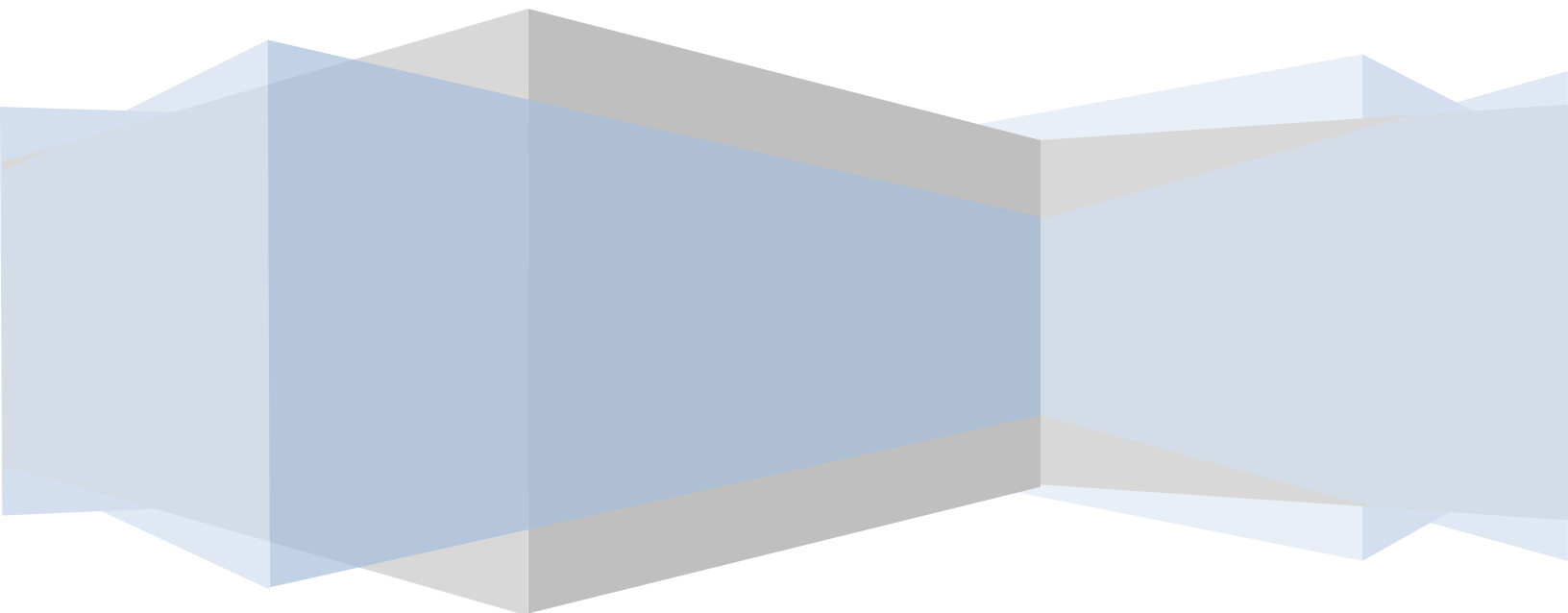


Montgomery County Equipment Maintenance and Operations Center

Technical Report 1

ASHRAE Standard 62.1-2007 Ventilation and
Standard 90.1-2007 Energy Design Evaluations

Michael Tellep
Mechanical Option
Advisor: Moses Ling



Montgomery County Equipment Maintenance and Operations Center-Building 1

Technical Report 1 - ASHRAE Standard 62.1-2007 and Standard 90.1-2007 Analysis

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Montgomery County Equipment Maintenance and Operations Center-Building 1

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Executive Summary:

The Montgomery County Equipment Maintenance and Operations Center, Building 1 (EMOC 1) is a 75,000 square foot building in Rockville, Maryland designed to be the new hub for Montgomery County's ground transportation services. EMOC 1 is a multi-purpose building consisting of both garage space for maintenance and office space for operations. The building is still under construction and is scheduled to be finished in February of 2013. The design strives for LEED silver or better.

This report will analyze the compliance of EMOC 1 to ASHRAE Standards 62.1-2007 and 90.1-2007. More specifically, in Standard 62.1-2007, sections 5 and 6 will be analyzed. Section 5 pertains to ventilation requirements for proper indoor air quality and prevention of harmful contaminants. Section 6 is more specific about ventilation requirements.

ASHRAE Standard 90.1-2007 defines the energy standard for a building. It set standards based on the climate zone and the building systems such as lighting, power, HVAC, and building envelope.

Montgomery County Equipment Maintenance and Operations Center-Building 1

Technical Report 1 - ASHRAE Standard 62.1-2007 and Standard 90.1-2007 Analysis

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Part 1: ASHRAE Standard 62.1-2007 Analysis:

Section 5: Systems and Equipment

Section 5.1 - Natural Ventilation

EMOC 1 uses rooftop gravity ventilators as a means of natural ventilation. This is not the only means of ventilation due to the potential for harmful emissions from vehicles in the maintenance areas. Power ventilators are in place as well if needed for proper indoor air quality. The specifications pertaining to the gravity ventilators state that submittals shall be produced to show that the installed ventilators are compliant to ASHRAE Standard 62.1 Section 5, therefore, EMOC 1 is compliant with this section.

Section 5.2 - Ventilation Air Distribution

EMOC 1 is able to meet minimum ventilation requirements. Outdoor air flow rates are posted to the construction documents for each RTU and each VAV unit therefore complying with this section. This is further analyzed in Section 6 later in this report.

Section 5.3 - Exhaust Duct Location

All exhaust ducts are negatively pressurized as per this standard so that exhaust air cannot leak back into the space. This is particularly important in the maintenance bays where the exhausted air will contain harmful contaminants prior to treatment. EMOC 1 complies with this section.

Section 5.4 - Ventilation System Controls

EMOC 1 is compliant with this standard in terms of both RTU ventilation and Powered Ventilators. Both systems are programmed to an occupancy schedule (except RTU-2, which operates at a constant load 24/7) and to sense indoor air quality. The schedule program and the sensors throughout the building dictate the operation of the fans and ventilation rates. These ventilation rates are further analyzed in Section 6 later in this report.

Section 5.5 - Airstream Surfaces

All metallic and non-metallic ducts and other airstream surfaces are specified to be compliant with this standard by conforming to UL 181 and ASTM C 1338. EMOC 1 is compliant with this section.

Montgomery County Equipment Maintenance and Operations Center-Building 1

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Section 5.6 - Outdoor Air Intakes

The outdoor air intakes for EMOC 1 needed to be placed in very specific locations due to the number of limitations applicable to the building from Table 5-1 of this section. All of the limitations listed apply to EMOC 1. The location of the outdoor air intakes are in compliance with this section and Table 5-1, Air Intake Minimum Separation Distance.

Rain water penetration is prevented by angled covers over the air intake. This prevents both rainfall and wind driven penetration.

EMOC 1 is compliant with this section.

Section 5.7 - Local Capture of Contaminants

This section applies to the kitchen area and the soldering area of EMOC 1. Both areas are compliant with this section in that the potential contaminants are exhausted directly to the roof. EMOC 1 is therefore compliant with this section.

Section 5.8 - Combustion Air

Combustion air in EMOC 1 is limited to only the exhaust from vehicles in the service bays. Hosereel Exhaust Units will be mounted in every bay so that all combustion exhaust will be vented directly to the roof. These units consist of a 1.5 HP fan creating an airflow of 750 CFM at 5 inches s.p. The exhaust created by the vehicles as they enter and exit the bays will be removed by the powered ventilation units at the roof of the bays. EMOC 1 is compliant with this section.

Section 5.9 - Particulate Matter Removal

According to the construction documents, the air filters are to be located upstream of the heating and cooling coils and are to be 12 inch thick with a MERV value of 13. This makes EMOC 1 compliant to this section.

Section 5.10 - Dehumidification Systems

It is specified that the relative humidity be less than 65% at all times in the building. The humidity in the summer months will be more than in the winter months but still less than 65%. Also, the net air intake is greater than the net air exhaust, therefore creating a net positive pressure in the building. EMOC 1 is compliant with this section.

Montgomery County Equipment Maintenance and Operations Center-Building 1

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Section 5.11 - Drain Pans

All drain pans in the building are specified to be stainless steel formed with pitch and drain connections in accordance with this standard (ASHRAE 62.1 - 2007). EMOC 1 is compliant with this section.

Section 5.12 - Finned-tube Coils and Heat Exchangers

It is specified in all sections regarding condensate-producing heat exchangers that a drain pan be provided. Access to these heat exchangers for cleaning purposes has been specified, but there is no mention of specific distances, however, it is specified that the RTUs be in compliance with this standard. EMOC 1 is in compliance with this section.

Section 5.13 - Humidifiers and Water-spray Systems

All water used in humidifiers and water-spray systems is drawn directly from a potable water source, giving it the appropriate quality. EMOC 1 is compliant with this section.

Section 5.14 - Access for Inspection, Cleaning, and Maintenance

All ventilation equipment is specified to have sufficient working space for inspection, cleaning, and maintenance either within the unit itself (RTUs) or next to it. These spaces are located throughout the ventilation system where they are necessary making EMOC 1 compliant with this section.

Section 5.15 - Building Envelope and Interior Surfaces

The building envelope has been designed to be in compliance with all points of this standard. The roof is engineered such that water does not penetrate, vapor barriers are incorporated into the walls and other envelope elements, and sufficient sealing of cracks and joints is specified. Also, all interior surfaces, such as pipes and ducts, that drop below the dew point are specified to be insulated. EMOC 1 is compliant with this section.

Section 5.16 - Building with Attached Parking Garages

The maintenance garages of EMOC 1 are kept at a relatively lower pressure than the office and storage space therefore minimizing the infiltration of contaminated air to those spaces. A stairway provides separation between the offices from the garage space and a corridor provides separation between the storage areas and the garage space. EMOC 1 is compliant with this section.

Montgomery County Equipment Maintenance and Operations Center-Building 1

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Section 5.17 - Air Classification and Recirculation

There are several different air classifications returned from the spaces in EMOC 1. The garage spaces are classified as Class 3 air due to vehicle exhaust. Class 2 air comes from the kitchen area. The rest of the building returns Class 1 air and that air is used for energy recovery in accordance with the percentages specified in this section. EMOC 1 is in compliance with this section.

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

As a potential LEED Silver certified building, and due to the many flammable hazards in the building, this is a non-smoking facility and this section does not apply.



Montgomery County Equipment Maintenance and Operations Center-Building 1

Technical Report 1 - ASHRAE Standard 62.1-2007 and Standard 90.1-2007 Analysis

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Section 6 - Procedures

The procedures defined in this section will determine if the rooftop air handling units of EMOC 1 are compliant with the ventilation and exhaust requirements set forth in ASHRAE Standard 62.1-2007. The three air handling units for the building will be analyzed in this section.

Breathing Zone Outdoor Airflow

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

where,

A_z = zone floor area [ft²]

P_z = zone population, the largest number of people expected to occupy the zone during typical usage
(Estimated from Table 6-1)

R_p = outdoor air flow rate required per person [CFM/person] from Table 6-1

R_a = outdoor air flow rate required per unit area [CFM/ft²]

Zone Air Distribution Effectiveness (E_z)

$E_z = 1.0$ as applies to a ceiling supply of cool air

Zone Outdoor Airflow (V_{oz})

$$V_{oz} = \frac{V_{bz}}{E_z}$$

Primary Outdoor Air Fraction (Z_p)

$$Z_p = \frac{V_{oz}}{V_{pz}}$$

where V_{pz} = zone primary airflow

System Ventilation Efficiency (E_v)

Determined from Table 6-3

Uncorrected Outdoor Air Intake (V_{ou})

$$V_{ou} = D \sum_{all\ zones} (R_p \cdot P_z) + \sum_{all\ zones} (R_a \cdot A_z)$$

Montgomery County Equipment Maintenance and Operations Center-Building 1

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Occupancy Density (D)

$$D = \frac{P_s}{\sum_{all\ zones} P_z}$$

where P_s = systems population (the total population in the area served by the system)

Outdoor Air Intake (V_{ot})

$$V_{ot} = \frac{V_{ou}}{E_v}$$

Summary and Results

EMOC 1 uses 3 rooftop air handling units to supply air to all VAV boxes located throughout the building. These RTUs were the basis of the calculations done to test outdoor ventilation requirements. Each zone serviced by each air handler is listed in the spreadsheets in Appendix B along with all zone data. This building did not have a typical zone to analyze due to the varying uses of the building spaces, so all zones needed to be considered.

According to the calculations, the building is in complete compliance with this standard. All outside air flows are higher than required as shown at the bottom of each spreadsheet in Appendix B. A summary of those airflows is as follows:

System	Required OA Rate [CFM]	Actual OA Rate [CFM]	Compliant?
RTU-1	1,193	1,200	Y
RTU-2	3,571	5,200	Y
RTU-3	1,294	1,300	Y

ASHRAE 62.1 - 2007 Building Compliance Summary

According to the construction documents and other building data, the Montgomery County Equipment Maintenance and Operations Center is completely compliant with ASHRAE Standard 62.1-2007. All pertinent sections of the building specifications and drawing sets have noted that the items in question should be compliant with this standard.

Montgomery County Equipment Maintenance and Operations Center-Building 1

Technical Report 1 - ASHRAE Standard 62.1-2007 and Standard 90.1-2007 Analysis

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Part 2: ASHRAE Standard 90.1-2007 Analysis

Section 5: Building Envelope

Section 5.1.4 - Climate

EMOC 1 is located in climate section 4A as show by Figure 1 below. Climate zone 4A is the upper range of subtropical climate.

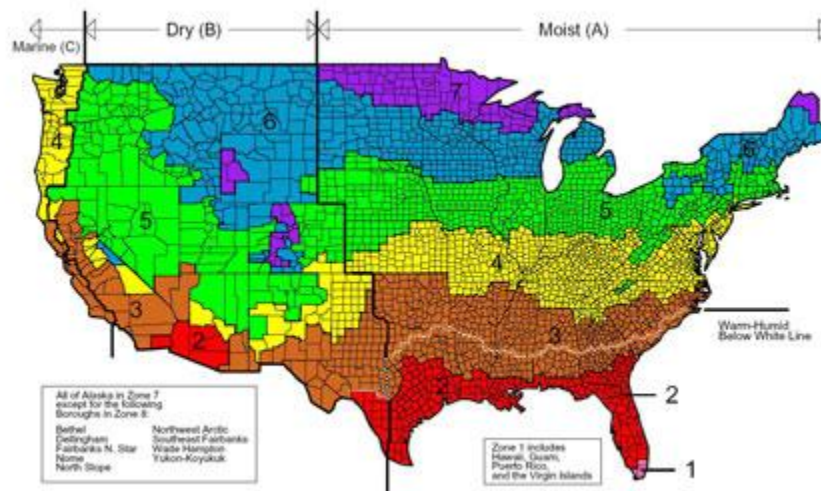


Figure 1 - United State Climate Zones

Section 5.4 - Mandatory Provisions

It is specified that all fenestrations, exterior doors, and glazing are to be sealed according to this standard. A COMcheck Energy Compliance Certificate was produced and is posted to the construction documents stating that the design envelope is 30% more efficient than the code requires.

Montgomery County Equipment Maintenance and Operations Center-Building 1

Technical Report 1 - ASHRAE Standard 62.1-2007 and Standard 90.1-2007 Analysis

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Section 5.5 - Prescriptive Building Envelope Option

The prescriptive building envelope method was used on the before mentioned Energy Compliance Certificate, shown below:

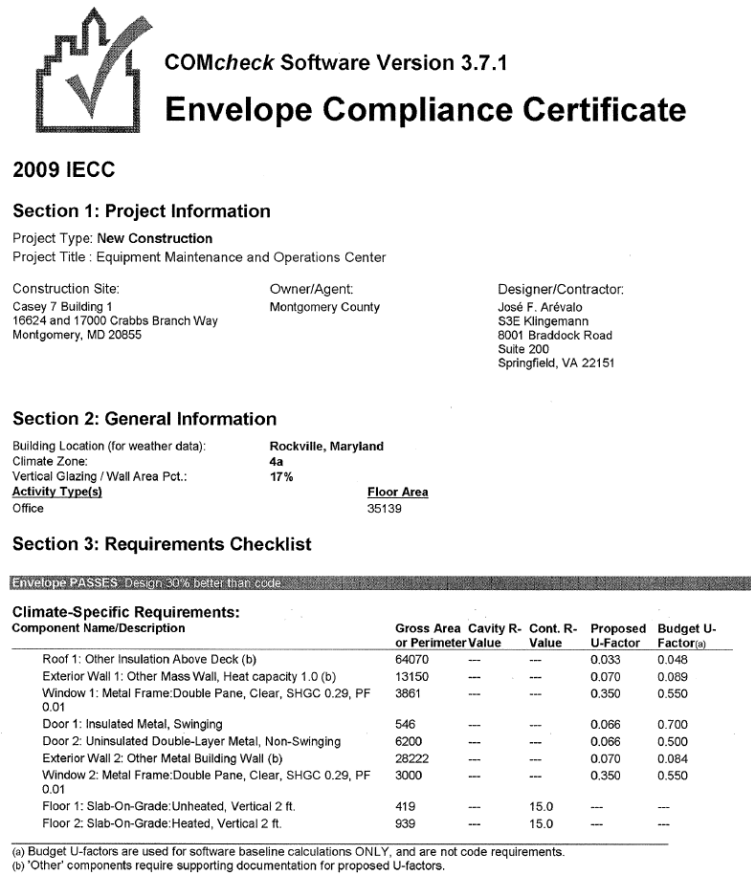


Figure 2: EMOC 1 Envelope Compliance Certificate

Montgomery County Equipment Maintenance and Operations Center-Building 1

Technical Report 1 - ASHRAE Standard 62.1-2007 and Standard 90.1-2007 Analysis

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Section 6: Heating, Ventilating, and Air Conditioning

Section 6.2 - Compliance Paths

The Mandatory Provisions path must be used as opposed to the Simplified Approach since the EMOC 1 is over 25,000 SF.

Section 6.4 - Mandatory Provisions

EMOC 1 meets all mandatory provisions required by this section. The construction documents pertaining to the equipment and materials in this section specifically state that they should be in compliance with this standard. There are no items in this section that excessively exceed or fall short of the efficiencies required by this standard.

Section 6.5 - Prescriptive Path

EMOC 1 is equipped with an air economizer. It is compliant with all pertaining sections of this standard as stated by the construction documents and as shown by the construction drawings.

All fans and their related nameplate horsepower are in compliance with this section.

Radiant floor heating is used as a supplemental heat source for the building and is in compliance with this section.

Section 6.7 - Submittals

Construction documents and operating manuals will be provided to the owner upon completion of the building. The commissioning of the building's systems will be in accordance with the requirements for LEED Certification.

Section 7: Service Water Heating

This section outlines requirements for the heating of service water in the building. The service water heating at EMOC 1 is done by a gas-fired boiler, which is compliant with all points of this section.

Section 8: Power

As outlined in the National Electric Code, all risers must not exceed a 2% voltage drop and all branch circuits must not exceed 3%. This is also the standard for this section of the ASHRAE standards. EMOC 1 is specified to be compliant to the National Electric Code and is therefore compliant with this section.

Montgomery County Equipment Maintenance and Operations Center-Building 1

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Section 9: Lighting

This section specifies the appropriate lighting power densities for specific spaces. All lighting power densities in EMOC 1 are compliant with this standard both in the office spaces and the garage spaces.

ASHRAE Standard 90.1-2007 Summary

Overall, EMOC 1 is in compliance with this standard. The building is designed to be LEED Silver certified, therefore energy efficiency and complete compliance to this standard is necessary.



Montgomery County Equipment Maintenance and Operations Center-Building 1

Technical Report 1 - ASHRAE Standard 62.1-2007 and Standard 90.1-2007 Analysis

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Appendix A - References

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

ASHRAE. 2007, ANSI/ASHRAE, Standard 90.1-2007, Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc., Atlanta, GA.

Construction Documents for The Montgomery County Equipment Maintenance and Operations Center



Montgomery County Equipment Maintenance and Operations Center-Building 1

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Appendix B - Ventilation Rate Procedure Spreadsheets

RTU-1

Project: EMOC - CASEY 7 BLDG 1		INTERNATIONAL MECHANICAL CODE 2009										SHEK Project		09/23/01				
System: RTU-1																		
Zone Identification		Occupancy Classification	Zone Floor Area (sf)	People Rate (cfm/person)	Table 403.3 Area Rate (cfm/sf)	Occupant Density (/ft ² /1000)	Zone Population Pz	Breathing Zone Outdoor Airflow (RpPz+ RaPz)	Table 403.3.1.2 Zone Air Distribution Effectiveness Ez	Zone Outdoor Airflow (cfm)	Design Case Zone Return Airflow (cfm)	Primary Outdoor Air Fraction Zp	SA CFM / SF VpZ/Az	ASHRAE 62.1, 2004 Appendix A Calculations	Unrecirculated Outdoor Air Infiltration	Ys (Your Vps)	Zd (Your Vd2) (1+Ys-d)	Ez
1204-1	CORRIDOR	CORRIDOR	197		0.06		0	12	0.8	15	100	0.15	0.51	12	0.0925696	0.15	0.94	
1204-2	CORRIDOR	CORRIDOR	420		0.06		0	28	0.8	35	100	0.35	0.21	28	0.0925696	0.35	0.74	
1204-3	CORRIDOR	CORRIDOR	180		0.06		0	11	0.8	14	50	0.27	0.28	11	0.0925696	0.27	0.82	
1204-4	CORRIDOR	CORRIDOR	359		0.06		0	24	0.8	29	80	0.37	0.2	24	0.0925696	0.37	0.72	
1204-5	CORRIDOR	CORRIDOR	101		0.06		0	8	0.8	14	70	0.20	0.69	11	0.0925696	0.20	0.90	
1204-6	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-7	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-8	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-9	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-10	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-11	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-12	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-13	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-14	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-15	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-16	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-17	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-18	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-19	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-20	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-21	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-22	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-23	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-24	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-25	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-26	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-27	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-28	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-29	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-30	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-31	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-32	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-33	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-34	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-35	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-36	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-37	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-38	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-39	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-40	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-41	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-42	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-43	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-44	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-45	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-46	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-47	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-48	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-49	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-50	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-51	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-52	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-53	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-54	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-55	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-56	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-57	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-58	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-59	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-60	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-61	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-62	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-63	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-64	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-65	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-66	OFFICE	OFFICE	90	5	0.06	5	1	10	0.8	13	60	0.22	0.67	10	0.0925696	0.22	0.88	
1204-67	OFFICE	OFFICE	90	5	0.06	5	1											

Montgomery County Equipment Maintenance and Operations Center-Building 1

Technical Report 1 - ASHRAE Standard 62.1-2007 and Standard 90.1-2007 Analysis

Michael Tellep

RTU-2

Zone Identification		Occupancy Classification	Zone Floor Area	People Density	Table 403.3	Occupant Density	Zone Population	Breathing Apparatus	Table 403.1.2	Zone Outdoor Airflow	Design Case	Primary Outdoor Airflow	SA CFM / SP	Unrecirculated Outdoor Air Inlet	Zone	Zs	ZL	Eqz
Zone	Area	Zone Floor Area	People Density	Table 403.3	Occupant Density	Zone Population	Breathing Apparatus	Table 403.1.2	Zone Outdoor Airflow	Design Case	Primary Outdoor Airflow	SA CFM / SP	Unrecirculated Outdoor Air Inlet	Zone	Zs	ZL	Eqz	
Zone	Area	Zone Floor Area	People Density	Table 403.3	Occupant Density	Zone Population	Breathing Apparatus	Table 403.1.2	Zone Outdoor Airflow	Design Case	Primary Outdoor Airflow	SA CFM / SP	Unrecirculated Outdoor Air Inlet	Zone	Zs	ZL	Eqz	
1105 CREW CHIEF TRANSIT	OFFICE	538	5	0.06	5	3	47	0.8	59	440	0.13	0.82	47	0.12753189	0.13	0.99		
1106 QUALITY ASSURANCE TECH	OFFICE	654	5	0.06	5	4	59	0.8	74	580	0.13	0.89	59	0.12753189	0.13	1.00		
1107 CONFERENCE ROOM	CONFERENCE	352	5	0.06	50	18	111	0.8	139	500	0.28	1.42	111	0.12753189	0.28	0.85		
1108 EQUIP SERVICE COORD	OFFICE	105	5	0.06	5	1	11	0.8	14	125	0.11	1.19	11	0.12753189	0.11	1.01		
1109 CREW CHIEF TRANSIT	OFFICE	181	5	0.06	5	1	16	0.8	20	200	0.10	1.1	16	0.12753189	0.10	1.03		
1110 BREAK ROOM	BREAK	131	5	0.06	10	2	18	0.8	22	300	0.07	2.29	18	0.12753189	0.07	1.05		
1111 MEN'S RESTROOM	RESTROOM	290	5	0.06	0	0	0	0.8	0	130	0.00	0.55	0	0.12753189	0.00	1.13		
1112 MEN'S RESTROOM	RESTROOM	232	5	0.06	0	0	0	0.8	0	20	0.00	0.66	0	0.12753189	0.00	1.13		
1113 HALLS/STAIRS/CHIEF- HEAVY EQUIP	OFFICE	157	5	0.06	5	3	46	0.8	18	130	0.10	1.08	46	0.12753189	0.10	1.05		
1114 EQUIP SERVICE COORD HEAVY EQUIP	OFFICE	748	5	0.06	5	4	65	0.8	137	170	0.10	1.08	65	0.12753189	0.10	1.05		
1116 SUPPLY CLERK I,II & III	OFFICE	104	5	0.06	5	1	11	0.8	81	780	0.10	1.04	11	0.12753189	0.10	1.02		
1127 SHIPPING/RECEIVING OFFICE	OFFICE	104	5	0.06	5	1	11	0.8	14	180	0.08	1.73	11	0.12753189	0.08	1.05		
1128 SENIOR SUPPLY CLERK	OFFICE	127	5	0.06	5	1	13	0.8	16	205	0.08	1.61	13	0.12753189	0.08	1.05		
1130 BOL./JS BINS STG.	STORAGE	130	5	0.12	0	0	0	0.8	18	50	0.77	0.42	0	0.12753189	0.36	0.77		
1200 LOBBY WAITING AREA	LOBBY	617	5	0.12	10	7	72	0.8	90	200	0.45	0.32	72	0.12753189	0.45	0.68		
1203A TRAINING ROOM	CLASSROOM	700	10	0.12	35	25	334	0.8	418	1200	0.35	1.71	334	0.12753189	0.35	0.78		
1203B TRAINING ROOM	CLASSROOM	670	10	0.12	35	24	320	0.8	401	1000	0.40	1.49	320	0.12753189	0.40	0.73		
1203C TRAINING ROOM	CLASSROOM	643	10	0.12	35	23	307	0.8	384	1000	0.38	1.56	307	0.12753189	0.38	0.74		
1205 BINS/BOL./STORAGE	STORAGE	202	20	0.12	0	0	24	0.8	30	160	0.19	0.79	24	0.12753189	0.19	0.94		
1234 MEN'S LOCKER ROOM	LOCKER ROOM	417	20	0.12	0	0	0	0.8	0	200	0.00	0.28	0	0.12753189	0.00	1.13		
1235 MEN'S RESTROOM/SHOWER	RESTROOM	47	5	0.06	0	0	0	0.8	0	100	0.00	0.24	0	0.12753189	0.00	1.13		
1237 WORKERS LOCKER ROOM	LOCKER ROOM	121	20	0.12	0	0	0	0.8	0	100	0.00	0.24	0	0.12753189	0.00	1.13		
1238 CORRIDOR	CORRIDOR	493	5	0.06	10	0	30	0.8	37	200	0.18	0.81	30	0.12753189	0.18	0.93		
1240 KITCHEN	BREAK	1332	5	0.06	20	14	151	0.8	189	1950	0.10	1.44	151	0.12753189	0.10	1.03		
1241 STORAGE	STORAGE	202	5	0.12	0	0	0	0.8	14	200	0.23	0.99	12	0.12753189	0.23	0.90		
1242 VENDING AREA	CORRIDOR	134	5	0.06	0	0	7	0.8	9	50	0.05	1.61	7	0.12753189	0.05	0.84		
1245-1 CORRIDOR	CORRIDOR	283	5	0.06	0	0	17	0.8	21	75	0.28	0.27	17	0.12753189	0.28	0.84		
1245-2 CORRIDOR	CORRIDOR	298	5	0.06	0	0	18	0.8	22	60	0.37	0.2	18	0.12753189	0.37	0.76		
1245-3 CORRIDOR	CORRIDOR	189	5	0.06	0	0	11	0.8	14	40	0.35	0.21	11	0.12753189	0.35	0.77		
1247 WOMEN'S SHOWER & RESTROOM	RESTROOM	347	5	0.06	0	0	0	0.8	0	105	0.00	0.73	0	0.12753189	0.00	1.13		
1248 MEN'S RESTROOM/SHOWER	RESTROOM	430	5	0.06	0	0	0	0.8	0	100	0.00	0.73	0	0.12753189	0.00	1.13		
1249 LOCKERS	LOCKER ROOM	631	20	0.12	0	0	0	0.8	0	480	0.00	0.16	0	0.12753189	0.00	1.13		
1249A MAIL ROOMS	CORRIDOR	116	5	0.06	0	0	9	0.8	0	50	0.17	0.53	9	0.12753189	0.17	0.95		
1251750 DISPATCH COORD WINDOW	OFFICE	115	5	0.06	5	4	97	0.8	121	150	0.10	1.48	97	0.12753189	0.10	1.05		
1254 RECEPTION LOBBY	LOBBY	348	5	0.06	15	4	38	0.8	48	480	0.16	1.58	38	0.12753189	0.16	1.05		
1255 DELIVER ROOM	BREAK	1071	5	0.06	25	50	968	0.8	460	3820	0.12	1.94	368	0.12753189	0.12	1.10		
1256 KITCHENETTE	BREAK	144	5	0.06	25	4	29	0.8	36	130	0.24	1.04	29	0.12753189	0.24	0.89		
1257 VENDING AREA	CORRIDOR	148	5	0.06	0	0	9	0.8	11	400	0.03	2.7	9	0.12753189	0.03	1.10		
1258 QUIET ROOM	BREAK	244	5	0.06	25	7	50	0.8	62	240	0.26	0.98	50	0.12753189	0.26	0.87		
1259 VESTIBULE	CORRIDOR	379	5	0.06	10	4	23	0.8	28	350	0.08	0.92	23	0.12753189	0.08	1.05		
1284 CORRIDOR	CORRIDOR	495	5	0.06	0	0	30	0.8	37	105	0.35	0.21	30	0.12753189	0.35	0.77		
1293 RECYCLING	CORRIDOR	123	5	0.06	0	0	0	0.8	0	125	0.00	1.02	0	0.12753189	0.00	1.13		
1295 LOCKERS	LOCKER ROOM	307	20	0.12	0	0	0	0.8	0	200	0.00	0.65	0	0.12753189	0.00	1.13		
Total		18,331				212	2,419		3,024	18,970	0.16		2,419				0.68	

NOTE (1) - Occupancy based on furniture layout.

Outdoor air intake (Vpd)	3,571	CFM	Annual Ventilation	5,200	CFM	Meets Standard?	Y
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System population (Ps): 212 people
 Occupant density (D): 1.00 based on Appendix A
 System Ventilation efficiency (Ev): 0.68
 Unrecirculated outdoor air (Vou): 2,419 cfm
 System outdoor air intake (Voi): 3,571 cfm
 Primary system airflow (Vps): 18,970 cfm
 System outdoor air fraction: 18.8%

INTERNATIONAL MECHANICAL CODE 2009
 Annual Ventilation CFM Meets Standard? Y

Design Case Primary Outdoor Airflow (Vpd) SA CFM / SP Unrecirculated Outdoor Air Inlet (Vou/Vpd) (Vou/Vpd) (1-x)(x-zD)

Zone Population Zone Outdoor Airflow (Vpd) Zone Outdoor Airflow (Vpd) Zone Outdoor Airflow (Vpd) Zone Outdoor Airflow (Vpd)

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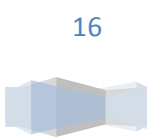
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Montgomery County Equipment Maintenance and Operations Center-Building 1

Technical Report 1 - ASHRAE Standard 62.1-2007 and Standard 90.1-2007 Analysis

Michael Tellep

RTU-3

Project: EMOC - CASEY 7 BLDG 1		INTERNATIONAL MECHANICAL CODE 2009										ASHRAE 62.1, 2004 Appendix A, Calculations							
System: RTU-3		SSEK Project 09/23/01										Uncommented Outdoor Air Intake							
Zone Identification		Design Case										You		Xs		Zd		Eyz	
Zone	Occupancy Classification	Zone Floor Area (sf)	People Outdoor Air Rate (cfm/person)	Table 403.3 Area Rate (cfm/sf)	Occupant Density (#/1000)	Zone Population	Breathing Zone Outdoor Airflow (RpZ+) (cfm)	Table 403.3.1.2 Distribution Effectiveness Ez	Zone Outdoor Airflow (cfm)	Zone Primary Outdoor Air Fraction (Voz/Vpz)	SA CFM / SF Voz/Az	(D*(Sum of all zones) RpZ+) + (Sum of all zones) RvAZ)	Ys	Zd	Eyz				
1245 ABC - OPEN OFFICES	OFFICE	244	5	0.06	5	2	25	0.8	31	0.12	1.02	25	0.134337	0.12	1.01				
1250 DISPATCH COORD LOCKER ALCOVE	STORAGE	186	5	0.12	0	0	22	0.8	28	0.37	0.4	22	0.134337	0.37	0.76				
1261 TRAINING ROOM	CLASSROOM	866	10	0.12	35	31	414	0.8	517	0.34	1.73	414	0.134337	0.34	0.79				
1262 MEN		204	0		0	0	0	0.8	0	0.00	0.49	0	0.134337	0.00	1.13				
1263 WOMEN		206	0		0	0	0	0.8	0	0.00	0.49	0	0.134337	0.00	1.13				
1264 TRAINING STORAGE	STORAGE	115	0	0.12	0	0	14	0.8	17	0.35	0.43	14	0.134337	0.35	0.79				
1265 UNIFORM STORAGE	STORAGE	262	0	0.12	0	0	31	0.8	39	0.26	0.57	31	0.134337	0.26	0.87				
1266 PERSONNEL RECORDS STORAGE	STORAGE	146	5	0.12	50	16	18	0.8	22	0.29	0.51	18	0.134337	0.29	0.84				
1267 CONFERENCE ROOM	CONFERENCE	195	5	0.06	10	2	22	0.8	124	0.21	1.91	22	0.134337	0.21	0.93				
1268 BREAK ROOM	BREAK	166	5	0.12	0	0	20	0.8	25	0.10	1.41	20	0.134337	0.10	1.04				
1271 CHAIR/TABLE STORAGE	STORAGE	160	0	0.12	0	0	19	0.8	24	0.25	0.6	19	0.134337	0.25	0.89				
1272 TRANSIT SERVICES SUPERVISOR	OFFICE	120	5	0.06	5	1	12	0.8	15	0.32	0.47	12	0.134337	0.32	0.81				
1273 TRANSIT SERVICES SUPERVISOR	OFFICE	109	5	0.06	5	1	12	0.8	14	0.05	2.42	12	0.134337	0.05	1.08				
1274 TRANSIT OPERNS SUPERVISOR	OFFICE	109	5	0.06	5	1	12	0.8	14	0.05	2.66	12	0.134337	0.05	1.08				
1275 TRANSIT OPERNS SUPERVISOR	OFFICE	120	5	0.06	5	1	12	0.8	15	0.06	2.06	12	0.134337	0.06	1.07				
1276 TRANSIT OPERNS SUPERVISOR	OFFICE	115	5	0.06	5	1	12	0.8	15	0.05	2.71	12	0.134337	0.05	1.09				
1277 TRANSIT OPERNS SUPERVISOR	OFFICE	111	5	0.06	5	1	12	0.8	15	0.05	2.58	12	0.134337	0.05	1.09				
1278 TRANSIT OPERNS SUPERVISOR	OFFICE	111	5	0.06	5	1	12	0.8	15	0.05	2.61	12	0.134337	0.05	1.08				
1279 TRANSIT OPERNS SUPERVISOR	OFFICE	110	5	0.06	5	1	12	0.8	15	0.05	2.88	12	0.134337	0.05	1.09				
1280 TRANSIT OPERNS SUPERVISOR	OFFICE	109	5	0.06	5	1	12	0.8	14	0.06	2.39	12	0.134337	0.06	1.08				
1281 SECTION CHIEF	OFFICE	167	5	0.06	5	1	15	0.8	19	0.08	1.5	15	0.134337	0.08	1.06				
1282-1 CORRIDOR	CORRIDOR	360	0	0.06	0	0	22	0.8	27	0.14	0.56	22	0.134337	0.14	1.00				
1282-2 CORRIDOR	CORRIDOR	257	0	0.06	0	0	15	0.8	19	0.19	0.39	15	0.134337	0.19	0.94				
1282-3 CORRIDOR	CORRIDOR	354	0	0.06	0	0	21	0.8	27	0.20	0.13	21	0.134337	0.20	1.00				
1282-4 CORRIDOR	CORRIDOR	195	0	0.06	0	0	12	0.8	15	0.13	0.51	12	0.134337	0.13	0.99				
1282-5 CORRIDOR	CORRIDOR	270	0	0.06	0	0	16	0.8	20	0.15	0.37	16	0.134337	0.15	0.93				
1286 VEHICLE COUNT REPORT STORAGE	STORAGE	286	5	0.12	0	0	36	0.8	44	0.37	0.41	36	0.134337	0.37	0.76				
1297 OFFWORK ROOM	COPY	236	5	0.05	5	2	24	0.8	30	0.20	0.85	24	0.134337	0.20	0.98				
1298 SCHEDULE/TRANSFER STORAGE	STORAGE	251	0	0.12	0	0	30	0.8	38	0.15	0.4	30	0.134337	0.15	0.76				
Total		6,473				63	981		1,225		7,300	981							

System population (Ps)	63	people
Occupant density (D):	1.00	based on Appendix A
System ventilation efficiency (Ev)	0.76	cfm
Uncommented outdoor air (You):	981	cfm
System outdoor air intake (Ys):	1,294	cfm
Primary system airflow (Vps)	7,300	cfm
System outdoor air fraction:	17.7%	

INTERNATIONAL MECHANICAL CODE 2009	Actual Ventilation	Meets Standard?
Outdoor air intake (Ys)	1,294	Y

NOTE (1) - Occupancy based on furniture layout.