Technical Report I

ASHRAE Standard 62.1 and 90.1 Evaluations

Charles E. Smith Center Renovation

Washington, DC

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Executive Summary

The Charles E. Smith Center is the newly renovated arena for George Washington University. It includes a basketball arena, natatorium, locker rooms, fitness center, weight room, offices, and suites in over 100,0 00SF. Construction has taken approximately 2 years.

The purpose of this technical report is to determine if the Smith Center Complies with both ASHRAE Stan dard 62.1 and ASHRAE Standard 90.1. Standard 62.1 showed that the air supply and exhaust system both were compliant as well as the ventilation rates. Standard 90.1 showed that the Smith Center also had co mpliance with its other utilities as well.

ASHRAE Standard 62.1 Evaluation

Section 5 Evaluation

Section 5.1 Natural Ventilation

This section does not apply as this project does not utilize natural ventilation because of the high humidity of a sports complex.

Section 5.2 Ventilation Air Distribution

This system should meet all ventilation requirements assuming that all of the equipment is calibrated correctly and the occupied spaces do not exceed the maximum number of people for the designated area.

Section 5.3 Exhaust Duct Location

All exhaust systems that contain potentially harmful contaminants from the kitchen or bathroom/shower areas are negatively pressurized at 3in W.G so as to prevent the cross contamination to supply systems.

Section 5.4 Ventilation System Controls

This control system consists of a Building Automated System with direct digital control to all field panels. All field panels are to communicate back to the Operator's Work Station and are to utilize interchangeable parts for ease of replacement.

Section 5.5 Airstream Surfaces

The system employed here uses mostly sheet metal and metal fasteners which are resistant to mold and erosion.

Section 5.6 Outdoor Air Intakes

All of the intake locations are above ground level and meet the required distance from any potential contaminants. Intakes are also properly designed to keep out rain and birds from the airflow.

Section 5.7 Local Capture of Contaminants

This section does not apply as this project does not utilize non-combustion equipment.

Section 5.8 Combustion Air

All equipment that require combustion have an exhaust to the outside to remove potential contaminants from the building.

Section 5.9 – Particulate Matter Removal

Air filters for the Smith Center have a minimum MERV rating of 8 which exceeds the required MERV rating of 6.

Section 5.10 – Dehumidification Systems

Most environmental conditions are set to have a relative humidity level of 35% - 50% or 40% - 60% in the racquetball court which are both under the required 65%. The spaces that do not adhere to this are the pool and sauna areas that are exempt from this requirement.

Section 5.11 – Drain Pans

All drain pans are of 18 or 20 gauge galvanized steel or zinc chromate treated and are self-draining to eliminate buildup or overflow.

Section 5.12 – Finned-Tube Coils and Heat Exchangers

All cooling coils and heat exchangers have the necessary drain pans underneath them.

Section 5.13 – Humidifiers and Water-Spray Systems

Humidifiers have type K or L copper pipe running to 304 stainless steel dispersion tubes that have total steam absorption in a maximum of 3 feet. Associated dielectric fittings are used and potable water.

Section 5.14 – Access for Inspection, Cleaning, and Maintenance

All access panels are a minimum of 12" x 16" and have a steel construction frame of 16 USG and and 14 USG panel door. Doors are sized to be able to fully open. Any type of concealed cleanout, valve, union, etc. also has an access panel.

Section 5.15 – Building Envelope and Interior Surfaces

The Smith Center has the appropriate vapor and liquid barrios on the exterior of the building along with insulation covering any pipe or duct that could potentially cause condensation buildup.

Section 5.16 – Buildings with Attached Parking Garages

This section does not apply as this project does not contain an attached parking garage.

Section 5.17 – Air Classification and Recirculation

Most of the air is classified as Class 1 in the offices and circulations and Class 2 in the locker rooms and fitness areas. All of the Class 4 air from the kitchen is exhausted.

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

This section does not apply as the Smith Center is a non-smoking facility with a minimum smoking distance of 25ft away from the exterior of the building.

Section 6 Evaluation

Ventilation Rate Procedure:

Breathing Zone Outdoor Airflow (V_{bz})

$$V_{bz} = R_p * P_z + R_a * A_z \quad (6\text{-}1)$$

Where: R_p = outdoor airflow rate required per person

P_z = the largest number of people expected to occupy the zone

R_a = outdoor airflow rate required per unit area

A_z = the net occupiable floor area of the zone

Zone Outdoor Airflow (V_{oz})

$$V_{oz} = V_{bz} / E_z \quad (6\text{-}2)$$

Where: $E_z = 1.0$

100% Outdoor Air Systems (V_{ot})

$$V_{ot} = \sum_{\text{all zones}} * V_{oz} \quad (6\text{-}4)$$

Primary Outdoor Air Fraction (Z_p)

$$Z_p = V_{oz} / V_{pz} \quad (6\text{-}5)$$

Where: V_{pz} = the zone primary airflow

Using these equations and the chart in the Appendix you are able to determine the ventilation rate of each AHU and the zones associated with it.

ASHRAE Standard 62.1 Conclusion

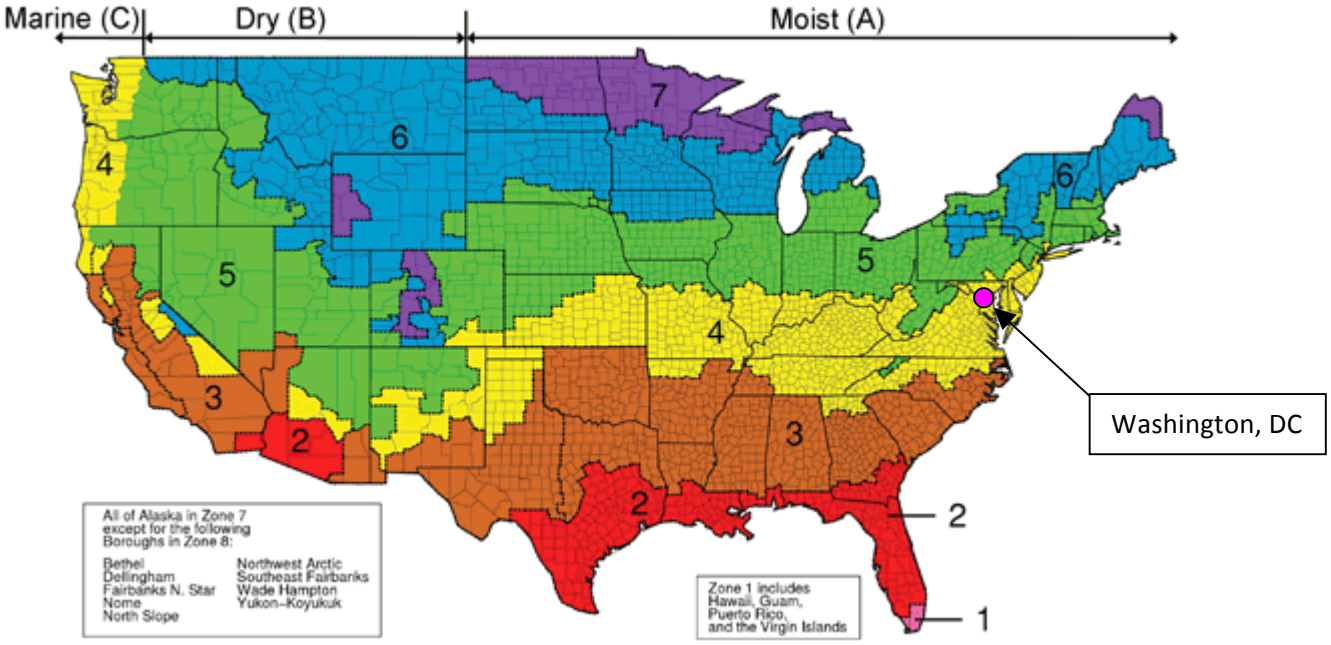
From the findings found in both Section 5 and Section 6 we can conclude that the Charles E. Smith Center is compliant with ASHRAE 62.1.

ASHRAE Standard 90.1 Evaluation

Section 5 - Building Envelope

5.1.4 - Climate

From the figure below the project site is located in climate zone 4.



5.4 - Manditory Provisions

All joints around fenestration and door frames are to be sealed to decrease any infiltration. All service doors are to have replaceable, adjustable, continuous, and compressible weather-stripping on both the top and bottom. The main entrances are all through vestibules greater than 7ft from exterior door to interior door.

5.5 - Prescriptive Building Envelope Option

The Smith Center has its minimum R-Values above the required R-Values and maximum U-Values below the required U-Values for walls, roofs, floors, and fenestration.

Section 6 - HVAC

Section 7 - Service Water Heating

The hot water heater has a greater efficiency than the required 85% and there is also a heat recovery system to help save energy as well.

Section 8 - Power

All feeders and branch circuits are sized to cohere with a maximum voltage drop of 2% and 3% respectively at design loads.

ASHRAE Standard 90.1 Conclusion

From the findings found in Sections 5 and Section 8 we can conclude that the Charles E. Smith Center is compliant with ASHRAE 90.1.

References

- ANSI/ASHRAE Standard 62.1-2007 Ventilation for Acceptable Indoor Air Quality

- ANSI/ASHRAE/IESNA Standard 90.1-2007 Energy Standard for Buildings Except Low-Rise Residential Buildings

Appendix

Building:	Charles E. Smith Center Renovation								
System Tag/Name:									
Operating Condition Description:									
Units (select from pull-down list)	IP								
Inputs for System	**Name**	**Units**			**System**				
Floor area served by system	As	sf			0				
Population of area served by system (including diversity)	Ps	P	100% diversity		0				
Design primary supply fan airflow rate	Vpsd	cfm			0				
OA req'd per unit area for system (Weighted average)	Ras	cfm/sf			0.00				
OA req'd per person for system area (Weighted average)	Rps	cfm/p			0.0				
Inputs for Potentially Critical zones						**Potentially Critical Zones**			
Zone Name		*Zone title turns purple italic for critical zone(s)*				*enter name*	*enter name*	*new zone*	*new zone*
Zone Tag						enter tag	enter tag	New zone ID	New zone ID
Space type		Select from pull-down list				Restaurant dining rooms	Office space	Office space	Office space
Floor Area of zone	Az	sf							
Design population of zone	Pz	P	(default value listed; may be overridden)			0	0	0	0
Design total supply to zone (primary plus local recirculated)	Vdzd	cfm							
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?		Select from pull-down list or leave blank if N/A							
Local recirc. air % representative of ave system return air	Er								
Inputs for Operating Condition Analyzed									
Percent of total design airflow rate at conditioned analyzed	Ds	%			100%	100%	100%	100%	100%
Air distribution type at conditioned analyzed		Select from pull-down list				CS	CS	CS	CS
Zone air distribution effectiveness at conditioned analyzed	Ez					1.00	1.00	1.00	1.00
Primary air fraction of supply air at conditioned analyzed	Ep								
Results									
Ventilation System Efficiency	Ev				#DIV/0!	#DIV/0!			
Outdoor air intake required for system	Vot	cfm			#DIV/0!				
Outdoor air per unit floor area	Vot/As	cfm/sf			#DIV/0!				
Outdoor air per person served by system (including diversity)	Vot/Ps	cfm/p			#DIV/0!				
Outdoor air as a % of design primary supply air	Ypd	cfm			#DIV/0!	#DIV/0!			
Detailed Calculations									
Initial Calculations for the System as a whole									
Primary supply air flow to system at conditioned analyzed	Vps	cfm	= VpdDs	=	0				
UncorrectedOA requirement for system	Vou	cfm	= Rps Ps + Ras As	=	0				
Uncorrected OA req'd as a fraction of primary SA	Xs		= Vou / Vps	=	0.00				
Initial Calculations for individual zones									
OA rate per unit area for zone	Raz	cfm/sf				0.18	0.06	0.06	0.06
OA rate per person	Rpz	cfm/p				7.50	5.00	5.00	5.00
Total supply air to zone (at condition being analyzed)	Vdz	cfm	###			0	0	0	0
Unused OA req'd to breathing zone	Vbz	cfm	= Rpz Pz + Raz Az	=		0.0	0.0	0.0	0.0
Unused OA requirement for zone	Voz	cfm	= Vbz/Ez	=		0	0	0	0
Fraction of zone supply not directly recirc. from zone	Fa		= Ep + (1-Ep)Er	=		1.00	1.00	1.00	1.00
Fraction of zone supply from fully mixed primary air	Fb		= Ep	=		1.00	1.00	1.00	1.00
Fraction of zone OA not directly recirc. from zone	Fc		= 1-(1-Ez)(1-Ep)(1-Er)	=		1.00	1.00	1.00	1.00
Unused OA fraction required in supply air to zone	Zd		= Voz / Vdz	=		0.00	0.00	0.00	0.00
Unused OA fraction required in primary air to zone	Zp		= Voz / Vpz	=		0.00	0.00	0.00	0.00
System Ventilation Efficiency									
Zone Ventilation Efficiency (App A Method)	Evz		= (Fa + FbXs - FcZ) / Fa	=		1.00	1.00	1.00	1.00
System Ventilation Efficiency (App A Method)	Ev		= min (Evz)	=	**1.00**				
Ventilation System Efficiency (Table 6.3 Method)	Ev		= Value from Table 6.3	=	1.15				
Minimum outdoor air intake airflow									
Outdoor Air Intake Flow required to System	Vot	cfm	= Vou / Ev	=	**#DIV/0!**				
OA intake req'd as a fraction of primary SA	Y		= Vot / Vps	=	**#DIV/0!**				
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Vot	cfm	= Vou / Ev	=	0	**#DIV/0!**			
OA intake req'd as a fraction of primary SA (Table 6.3 Method)	Y		= Vot / Vps	=	#DIV/0!	**#DIV/0!**			
OA Temp at which Min OA provides all cooling									
OAT below which OA Intake flow is @ minimum		Deg F	= {(Tp-dTsf)-(1-Y)*(Tr+dTri	=	#DIV/0!				