Technical Assignment 1

ASHRAE Standard 62.1-2004
Ventilation Compliance Evaluation

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Executive Summary:

ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality, analyzes the amount of outdoor air intake needed to provide adequate ventilation. The Center for the Arts on the campus of the University of Delaware is a 52,000 square foot performing arts center that includes a proscenium theatre, recital hall, orchestra rehearsal, theatre rehearsal, practice rooms and administrative offices. Six air-handling units service the Center for the Arts, four constant volume and two variable air volume, ranging from 7,000 cfm to 35,000 cfm providing a total of 89,050 cfm.

The ventilation effectiveness for each zone needed to be assumed in order to complete the ventilation rate procedure. For the variable air volume units the ventilation effectiveness can be assumed by assuming that the air is supplied and returned to the spaces is through ceiling diffusers (E_z=0.8). The unit servicing the Recital Hall air is supplied through an under floor distribution system due to stringent noise criteria rating for the space (E_z=1.2). The remaining units that service the proscenium seating, proscenium stage and orchestra rehearsal respectively supply and return air through the ceiling but due to the height of the spaces the supply temperature is less then 15 degrees above space temperature (E_z=1.0).

Standard 62 was used to determine the minimum amount of outdoor air the air handling units need to supply to there respective spaces. Using Standard 62 it was found that the air handling units supply from 10% to 51% outdoor air. For all the air-handling units the sum of the zone outdoor airflow (ΣV_{oz}) was less then the design outdoor air intake airflow (V_{ot}). The scheduled minimum outdoor air is such that all units will provide their zones with at least the minimum required outdoor air as specified in Standard 62.1-2004. The maximum outdoor air fraction for the entire Center for the Arts is 0.86, which occurs in the Lobby on the north side of the building. All the air-handling units were found to comply with the ASHRAE Standard 62.1-2004 ventilation rate procedure.

ASHRAE Standard 62.1-2004 vs. IAQ:

The ASHRAE Standard 62.1 ventilation rate procedure determines outdoor intake rates based on the space use, occupancy and floor area. The spaces served by each air-handling unit are divided up into zones. The use of each zone dictates the people outdoor air rate and the area outdoor air rate. From the ASHRAE designated minimum ventilation rates and the zone air distribution effectiveness the outdoor air intakes are determined.

The Indoor Air Quality (IAQ) procedure determines the outdoor air intake based on contaminant concentration levels. The IAQ procedure does not account for perceived indoor air quality due to factors relating to thermal comfort, lighting, noise, and vibration.

The IAQ procedure provides better design criteria if the spaces evaluated are producing a large amount of contaminates or are sensitive to contaminate levels and concentrations. The ventilation rate procedure does take into account contaminate levels in the amount of air that needs to be supplied per person and per square foot of floor area. The amount of outdoor air combats the minimum contaminate levels for typical spaces.

Assumptions:

ASHRAE Standard 62.1-2004 assumes that the outdoor air intake is sufficiently far away from the exhausted air of the building to ensure that outdoor air supply is not recirculating exhausted air.

It is assumed that when less then 100% outdoor is supplied that the outdoor air is evenly mixed with the recirculated return air.

The majority of the spaces in the Center for the Arts directly fell in the occupancy categories listed in Table 6-1. For those that did not directly correlate to an occupancy category I made the following assumptions:

Light and sound booths; dressing rooms; and practices rooms are similar to office spaces.

Green rooms are similar to conference or meeting rooms.

Theatre rehearsal is similar to a multi-use assembly area.

The occupant diversity (D) factor is 1.0. The zone air distribution effectiveness varies by air-handling unit. For AHU-1 and AHU-4 the $E_z = 0.8$, ceiling supply of warm air 15˚F or more above space temperature and ceiling return. For AHU-2, AHU-3, and AHU-6 the $E_z = 1.0$, ceiling supply of warm air less then 15˚F above space temperature and ceiling return. For AHU-5 $E_z = 1.2$, floor supply of cool air and ceiling return.

Appendix A is used to determine System Ventilation Efficiency when the max Z_p exceeds 0.55.

Sample Calculations for AHU-2:

- Determine area and occupancy of zones of air-handling unit.

Room Number	Room Name	Area (Sq. Ft)	Occupancy
155	Proscenium Theatre Seating	4,387	502

- From Table 6-1 identify People Outdoor Air Rate (cfm/person) and Area Outdoor Air Rate (cfm/sq. ft) based on occupancy use.

	R_p	R_a
Space Description	CFM/ person	CFM/ ft^2
Auditorium Seating	5	0.06

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

  V_{bz} = (5 cfm/person) * (502 people) + (0.06 cfm/ft^2) * (4387 ft^2)
  V_{bz} = 2773 cfm

- Design zone outdoor airflow, V_{oz}
  $V_{oz} = V_{bz} / E_z$

  E_z = 1.0 (determined from Table 6-2)
  V_{oz} = (2773 cfm) / 1.0
  V_{oz} = 2773 cfm

- Primary outdoor air fraction, Z_p
  $Z_p = V_{oz} / V_{pz}$

  V_{pz} = 7900 cfm (zone primary airflow)
  Z_p = (2773 cfm) / (7900 cfm)
  Z_p = 0.35

- Uncorrected outdoor air intake, V_{ou}
  $V_{ou} = D * \Sigma_{all\ zones} R_p P_z + \Sigma_{all\ zones} R_a A_z$
  V_{ou} = (1.0) * (2510 cfm) + (263 cfm)
  V_{ou} = 2773 cfm

- Outdoor air intake, V_{ot}
  $V_{ot} = V_{ou} / E_v$

E_v = 0.80 (determined from Table 6-3, Z_p = 0.35)
V_{ot} = (2773 cfm) / (0.80)
V_{ot} = 3467 cfm

- Minimum outdoor air percentage
  OA_{min} = V_{ot} / AHU total airflow * 100

  OA_{min} = (3467 cfm) / (7900 cfm) * 100
  OA_{min} = 44%

Summary of Findings:

AHU-1
Air-Handling Unit 1 is a variable air volume unit that supplies 19,200cfm to 19 zones. This air-handling unit serves the Orchard Street lobby on the south side of the building as well as corridors and interior spaces. According to ASHRAE Standard 62.1-2004, the minimum outdoor air percentage was found to be 35%. The nominal amount of outdoor air or sum of the zones outdoor air was 5,312cfm. The required outdoor air for the air-handling unit was 6,674cfm. In order to comply with ASHRAE Standard 62.1 the scheduled minimum amount of outdoor air was bumped up to 6700cfm. The maximum Z_p is 0.81 and it occurs in the Concessions area.

AHU-2
Air-Handling Unit 2 is a constant air volume unit that supplies 7,900cfm to one zone. This air-handling unit serves the Proscenium Theatre seating area. According to ASHRAE Standard 62.1-2004, the minimum outdoor air percentage was found to be 44%. The nominal amount of outdoor air or sum of the zones outdoor air was 2,773cfm. The required outdoor air for the air-handling unit was 3,467cfm. In order to comply with ASHRAE Standard 62.1 the scheduled minimum amount of outdoor air was bumped up to 4,000cfm. The maximum Z_p is 0.35 and it occurs in the Proscenium seating area.

AHU-3
Air-Handling Unit 3 is a constant air volume unit that supplies 9,450 cfm to one zone. This air-handling unit serves the Proscenium Theatre stage. According to ASHRAE Standard 62.1-2004, the minimum outdoor air percentage was found to be 8%. The nominal amount of outdoor air or sum of the zones outdoor air was 786 cfm. The required outdoor air for the air-handling unit was 786cfm. In order to comply with ASHRAE Standard 62.1 the scheduled minimum amount of outdoor air was bumped up to 950 cfm. The maximum Z_p is 0.08 and it occurs on the Proscenium stage.

AHU-4
Air-Handling Unit 4 is a variable air volume unit that supplies 35,000cfm to 62 zones. This air-handling unit serves the lower level, theatre rehearsal, back of the house interior spaces, and practice rooms on the second level. According to ASHRAE Standard 62.1-2004, the minimum outdoor air percentage was found to be 33%. The nominal amount of outdoor air or sum of the zones outdoor air was 6,314cfm. The required outdoor air for the air-handling unit was 11,389cfm. In order to comply with ASHRAE Standard 62.1 the scheduled minimum amount of outdoor air was bumped up to 11,700cfm. The maximum Z_p is 0.86 and it occurs in the North Lobby.

AHU-5
Air-Handling Unit 5 is a constant air volume unit that supplies 10,500cfm to one zone through an under floor distribution system. This air-handling unit serves the Recital Hall seating area and stage. According to ASHRAE Standard 62.1-2004, the minimum outdoor air percentage was found to be 17%. The nominal amount of outdoor air or sum of the zones outdoor air was 1,322cfm. The required outdoor air for the air-handling unit

was 1,763cfm. In order to comply with ASHRAE Standard 62.1 the scheduled minimum amount of outdoor air was bumped up to 1,800cfm. The maximum Z_p is 0.17 which occurs on the Recital Hall stage.

AHU-6

Air-Handling Unit 6 is a constant air volume unit that supplies 7,000cfm to one zone. This air-handling unit serves the Orchestra Rehearsal room. According to ASHRAE Standard 62.1-2004, the minimum outdoor air percentage was found to be 42%. The nominal amount of outdoor air or sum of the zones outdoor air was 2,357cfm. The required outdoor air for the air-handling unit was 2,946cfm. In order to comply with ASHRAE Standard 62.1 the scheduled minimum amount of outdoor air was bumped up to 3,000cfm. The maximum Z_p is 0.34 and it occurs in the orchestra rehearsal room.

Appendix A:

AHU-1

Room Number	Room Name	Space Description	Area (Sq. Ft)	Occupancy	CFM/ person	CFM/ ft^2	R_pP_z	R_aA_z	Zone Outdoor Airflow	Zone Primary Airflow	Zone Minimum Airflow	Primary OA Fraction	Zone Ventilation Efficiency
120C	Concession	Cafeteria	**241**	**2**	**7.5**	**0.18**	**15.00**	**43.38**	**73**	**230**	**90**	**0.81**	**0.64**
131	Coats	Storage	**159**	**0**	**5**	**0.12**	**0.00**	**19.08**	**24**	**80**	**45**	**0.53**	**0.92**
100F	Inner Lobby	Lobby	**550**	**40**	**5**	**0.06**	**200.00**	**33.00**	**291**	**900**	**410**	**0.71**	**0.74**
132	Men	Restroom	347	0						240			
135	Women	Restroom	474	0						320			
			821	**0**	**0**	**0.06**	**0.00**	**49.26**	**62**	**560**	**560**	**0.11**	**1.34**
168	Elevator Room	Storage	**52**	**0**	**0**	**0.12**	**0.00**	**6.24**	**8**	**320**	**130**	**0.06**	**1.39**
155G	Light Booth	Office Space	179	1						180			
155H	Sound Booth	Office Space	97	1						380			
			276	**2**	**5**	**0.06**	**10.00**	**16.56**	**33**	**560**	**225**	**0.15**	**1.30**
100B	Orchard Street Lobby	Lobby	**660**	**121**	**5**	**0.06**	**605.00**	**39.60**	**806**	**2,730**	**1090**	**0.74**	**0.71**
100B	Orchard Street Lobby/Cupolas	Lobby	**696**	**72**	**5**	**0.06**	**360.00**	**41.76**	**502**	**1,620**	**650**	**0.77**	**0.67**
100B	Orchard Street Lobby	Lobby	**613**	**67**	**5**	**0.06**	**335.00**	**36.78**	**465**	**1,500**	**600**	**0.77**	**0.67**
100B	Orchard Street Lobby/Cupolas	Lobby	**665**	**72**	**5**	**0.06**	**360.00**	**39.90**	**500**	**1,620**	**650**	**0.77**	**0.68**
100B	Orchard Street Lobby	Lobby	**568**	**66**	**5**	**0.06**	**330.00**	**34.08**	**455**	**1,500**	**600**	**0.76**	**0.69**
100B	Orchard Street Lobby/Cupolas	Lobby	**567**	**72**	**5**	**0.06**	**360.00**	**34.02**	**493**	**1,620**	**650**	**0.76**	**0.69**
100B	Orchard Street Lobby	Lobby	**941**	**121**	**5**	**0.06**	**605.00**	**56.46**	**827**	**2,730**	**1090**	**0.76**	**0.69**
200C	Circulation	Lobby / Corridor	710	21						1,240			
250A	Lock	Lobby / Corridor	143	0						220			
			853	**21**	**5**	**0.06**	**105.00**	**51.18**	**195**	**1,460**	**525**	**0.37**	**1.08**
237	Booth	Office Space	350	2						1,120			
239	Sound Room	Storage	91	0						250			
243	Dimmer (RH)	Storage	125	0						225			
			566	**2**	**5**	**0.12**	**10.00**	**46.92**	**71**	**1,595**	**600**	**0.12**	**1.33**
200C	Circulation	Lobby / Corridor	145	4						230			
250D	Lock	Lobby / Corridor	382	0						70			
250G	Vestibule	Lobby	46	0						50			
			573	**4**	**5**	**0.06**	**20.00**	**34.38**	**68**	**350**	**125**	**0.54**	**0.90**

AHU-2

Room Number	Room Name	Space Description	Area (Sq. Ft)	Occupancy	CFM/ person	CFM/ ft^2	R_pP_z	R_aA_z	Zone Outdoor Airflow	Zone Primary Airflow	Zone Minimum Airflow	Primary OA Fraction
155	Proscenium Theatre Seating	Auditorium Seating	4,387	502	5	0.06	2510	263	2773	7,900	7900	0.35

AHU-3

Room Number	Room Name	Space Description	Area (Sq. Ft)	Occupancy	CFM/ person	CFM/ ft^2	R_pP_z	R_aA_z	Zone Outdoor Airflow	Zone Primary Airflow	Zone Minimum Airflow	Primary OA Fraction
154	Proscenium Theatre Stage	Stages, Studios	3,094	60	10	0.06	600	186	786	9,450	9450	0.08

AHU-4

Room Number	Room Name	Space Description	Area (Sq. Ft)	Occupancy	CFM/ person	CFM/ ft^2	R_pP_z	R_aA_z	Zone Outdoor Airflow	Zone Primary Airflow	Zone Minimum Airflow	Primary OA Fraction	Zone Ventilation Efficiency
104	Women	Restroom	182	5						110			
105	Men	Restroom	181	5						270			
			363	**10**	**0**	**0.06**	**0.00**	**21.78**	**27**	**380**	**380**	**0.07**	**1.23**
102A	Elevator Room	Storage	**54**	**0**	**0**	**0.06**	**0.00**	**3.24**	**4**	**480**	**195**	**0.02**	**1.28**
102	Band Storage	Storage	654	--						430			
101D	Instrument Storage	Storage	1,857	--						1,400			
			2,511	**0**	**0**	**0.12**	**0.00**	**301.32**	**377**	**1,830**	**745**	**0.51**	**0.80**
100A	North Lobby	Lobby	719	97						1,600			
100C	Corridor	Corridor	337	--						340			
			1,060	**97**	**5**	**0.06**	**485.00**	**63.60**	**686**	**1,940**	**795**	**0.86**	**0.44**
100A	North Lobby	Lobby	**770**	**108**	**5**	**0.06**	**540.00**	**46.20**	**733**	**2,180**	**870**	**0.84**	**0.46**
110	Reception	Reception	123	1						70			
100D	Corridor	Corridor	292	--						380			
100D	Corridor Ramp	Corridor	275	--						570			
			690	**1**	**5**	**0.06**	**5.00**	**41.40**	**58**	**1,020**	**410**	**0.14**	**1.16**
111	Management Office	Office Space	111	1						75			
112	Operations Office	Office Space	115	1						75			
			226	**2**	**5**	**0.06**	**10.00**	**13.56**	**29**	**150**	**60**	**0.49**	**0.81**
106	NSO Office	Office Space	**129**	**1**	**5**	**0.06**	**5.00**	**7.74**	**16**	**110**	**45**	**0.35**	**0.95**
106A	NSO Library	Office Space	491	6						331			
100E	Corridor	Corridor	880	--						300			
			1,371	**6**	**5**	**0.06**	**30.00**	**82.26**	**140**	**630**	**250**	**0.56**	**0.74**
123	Instrument Uncasing	Storage	**670**	**0**	**0**	**0.06**	**0.00**	**40.20**	**50**	**250**	**100**	**0.50**	**0.80**
114	Usher	Office Space	164	4						110			
115B	Box Office Manager	Office Space	120	2						80			
			284	**6**	**5**	**0.06**	**30.00**	**17.04**	**59**	**190**	**100**	**0.59**	**0.72**
115	Box Office	Office Space	121	3						170			
115A	Box Office Workroom	Office Space	267	3						230			
			388	**6**	**5**	**0.06**	**30.00**	**23.28**	**67**	**400**	**160**	**0.42**	**0.89**
122	Piano Storage	Storage	**227**	**0**	**0**	**0.12**	**0.00**	**27.24**	**34**	**110**	**60**	**0.57**	**0.74**
124	Green Room 2	Conference / Meeting Room	282	7						220			
100E	Corridor South	Corridor	444	--						160			
			726	**7**	**5**	**0.06**	**35.00**	**43.56**	**98**	**380**	**150**	**0.65**	**0.65**
136	Front of House Storage	Storage	81	--						90			
137	Building Storage	Storage	89	--						80			
139	Pantry		168	0						500			
			257	**0**	**0**	**0.12**	**0.00**	**30.84**	**39**	**670**	**335**	**0.12**	**1.19**
140	Dressing Room	Office Space	**284**	**4**	**5**	**0.06**	**20.00**	**17.04**	**46**	**410**	**165**	**0.28**	**1.02**
141	Dressing Room	Office Space	**390**	**4**	**5**	**0.06**	**20.00**	**23.40**	**54**	**470**	**190**	**0.29**	**1.02**
143	Elec	Storage	**82**	**0**	**0**	**0.12**	**0.00**	**9.84**	**12**	**300**	**60**	**0.21**	**1.10**
142	Dressing Room	Office Space	**341**	**8**	**5**	**0.06**	**40.00**	**20.46**	**76**	**900**	**360**	**0.21**	**1.09**
144	Makeup	Office Space	**353**	**10**	**5**	**0.06**	**50.00**	**21.18**	**89**	**720**	**290**	**0.31**	**1.00**
146	Dressing Room	Office Space	**341**	**8**	**5**	**0.06**	**40.00**	**20.46**	**76**	**900**	**360**	**0.21**	**1.09**
147	Green Room	Conference / Meeting Room	**694**	**18**	**5**	**0.06**	**90.00**	**41.64**	**165**	**900**	**360**	**0.46**	**0.85**

148	Prop Kitchen	Office Space	**148**	**2**	**5**	**0.06**	**10.00**	**8.88**	**24**	**140**	**140**	**0.17**	**1.14**
150	Electric Storage	Storage	127	--		0.12				70			
100H	Corridor	Corridor	386	--		0.06				230			
100K	Corridor	Corridor	611	--		0.06				360			
			1,124	**0**	**0**	**0.06**	**0.00**	**67.44**	**84**	**660**	**280**	**0.30**	**1.00**
164	Scenery Dock	Office Space	756	8						1,440			
164A	Painting Area	Art Classroom	232	2						100			
			988	**10**	**5**	**0.06**	**50.00**	**59.28**	**137**	**1,540**	**500**	**0.27**	**1.03**
165	Receiving	Storage	284	--		0.12				170			
166	Stage Door Office	Office Space	220	2		0.06				210			
			504	**2**	**5**	**0.12**	**10.00**	**60.48**	**88**	**380**	**380**	**0.23**	**1.07**
167	Cust Storage	Storage	242	--						160			
100R	Reception	Reception	138	3						330			
			380	**3**	**5**	**0.06**	**15.00**	**22.80**	**47**	**490**	**490**	**0.10**	**1.21**
163	Piano Storage	Storage	147	--						80			
162D	Storage	Storage	126	--						340			
			273	**0**	**0**	**0.12**	**0.00**	**32.76**	**41**	**420**	**170**	**0.24**	**1.06**
100P	Corridor	Corridor	672	--						510			
100P	Corridor West	Corridor	181	--						100			
			853	**0**	**0**	**0.06**	**0.00**	**51.18**	**64**	**610**	**240**	**0.27**	**1.04**
138	Elec	Storage	**98**	**0**	**0**	**0.12**	**0.00**	**11.76**	**15**	**600**	**240**	**0.06**	**1.24**
101C	Lock	Corridor	160	0	5	0.06				50			
101E	Dimmer Room	Storage	109	0	0	0.12				550			
			269	**0**			**0.00**	**0.00**	**28**	**600**	**240**	**0.12**	**1.19**
100L	Corridor	Corridor	**245**	**0**	**0**	**0.06**	**0.00**	**14.70**	**18**	**440**	**440**	**0.04**	**1.26**
131	Coats	Storage	**165**	**0**	**0**	**0.06**	**0.00**	**9.90**	**12**	**80**	**45**	**0.28**	**1.03**
201	Ensemble	Office Space	**268**	**6**	**5**	**0.06**	**30.00**	**16.08**	**58**	**400**	**170**	**0.34**	**0.97**
202	Ensemble	Office Space	**264**	**6**	**5**	**0.06**	**30.00**	**15.84**	**57**	**380**	**150**	**0.38**	**0.92**
211	Electric Composition	Office Space	**750**	**5**	**5**	**0.06**	**25.00**	**45.00**	**88**	**380**	**150**	**0.58**	**0.72**
204,206,208	Practice Rooms	Office Space	**246**	**3**	**5**	**0.06**	**15.00**	**14.76**	**37**	**380**	**150**	**0.25**	**1.06**
213-215	Practice Rooms 213 & 215 (2 Rooms)	Office Space	**568**	**2**	**5**	**0.06**	**10.00**	**34.08**	**55**	**220**	**95**	**0.58**	**0.72**
210,212,214	Practice Rooms	Office Space	**249**	**3**	**5**	**0.06**	**15.00**	**14.94**	**37**	**300**	**120**	**0.31**	**0.99**
200B	Alcove	Corridor	**218**	**0**	**5**	**0.06**	**0.00**	**13.08**	**16**	**315**	**125**	**0.13**	**1.17**
216,218,220	Practice Rooms	Office Space	**249**	**3**	**5**	**0.06**	**15.00**	**14.94**	**37**	**300**	**120**	**0.31**	**0.99**
222,224,226	Practice Rooms	Office Space	**249**	**3**	**5**	**0.06**	**15.00**	**14.94**	**37**	**300**	**120**	**0.31**	**0.99**
223	Double Piano	Office Space	273	2						280			
225	Double Piano	Office Space	253	2						250			
			756	**4**	**5**	**0.06**	**20.00**	**45.36**	**82**	**610**	**240**	**0.34**	**0.96**
227-231	Practice Rooms 227, 229, & 231 (3 Rooms)	Office Space	**561**	**6**	**5**	**0.06**	**30.00**	**33.66**	**80**	**335**	**135**	**0.59**	**0.71**
228,230,232	Practice Rooms	Office Space	**249**	**3**	**5**	**0.06**	**15.00**	**14.94**	**37**	**300**	**120**	**0.31**	**0.99**
234,236,238	Practice Rooms	Office Space	**249**	**3**	**5**	**0.06**	**15.00**	**14.94**	**37**	**300**	**120**	**0.31**	**0.99**
240,242	Practice Rooms	Office Space	**221**	**3**	**5**	**0.06**	**15.00**	**13.26**	**35**	**240**	**100**	**0.35**	**0.95**
233	Practice Room	Office Space	119	2						120			
241	Practice Room	Office Space	102	2						85			
			436	**4**	**5**	**0.06**	**20.00**	**26.16**	**58**	**285**	**110**	**0.52**	**0.78**
244	Tel/Data	Storage	**75**	**0**	**0**	**0.06**	**0.00**	**4.50**	**6**	**100**	**50**	**0.11**	**1.19**
162	Theater Rehearsal	Multi-use Assembly	**605**	**36**	**7.5**	**0.06**	**270.00**	**36.30**	**383**	**1,605**	**650**	**0.59**	**0.72**

163	Theater Rehearsal	Multi-use Assembly	**605**	**36**	**7.5**	**0.06**	**270.00**	**36.30**	**383**	**1,605**	**650**	**0.59**	**0.72**
164	Theater Rehearsal	Multi-use Assembly	**605**	**36**	**7.5**	**0.06**	**270.00**	**36.30**	**383**	**1,605**	**650**	**0.59**	**0.72**
165	Theater Rehearsal	Multi-use Assembly	**605**	**36**	**7.5**	**0.06**	**270.00**	**36.30**	**383**	**1,605**	**650**	**0.59**	**0.72**
253	Theater Rehearsal Platform	Multi-use Assembly	547	3						630			
	Director's Niche	Multi-use Assembly	140	2						180			
			687	**5**	**7.5**	**0.06**	**37.50**	**41.22**	**98**	**810**	**325**	**0.30**	**1.00**
251	Dimmer (PT)	Storage	**394**	**--**	**---**	**0.06**				**1,600**	**640**	**0.00**	**1.30**
006	Laundry	Coin-operated Laundries	**203**	**0**	**7.5**	**0.06**	**0.00**	**12.18**	**15**	**640**	**260**	**0.06**	**1.25**
001C	Corridor	Corridor	504	--						95			
005	Wardrobe	Storage	347	0						560			
016	Student Storage	Storage	291	0						150			
			1,142	**0**	**5**	**0.06**	**0.00**	**68.52**	**86**	**805**	**320**	**0.27**	**1.04**
013	Trap Room	Storage	**720**	**0**	**0**	**0.12**	**0.00**	**86.40**	**108**	**350**	**185**	**0.58**	**0.72**
001A	Corridor	Corridor	620	--						260			
010	Comm Room	Storage	95	0						170			
			715	**0**	**0**	**0.12**	**0.00**	**85.80**	**107**	**430**	**170**	**0.63**	**0.67**
002B	Elevator Room	Storage	**67**	**0**	**0**	**0.12**	**0.00**	**8.04**	**10**	**330**	**130**	**0.08**	**1.23**
007	Sound Storage	Storage	**295**	**0**	**0**	**0.12**	**0.00**	**35.40**	**44**	**170**	**75**	**0.59**	**0.71**
001B	Corridor	Corridor	226	--						95			
011	Stage Manager	Office Space	134	1						100			
012	Technical Director	Office Space	228	2						170			
			588	**3**	**5**	**0.06**	**15.00**	**35.28**	**63**	**365**	**150**	**0.42**	**0.89**

AHU-5

Room Number	Room Name	Space Description	Area (Sq. Ft)	Occupancy	CFM/ person	CFM/ ft^2	R_pP_z	R_aA_z	Zone Outdoor Airflow	Zone Primary Airflow	Zone Minimum Airflow	Primary OA Fraction
120	Recital Hall Seating Area	Auditorium Seating	2,420	200	5	0.06	1000	145	954	8300	8,300	0.11
121	Recital Hall Stage	Stages, Studios	692	40	10	0.06	400	42	368	2200	2,200	0.17

AHU-6

Room Number	Room Name	Space Description	Area (Sq. Ft)	Occupancy	CFM/ person	CFM/ ft^2	R_pP_z	R_aA_z	Zone Outdoor Airflow	Zone Primary Airflow	Zone Minimum Airflow	Primary OA Fraction
101	Orchestra Rehearsal	Auditorium Seating	5,114	410	5	0.06	2050	307	2357	7,000	7000	0.34

Appendix B:

	AHU -1	AHU-2	AHU-3	AHU-4	AHU-5	AHU-6
ASHRAE Std. 62.1-2004						
Vou	4250	2773	786	5028	1587	2357
Ev	0.64	0.80	1.00	0.44	0.90	0.80
Vot	6674	3467	786	11389	1763	2946
ΣVoz	5312	2773	786	6314	1322	2357
Max Zp	0.81	0.35	0.08	0.86	0.17	0.34
Min OA %	0.35	0.44	0.08	0.33	0.17	0.42
Design Conditions						
AHU Total Air Flow	19200	7900	9450	35000	10500	7000
Scheduled Min OA	6700	4000	950	11700	1800	3000
% OA	0.35	0.51	0.10	0.33	0.17	0.43
ASHRAE Std. 62.1-2004 Compliance	Yes	Yes	Yes	Yes	Yes	Yes

Bibliography:

ANSI/ASHRAE Standard 62.1-2004 – Ventilation for Acceptable Indoor Air Quality. ASHRAE Incorporated, Atlanta, GA, 2004.