
ASHRAE STANDARD 62 VENTILATION REPORT



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NATIONAL AUDIO VISUAL CONSERVATION CENTER

CULPEPER COUNTY, VA

PREPARED FOR:

JAE-WEON JEONG, PH.D.

THE PENNSYLVANIA STATE UNIVERSITY

DEPARTMENT OF ARCHITECTURAL ENGINEERING

PREPARED BY:

MALORY J. FAUST

MECHANICAL OPTION

OCTOBER 6, 2006



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EXECUTIVE SUMMARY

The National Audio Visual Conservation Center mechanical systems were evaluated with ASHRAE Standard 62.1 – 2004 to verify that the ventilation requirements were met by the design. The building serves many different functions including storage spaces for different media types, conservation office and lab space where the media is restored and conserved, and public areas to view and listen to the media.

Each type of space requires a different amount of ventilation for its purposes. The vaults require ventilation only to prevent the chemicals they emit from building up to unacceptable levels, but require very little ventilation for people, since they are rarely occupied.

The conservation labs and workrooms are generally served by 100 % outdoor air units due to the amount of air exhausted to keep the chemical concentrations under the specified limits.

Public and offices spaces are served through variable volume air handling units and were designed according to ASHRAE 62.1 2001. For this reason the design values were expected to vary from the calculations provided with this report.



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ASSUMPTIONS

- No ventilation is required in unoccupied spaces including mechanical rooms, electrical rooms, shafts, and communications closets.
- Outdoor air conditions will be suitable for ventilation purposes.
- Where occupancy is not known, occupant density will be taken from Table 6-1.



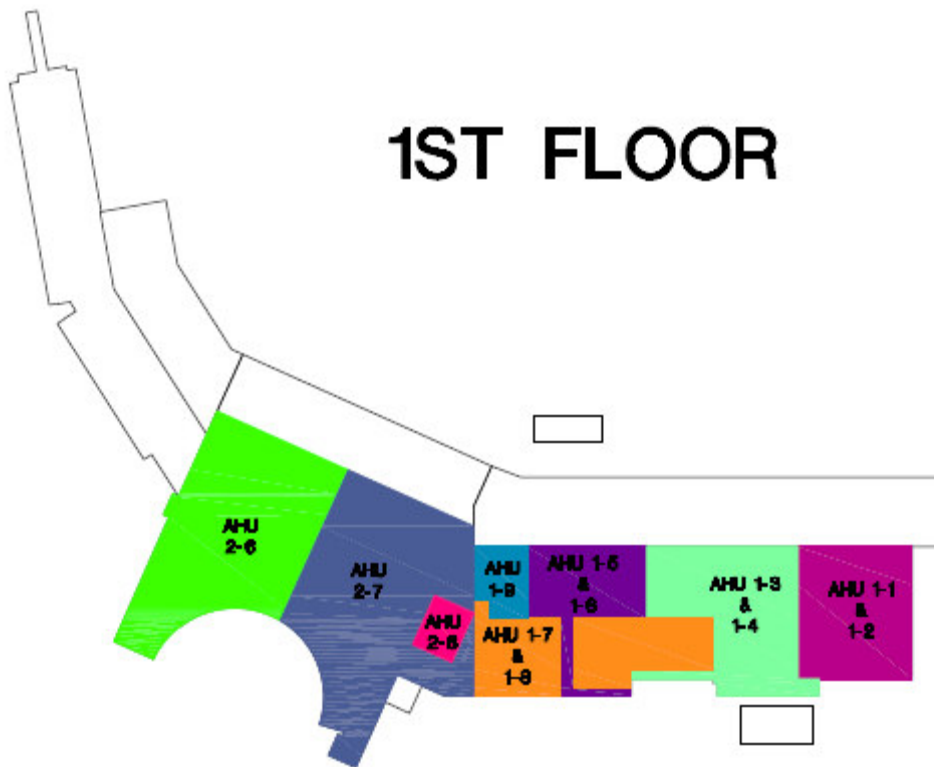
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AHU ZONING

The AHU zoning is broken up based upon the function of each space. Since more than one AHU may serve each a given section of the building, only one of each major AHU function was analyzed. Below is a diagrammatical break down of AHU zoning followed by a table providing the functions:



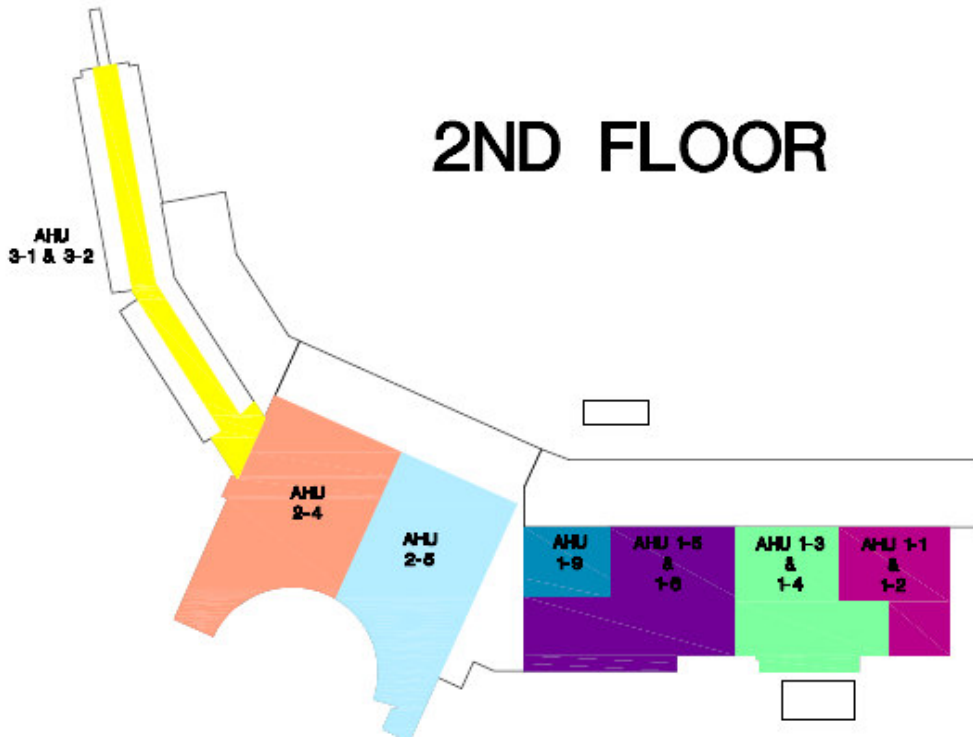


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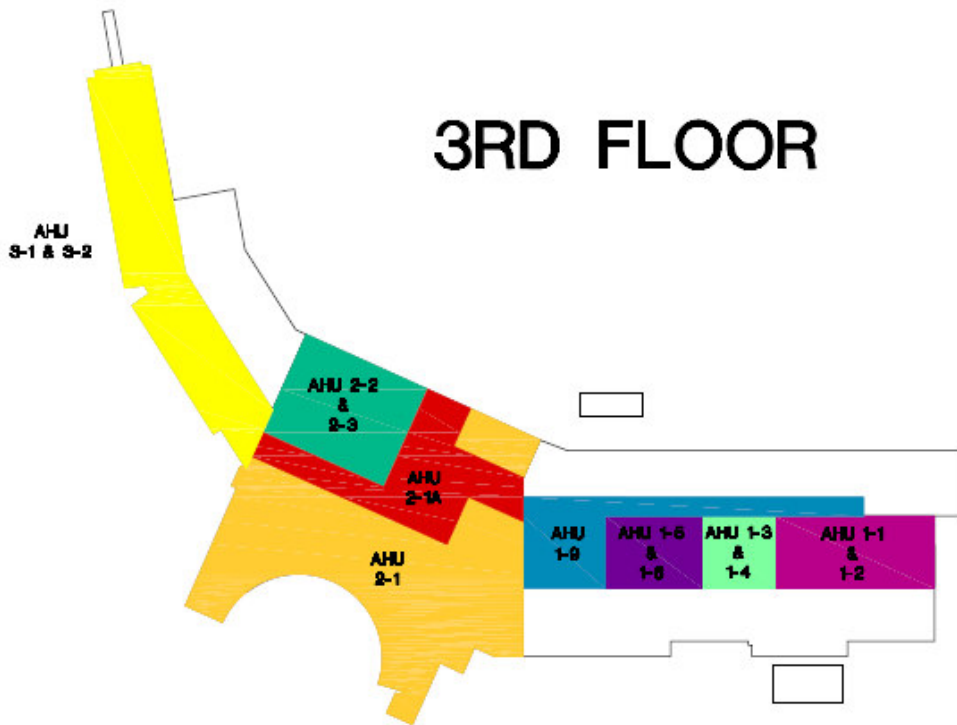
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2ND FLOOR



3RD FLOOR





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AHU Tag	Location	Service
AHU 1-1	4 th Floor Collections Building	Collections Vaults
AHU 1-2	4 th Floor Collections Building	Collections Vaults
AHU 1-3	4 th Floor Collections Building	Collections Vaults
AHU 1-4	4 th Floor Collections Building	Collections Vaults
AHU 1-5	4 th Floor Collections Building	Collections Vaults
AHU 1-6	4 th Floor Collections Building	Collections Vaults
AHU 1-7	4 th Floor Collections Building	Collections Vaults
AHU 1-8	4 th Floor Collections Building	Collections Vaults
AHU 1-9	4 th Floor Collections Building	Collections Office
AHU 1-10	4 th Floor Collections Building	Main Electrical Room
AHU 2-1	4 th Floor Collections Building	Cons 3 rd Floor office
AHU 2-1A	4 th Floor Collections Building	Cons A/V Lab
AHU 2-2	4 th Floor Collections Building	Cons Film Lab
AHU 2-3	4 th Floor Collections Building	Cons Film Lab
AHU 2-4	2 nd Floor Conservation Bldg	Cons 2 nd Floor office
AHU 2-5	2 nd Floor Conservation Bldg	Cons 2 nd Floor office
AHU 2-6	1 st Floor Conservation Bldg	Cons 1 st Floor office
AHU 2-7	1 st Floor Conservation Bldg	Cons 1 st Floor office
AHU 2-8	1 st Floor Conservation Bldg	Theater
AHU 2-9	1 st Floor Conservation Bldg	Holding Room
AHU 3-1	Nitrate Vault Mech Room	Nitrate Vaults
AHU 3-1	Nitrate Vault Mech Room	Nitrate Vaults



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CALCULATIONS

AHU 1-1 & 1-2:

AHU 1-1 and 1-2 represent the typical pair of units that supply a region of the Collection Vaults. These units are each constant air volume dessicant units supplying 20,000 CFM each. Since the content of the vaults is sensitive, each unit is capable of supplying 100% Outdoor air for smoke evacuation purposes. In this case the ventilation rate is driven primarily by the requirements for the content of the vaults, the 15% outdoor air that each unit supplies is enough for each unit to meet the standard 62 requirements as shown in the table on the following page.

Project Name	NAVCC
System Tag	AHU 1-1 & 1-2
Location	4th Floor Collections, Part C
Service	Collections Vaults
Design Total CFM	20000 CFM Each
Design OA CFM	3000 CFM Each
% OA	15%

A_z	Floor Area (SF)	V_{pz}	Primary airflow (w/o local recirculation)
P_z	Maximum # of Occupants	V_{dz}	Supply airflow (incl. local recirculation)
R_a	OA per ft ² (CFM/SF)	V_{dzm}	Minimum airflow
R_p	OA per person (CFM/person)	Z_p	OA Fraction
A_z*R_a	Uncorrected CFM/SF	E_v	Ventilation Efficiency
P_z*R_p	Uncorrected CFM/Person	E_z	Zone air dist effectiveness
V_{oz}	Corrected OA = A _z *R _a + P _z *R _p /E _z		

Room Name	Room Type	A _z	P _z	R _a	R _p	A _z *R _a	P _z *R _p	E _z	V _{oz}	V _{pz}	V _{dz}	Z _p
Future Development	Bank vaults/safe deposit	5457	1	0.06	5	327	5	1	332	8850	10050	0.038
Electric Room	Storage rooms	48	0	0.12	0	6	0	1	6	75	75	0.077
Security Room	Office space	48	1	0.06	5	3	5	1	8	75	75	0.105
Corridor	Corridors	1580	0	0.06	0	95	0	1	95	1320	1320	0.072
NFPA Vault 1218	Bank vaults/safe deposit	2304	1	0.06	5	138	5	1	143	2460	2460	0.058
NFPA Vault 1227	Bank vaults/safe deposit	1440	1	0.06	5	86	5	1	91	1880	1880	0.049
NFPA Vault 1225	Bank vaults/safe deposit	1440	1	0.06	5	86	5	1	91	1880	1880	0.049
NFPA Vault 1223	Bank vaults/safe deposit	1760	1	0.06	5	106	5	1	111	1810	1810	0.061
Electric Room	Storage rooms	48	0	0.12	0	6	0	1	6	100	100	0.058
Security Room	Office space	48	1	0.06	5	3	5	1	8	100	100	0.079
Unoccupied		692	0	N/A	N/A	0	0	1	0	140	140	0.000
Vault 1116	Bank vaults/safe deposit	2000	1	0.06	5	120	5	1	125	2700	2700	0.046
Vault 1118	Bank vaults/safe deposit	2000	1	0.06	5	120	5	1	125	2700	2700	0.046
Vault 1113	Bank vaults/safe deposit	2576	1	0.06	5	155	5	1	160	2700	2700	0.059
Vault 1120	Bank vaults/safe deposit	2000	1	0.06	5	120	5	1	125	2700	2700	0.046
Vault 1122	Bank vaults/safe deposit	2000	1	0.06	5	120	5	1	125	2700	2700	0.046
Vault 1115	Bank vaults/safe deposit	2240	1	0.06	5	134	5	1	139	3000	3000	0.046
Vault 1117	Bank vaults/safe deposit	1440	1	0.06	5	86	5	1	91	2850	2850	0.032
Corridor	Corridors	1260	0	0.06	0	76	0	1	76	1110	1110	0.068

P_s	System Population	5
D	Occupant Diversity Ratio	0.36
V_{ou}	Uncorrected OA intake	708
Z_{p,max}	Max Z _p	0.105
E_v	Ventilation Efficiency	1
V_{OT}	System OA intake	708
V_{PS}	System primary supply	39150
X_s	System Mixed Air Ratio	0.018



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AHU 1-7 & 1-8

The function of these units is to serve the low temperature vaults housing the motion picture storage. Like the standard collection vault units, these air handlers are also constant air volume dessicant units. They supply 9000 CFM of 32 degree air which is then cooled by recooling coils and served to the space at 15 degrees. Since there is a very low occupancy load on these units, the 12% outdoor air that is supplied by the unit meets the ASHRAE 62 requirements when diversity is applied.

Project Name	NAVCC
System Tag	AHU 1-7 & 1-8
Location	4th Floor Collections
Service	Low Temp Vaults
Design Total CFM	9000 CFM Each
Design OA CFM	1120 CFM Each
% OA	12%

A_z	Floor Area (SF)	V_{pz}	Primary airflow (w/o local recirculation)
P_z	Maximum # of Occupants	V_{dz}	Supply airflow (incl. local recirculation)
R_a	OA per ft ² (CFM/SF)	V_{dzm}	Minimum airflow
R_p	OA per person (CFM/person)	Z_p	OA Fraction
A_z*R_a	Uncorrected CFM/SF	E_v	Ventilation Efficiency
P_z*R_p	Uncorrected CFM/Person	E_z	Zone air dist effectiveness
V_{oz}	Corrected OA = A _z *R _a + P _z *R _p /E _z		

Room Name	Room Type	A _z	P _z	R _a	R _p	A _z *R _a	P _z *R _p	E _z	V _{oz}	V _{pz}	V _{dz}	Z _p
Corridor	Corridors	312	0	0.06	0	19	0	1	19	190	190	0.099
Vault 1102	Bank vaults/safe deposit	2552	1	0.06	5	153	5	1	158	4440	4440	0.036
Unoccupied		1120	0	0	0	0	0	1	0	160	160	0.000
Vault 1104	Bank vaults/safe deposit	2816	1	0.06	5	169	5	1	174	4800	4800	0.036
Vestibule	Corridors	240	4	0.06	0	14	0	1	14	200	200	0.072
Vault 1106	Bank vaults/safe deposit	2848	1	0.06	5	171	5	1	176	3375	3375	0.052
Vault 1108	Bank vaults/safe deposit	1392	1	0.06	5	84	5	1	89	2000	2000	0.044
Vault 1110	Bank vaults/safe deposit	2264	1	0.06	5	136	5	1	141	2835	2835	0.050

P_s	System Population	3
D	Occupant Diversity Ratio	0.33
V_{ou}	Uncorrected OA intake	273
Z_{p,max}	Max Z _p	0.099
E_v	Ventilation Efficiency	1.0
V_{OT}	System OA intake	273
V_{PS}	System primary supply	18000
X_s	System Mixed Air Ratio	0.015



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AHU 2-1

This air handling unit is one of the few typical units in the building. Because it serves primarily office spaces it is a variable air volume unit serving 22,500 CFM with a minimum of 25% is outdoor air. Since this building was designed following ASHRAE standard 62.1 2001, the outdoor air requirements vary somewhat due to the higher ventilation rate per person and the lack of ventilation per square foot. Although this causes the ventilation rates to be low in spaces such as storage rooms, the overall system still meets Standard 62.1 2004.

Project Name	NAVCC
System Tag	AHU 2-1
Location	4th Floor Collections
Service	Conservation 3rd Floor Office
Design Total CFM	22500 CFM Each
Design OA CFM	5700 CFM Each
% OA	25%

A_z	Floor Area (SF)	V_{pz}	Primary airflow (w/o local recirculation)
P_z	Maximum # of Occupants	V_{dz}	Supply airflow (incl. local recirculation)
R_a	OA per ft ² (CFM/SF)	V_{dzm}	Minimum airflow
R_p	OA per person (CFM/person)	Z_p	OA Fraction
$A_z * R_a$	Uncorrected CFM/SF	E_v	Ventilation Efficiency
$P_z * R_p$	Uncorrected CFM/Person	E_z	Zone air dist effectiveness
V_{oz}	Corrected OA = $A_z * R_a + P_z * R_p / E_z$		

Room Name	Room Type	A_z	P_z	R_a	R_p	$A_z * R_a$	$P_z * R_p$	E_z	V_{oz}	V_{pz}	V_{dz}	Z_p
Open Office	Office space	9000	45	0.06	5	540	225	1	765	10375	3112.5	0.246
Tape Bake	Photo studios	112	2	0.12	5	13	10	1	23	205	61.5	0.381
Tape Prep	Photo studios	180	2	0.12	5	22	10	1	32	200	60	0.527
Disc Prep	Photo studios	700	7	0.12	5	84	35	1	119	795	238.5	0.499
Clean Holding	Storage rooms	96	0	0.12	0	12	0	1	12	90	27	0.427
Storage	Storage rooms	210	0	0.12	0	25	0	1	25	200	60	0.420
Stair Press		N/A	0	0	0	0	0	1	0	650	195	0.000
Corridor	Corridors	320	0	0.06	0	19	0	1	19	160	48	0.400
Storage	Storage rooms	80	0	0.12	0	10	0	1	10	95	28.5	0.337
Corridor	Corridors	350	0	0.06	0	21	0	1	21	195	58.5	0.359
Holding	Storage rooms	220	0	0.12	0	26	0	1	26	185	55.5	0.476
Tape Rewind	Office space	300	2	0.06	5	18	10	1	28	285	85.5	0.327
Corridor	Corridors	1632	0	0.06	0	98	0	1	98	1820	546	0.179
Office	Office space	300	2	0.06	5	18	10	1	28	300	90	0.311
Video Edit	Office space	456	3	0.06	5	27	15	1	42	400	120	0.353
Lab Head	Office space	143	1	0.06	5	9	5	1	14	110	33	0.412
CTO/P	Office space	143	1	0.06	5	9	5	1	14	110	33	0.412
D 3102	Office space	276	2	0.06	5	17	10	1	27	210	63	0.422
A/V Maintenance	Office space	552	3	0.06	5	33	15	1	48	430	129	0.373
Section Head	Office space	415	2	0.06	5	25	10	1	35	260	78	0.447
Research Fellow	Office space	1380	7	0.06	5	83	35	1	118	2050	615	0.192
Conference	Conference / meeting	256	6	0.06	5	15	30	1	45	740	222	0.204
Equipment	Storage rooms	728	0	0.12	0	87	0	1	87	470	141	0.620
Media Prep	Photo studios	550	6	0.12	5	66	30	1	96	800	240	0.400
Restrooms		624	0	0	0	0	0	1	0	300	90	0.000
Expansion	Office space	3520	18	0.06	5	211	90	1	301	3800	1140	0.264
Screening	Media Center	2050	10	0.12	10	246	100	1	346	2000	600	0.577
Corridor	Corridors	288	0	0.06	0	17	0	1	17	150	45	0.384

P_s	System Population	119
D	Occupant Diversity Ratio	1.00
V_{ou}	Uncorrected OA intake	2396
$Z_{p,max}$	Max Z_p	0.620
E_v	Ventilation Efficiency	0.6
V_{OT}	System OA intake	3993
V_{PS}	System primary supply	27385
X_s	System Mixed Air Ratio	0.146



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AHU 3-1 & 3-2

Due to the small size of the vaults in the Nitrate Building, each vault will rarely experience any occupant load. Because of this, diversity has a large effect on the ventilation requirements, and again the ventilation rates are determined mainly due to the content of the vaults. Therefore, each AHU supplying 20,000 CFM at 10 % outdoor air meet the requirements set in ASHRAE Standard 62 2004.

Project Name	NAVCC
System Tag	AHU 3-1 & 3-2
Location	Nitrate Vaults Mech Room
Service	Nitrate Vaults Mech Room
Design Total CFM	20000 CFM Each
Design OA CFM	2000 CFM Each
% OA	10%

A_z	Floor Area (SF)	V_{pz}	Primary airflow (w/o local recirculation)
P_z	Maximum # of Occupants	V_{dz}	Supply airflow (incl. local recirculation)
R_a	OA per ft ² (CFM/SF)	V_{dzm}	Minimum airflow
R_p	OA per person (CFM/person)	Z_p	OA Fraction
A_z*R_a	Uncorrected CFM/SF	E_v	Ventilation Efficiency
P_z*R_p	Uncorrected CFM/Person	E_z	Zone air dist effectiveness
V_{oz}	Corrected OA = A _z *R _a + P _z *R _p /E _z		

Room Name	Room Type	A _z	P _z	R _a	R _p	A _z *R _a	P _z *R _p	E _z	V _{oz}	V _{pz}	V _{dz}	Z _p
Vaults	Bank vaults/safe deposit	13330	124	0.06	5	800	620	1	1420	31000	31000	0.046
Corridor	Corridors	2960	0	0.06	0	178	0	1	178	4810	4810	0.037

Ps	System Population	3
D	Occupant Diversity Ratio	0.02
V_{ou}	Uncorrected OA intake	644
Z_{p,max}	Max Z _p	0.046
E_v	Ventilation Efficiency	1.0
V_{OT}	System OA intake	644
V_{PS}	System primary supply	35810
X_s	System Mixed Air Ratio	0.018



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CONCLUSION

After completing the calculations shown in the previous section all units in the building comply with ASHRAE Standard 62 2004. The units not evaluated in this section are either comparable to the evaluated units, serve spaces not requiring ventilation, or serve 100% outdoor air and do not require a calculation to prove compliance.



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