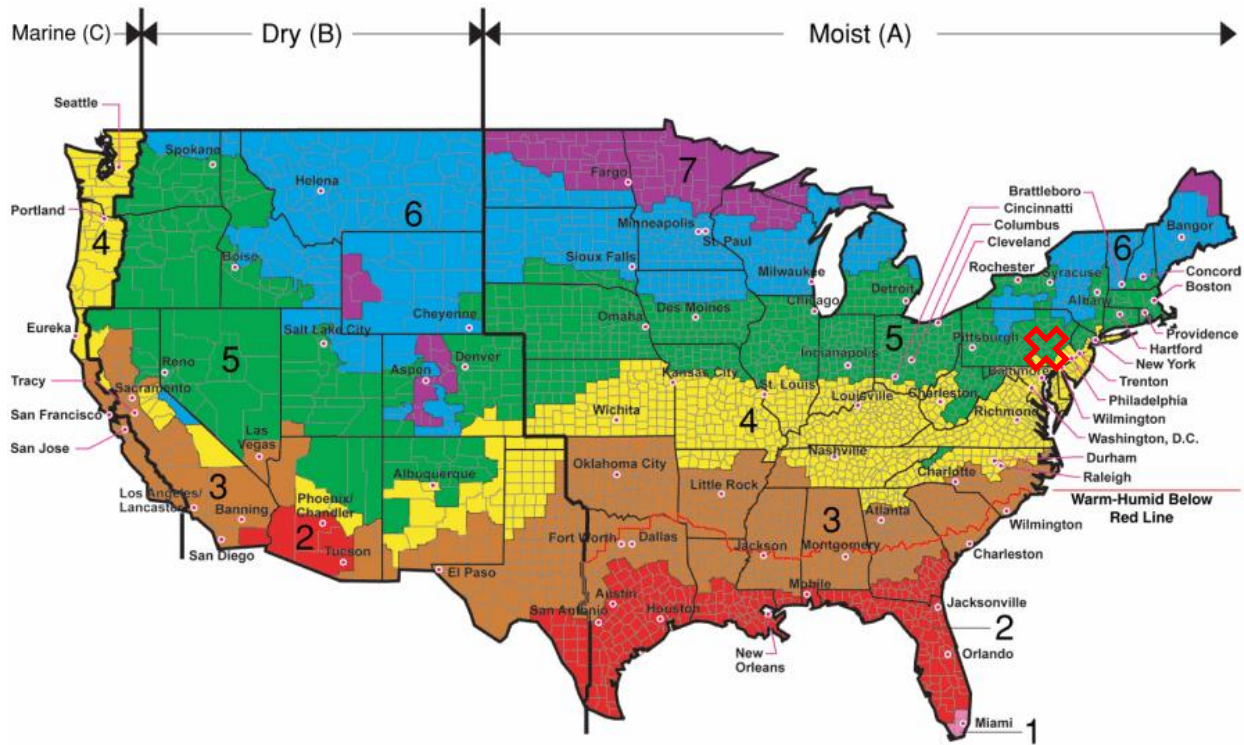
TABLE 6-1 MINIMUM VENTILATION RATES IN BREATHING ZONE (continued)
 (This table is not valid in isolation; it must be used in conjunction with the accompanying notes.)

Occupancy Category	People Outdoor Air Rate		Area Outdoor Air Rate		Notes	Default Values			Air Class
	R_p		R_a			Occupant Density (see Note 4)	Combined Outdoor Air Rate (see Note 5)		
	cfm/person	L/s-person	cfm/ft ²	L/s-m ²			#/1000 ft ² or #/100 m ²	cfm/person	
Office Buildings									
Office space	5	2.5	0.06	0.3		5	17	8.5	1
Reception areas	5	2.5	0.06	0.3		30	7	3.5	1
Telephone/data entry	5	2.5	0.06	0.3		60	6	3.0	1
Main entry lobbies	5	2.5	0.06	0.3		10	11	5.5	1
Miscellaneous Spaces									
Bank vaults/safe deposit	5	2.5	0.06	0.3		5	17	8.5	2
Computer (not printing)	5	2.5	0.06	0.3		4	20	10.0	1
Electrical equipment rooms	–	–	0.06	0.3	B	–			1
Elevator machine rooms	–	–	0.12	0.6	B	–			1
Pharmacy (prep. area)	5	2.5	0.18	0.9		10	23	11.5	2
Photo studios	5	2.5	0.12	0.6		10	17	8.5	1
Shipping/receiving	–	–	0.12	0.6	B	–			1
Telephone closets	–	–	0.00	0.0		–			1
Transportation waiting	7.5	3.8	0.06	0.3		100	8	4.1	1
Warehouses	–	–	0.06	0.3	B	–			2
Public Assembly Spaces									
Auditorium seating area	5	2.5	0.06	0.3		150	5	2.7	1
Places of religious worship	5	2.5	0.06	0.3		120	6	2.8	1
Courtrooms	5	2.5	0.06	0.3		70	6	2.9	1
Legislative chambers	5	2.5	0.06	0.3		50	6	3.1	1
Libraries	5	2.5	0.12	0.6		10	17	8.5	1
Lobbies	5	2.5	0.06	0.3		150	5	2.7	1
Museums (children's)	7.5	3.8	0.12	0.6		40	11	5.3	1
Museums/galleries	7.5	3.8	0.06	0.3		40	9	4.6	1
Residential									
Dwelling unit	5	2.5	0.06	0.3	F,G	F			1
Common corridors	–	–	0.06	0.3					1
Retail									
Sales (except as below)	7.5	3.8	0.12	0.6		15	16	7.8	2
Mall common areas	7.5	3.8	0.06	0.3		40	9	4.6	1
Barbershop	7.5	3.8	0.06	0.3		25	10	5.0	2
Beauty and nail salons	20	10	0.12	0.6		25	25	12.4	2
Pet shops (animal areas)	7.5	3.8	0.18	0.9		10	26	12.8	2
Supermarket	7.5	3.8	0.06	0.3		8	15	7.6	1
Coin-operated laundries	7.5	3.8	0.06	0.3		20	11	5.3	2

Appendix B

Table 1

Climate zone map, used to confirm that the new office building was located in climate zone 5a.



All of Alaska in Zone 7 except for the following Boroughs in Zone 8: Bethel, Dellingham, Fairbanks, N. Star, Nome North Slope, Northwest Arctic, Southeast Fairbanks, Wade Hampton, and Yukon-Koyukuk

Zone 1 includes: Hawaii, Guam, Puerto Rico, and the Virgin Islands

Image courtesy of architecture.uwaterloo.ca

Table 2

ASHRAE Standard 90.1 Table 5.5-5 Building Envelope Requirements for buildings in climate zone a.

TABLE 5.5-5 Building Envelope Requirements For Climate Zone 5 (A, B, C)*

Opaque Elements	Nonresidential		Residential		Semiheated	
	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value
<i>Roofs</i>						
Insulation Entirely above Deck	U-0.048	R-20.0 c.i.	U-0.048	R-20.0 c.i.	U-0.119	R-7.6 c.i.
Metal Building	U-0.065	R-19.0	U-0.065	R-19.0	U-0.097	R-10.0
Attic and Other	U-0.027	R-38.0	U-0.027	R-38.0	U-0.053	R-19.0
<i>Walls, Above-Grade</i>						
Mass	U-0.090	R-11.4 c.i.	U-0.080	R-13.3 c.i.	U-0.151 ^a	R-5.7 c.i. ^a
Metal Building	U-0.113	R-13.0	U-0.057	R-13.0 + R-13.0	U-0.123	R-11.0
Steel-Framed	U-0.064	R-13.0 + R-7.5 c.i.	U-0.064	R-13.0 + R-7.5 c.i.	U-0.124	R-13.0
Wood-Framed and Other	U-0.064	R-13.0 + R-3.8 c.i.	U-0.051	R-13.0 + R-7.5 c.i.	U-0.089	R-13.0
<i>Walls, Below-Grade</i>						
Below-Grade Wall	C-0.119	R-7.5 c.i.	C-0.119	R-7.5 c.i.	C-1.140	NR
<i>Floors</i>						
Mass	U-0.074	R-10.4 c.i.	U-0.064	R-12.5 c.i.	U-0.137	R-4.2 c.i.
Steel-Joist	U-0.038	R-30.0	U-0.038	R-30.0	U-0.052	R-19.0
Wood-Framed and Other	U-0.033	R-30.0	U-0.033	R-30.0	U-0.051	R-19.0
<i>Slab-On-Grade Floors</i>						
Unheated	F-0.730	NR	F-0.540	R-10 for 24 in.	F-0.730	NR
Heated	F-0.860	R-15 for 24 in.	F-0.860	R-15 for 24 in.	F-1.020	R-7.5 for 12 in.
<i>Opaque Doors</i>						
Swinging	U-0.700		U-0.500		U-0.700	
Nonswinging	U-0.500		U-0.500		U-1.450	
Fenestration						
	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC
<i>Vertical Glazing, % of Wall</i>						
Nonmetal framing (all) ^b	U-0.35		U-0.35		U-1.20	
Metal framing (curtainwall/storefront) ^c	U-0.45	SHGC-0.40 all	U-0.45	SHGC-0.40 all	U-1.20	SHGC-NR all
Metal framing (entrance door) ^c	U-0.80		U-0.80		U-1.20	
Metal framing (all other) ^c	U-0.55		U-0.55		U-1.20	
<i>Skylight with Curb, Glass, % of Roof</i>						
0%-2.0%	U _{all} -1.17	SHGC _{all} -0.49	U _{all} -1.17	SHGC _{all} -0.49	U _{all} -1.98	SHGC _{all} -NR
2.1%-5.0%	U _{all} -1.17	SHGC _{all} -0.39	U _{all} -1.17	SHGC _{all} -0.39	U _{all} -1.98	SHGC _{all} -NR
<i>Skylight with Curb, Plastic, % of Roof</i>						
0%-2.0%	U _{all} -1.10	SHGC _{all} -0.77	U _{all} -1.10	SHGC _{all} -0.77	U _{all} -1.90	SHGC _{all} -NR
2.1%-5.0%	U _{all} -1.10	SHGC _{all} -0.62	U _{all} -1.10	SHGC _{all} -0.62	U _{all} -1.90	SHGC _{all} -NR
<i>Skylight without Curb, All, % of Roof</i>						
0%-2.0%	U _{all} -0.69	SHGC _{all} -0.49	U _{all} -0.69	SHGC _{all} -0.49	U _{all} -1.36	SHGC _{all} -NR
2.1%-5.0%	U _{all} -0.69	SHGC _{all} -0.39	U _{all} -0.69	SHGC _{all} -0.39	U _{all} -1.36	SHGC _{all} -NR

*The following definitions apply: c.i. = continuous insulation (see Section 3.2), NR = no (insulation) requirement.

^aException to Section A3.1.3.1 applies.

^bNonmetal framing includes framing materials other than metal with or without metal reinforcing or cladding.

^cMetal framing includes metal framing with or without thermal break. The "all other" subcategory includes operable windows, fixed windows, and non-entrance doors.

5.5.3.2 Above-Grade Wall Insulation. All above-grade walls shall comply with the insulation values specified in Tables 5.5-1 through 5.5-8. When a wall consists of both above-grade and below-grade portions, the entire wall for that story shall be insulated on either the exterior or the interior or be integral.

a. If insulated on the interior, the wall shall be insulated to the above-grade wall requirements.

b. If insulated on the exterior or integral, the below-grade wall portion shall be insulated to the below-grade wall requirements, and the above-grade wall portion shall be insulated to the above-grade wall requirements.

5.5.3.3 Below-Grade Wall Insulation. Below-grade walls shall have a rated R-value of insulation not less than the insulation values specified in Tables 5.5-1 through 5.5-8.

Table 3

Drawing detail provided by project engineer. Provides information on typical wall construction including insulation. Used to confirm compliance with ASHRAE Standard 90.1 Table 5.505.

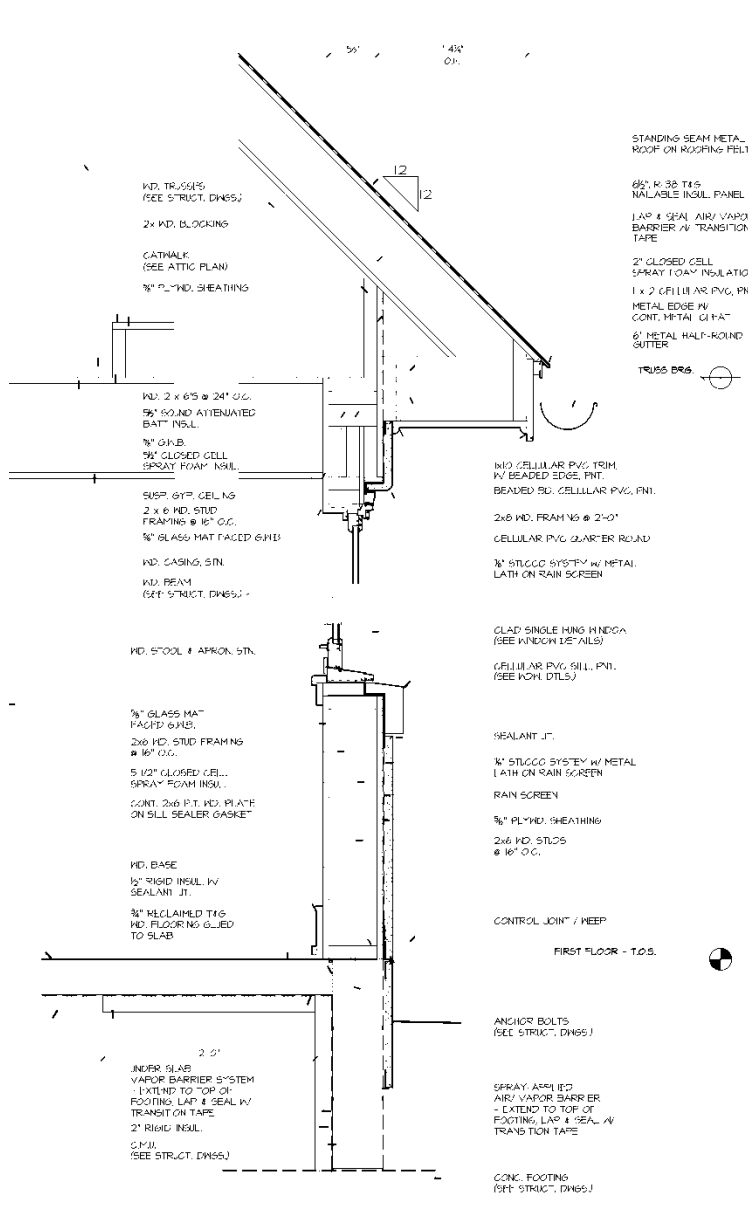


Table 4

Table derived from energy model provided by project engineer. Used to confirm percentage of window area and designed average U-value for wall, floor, and roof construction.

	Average U-Value of Windows	Average U-Value of Walls	Window Area	Wall Area	% Window Area
	BTU/(hr SF)	BTU/(hr SF)	SF	SF	
North	0.487	0.078	1184	4282	28
North-East	0.000	0.081	0.0000	174	0
East	0.487	0.149	842	4068	21
South-East	0.487	0.179	151	473	32
South	0.487	0.201	1560	3591	43
South-West	0.487	0.14	89	522	17
West	0.487	0.173	983	3263	30
North-West	0.487	0.155	103	468	22
Floor	0.000	0.099	0.0000	31	0
Roof	0.000	0.033	0.0000	32144	0
Overall			4912	49016	10

Table 5

Voltage drop calculations performed by project engineer to confirm ASHRAE 90.1 Section 8.

RLPS OFFICE																
2007059																
Notes	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Circuit #	Est. Length	Cont Factor	Calc. Length	Conduit	Voltage	VA	Phase	Amps	p.f.	Wire size	Crrctn Factor	Factor	cndrs / phase	Voltage Drop	% Drop	Result
MDS	35	1.10	39	N	208	446,575	3	1239.60	1	500	1	0.0049	5	0.47	0.23	Acceptable
P1	25	1.10	28	S	208	83,888	3	232.86	1	350	1	0.0069	1	0.45	0.22	Acceptable
P2	130	1.10	143	S	208	15,110	3	41.94	1	1	1	0.0267	1	1.60	0.77	Acceptable
P3	165	1.10	182	S	208	38,906	3	108.00	1	3X	1	0.0136	1	2.67	1.29	Acceptable
M1	27	1.10	30	S	208	276,834	3	768.44	1	300	1	0.008	3	0.61	0.30	Acceptable
M2	130	1.10	143	S	208	68,345	3	189.71	1	250	1	0.0094	1	2.55	1.23	Acceptable
M3	165	1.10	182	S	208	95,046	3	263.83	1	500	1	0.0053	1	2.54	1.22	Acceptable
L1	25	1.10	28	S	208	54,353	3	150.87	1	250	1	0.0094	1	0.40	0.19	Acceptable
L2	125	1.10	138	S	208	9,413	3	26.13	1	1	1	0.0267	1	0.96	0.46	Acceptable
L3	161	1.10	178	S	208	26,261	3	72.90	1	1	1	0.0267	1	3.46	1.67	Acceptable
S1	50	1.10	55	S	208	4,500	3	12.49	1	4	1	0.0534	1	0.37	0.18	Acceptable