Technical Report 1

Mechanical

Evaluation of ASHRAE Standards 62.1 and 90.1

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September 19, 2013

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Executive Summary

The purpose of this assignment is to evaluate the Twin Rivers Elementary/Intermediate according to ASHRAE Standards 62.1-2010 and 90.1-2010.

In 62.1, The building is held up to requirements dealing with indoor air quality and it's respective ventilation system. Overall, this school complies with the standard. It has two dedicated outdoor air systems which provide the majority of the building solely with conditioned outside air. The four other air handling supply the library, cafeteria, gymnasium, and office areas. These all supply good quality air to each of its individual supply zones.

Standard 90.1, which provides the minimum requirements for energy-efficient design of buildings and their systems. The Elementary/Intermediate is expected to gain Silver LEED certification. All necessary precautions to energy-efficiency have been made. Twin Rivers complies with standard 90.1.

Project Summary

The Twin Rivers Elementary/Intermediate School will house 800 students of the Mckeesport Area School District. It is a two story building of 30,000 sq. ft. The Mechanical system is designed to save 30% of energy when compared to ASHRAE standard 90.1-2007. ASHRAEs Advanced Energy Design Guide for K-12 School Buildings also had a major impact on the design.

The main heating and cooling will come from a geothermal system. This will be an earth coupled water loop connected to water-to-air heat pumps. There will be 2 well fields located slightly north of the building's foundation.

The ventilation system consists of 2 dedicated outside air systems (DOAS) which serve the classrooms and most of the building. The library, cafeteria, gymnasium, and offices each have individual air handling units (AHU).

ASHRAE 62.1-2010

Section 5 Compliance

5.1 Ventilation Air Distribution

Designing for Air Balancing: The DOASs and AHUs shall be connected to a Direct Digital Control (DDC). This will allow constant knowledge of system status. Also, this allows for adjustment within the system. The dampers and variable speed drives for the fans will be able to be controlled easily. More will be discussed in the Ventilation Rate Procedure Analysis section of this paper.

Plenum Systems: The plenum is not used as a mixing chamber for the outside and return air. Therefore this section does not apply.

Documentation: .

NOTES: 1. OUTSIDE QUANTITY CONTROLLED ON DEMAND BY CARBON DIOXIDE LEVEL IN SPACE.
2. AHU-1 TRANSFER AIR REFLECTS OUTSIDE AIR USED FOR KITCHEN EXHAUST.
3. MAU-1 OUTSIDE AIR USED COMPLETELY FOR KITCHEN EXHAUST.

SYSTEM AIR BALANCING DATA

SYSTEM NO.	SERVES	CONN. LOAD MIN	CONN. LOAD MAX	SUPPLY CFM (A)	RETURN CFM MAX (B)	OUTSIDE CFM MIN (C)	TRANSFER /RELIEF CFM MIN (D)	EXHAUST CFM (E)	BUILDING PRESSURIZATION CFM (F)	NOTES (See Above)
DOAS-1	CLASSROOMS	11150	11150	10370	0	11150	0	10650	500	
DOAS-2	CLASSROOMS	15380	15380	15380	0	15380	0	14200	1180	
AHU-1	CAFETERIA	4688	10493	10500	6783	3710	1784	4284	1926	1, 2
AHU-2	LIBRARY	3695	8351	8350	5850	2501	0	100	2401	
AHU-3	GYMNASIUM	7175	11251	11250	6416	4835	0	100	4735	1
AHU-4	OFFICES	4022	8643	8650	6960	1683	0	1090	593	
MAU-1	KITCHEN	2500	2500	2500	0	2500	2500	0	0	3
HP-A	CLASSROOMS	1000	1000	1000	1000	0	0	0	0	
HP-B	CLASSROOMS	1100	1100	1100	1100	0	0	0	0	
HP-C	CLASSROOMS	1300	1300	1300	1300	0	0	0	0	
HP-D	CLASSROOMS	1500	1500	1500	1500	0	0	0	0	
HP-E	CLASSROOMS	1800	1800	1800	1800	0	0	0	0	
HP-F	STAIRWELLS	600	600	600	600	0	0	0	0	

SUPPLY AIR CFM (A) = (B) + (C) OUTDOOR AIR CFM (C) = (D) + (E) + (F)

Figure 1: Air Balancing Schedule

5.2 Exhaust Duct Location

Most of the exhaust fans are located on the roof. This allows for the exhaust air duct to be negatively pressurized. This meets requirements.

5.3 Ventilation System Controls

Ventilation is controlled through DDC. This allows the system's fans to operate when the spaces are occupied.

5.4 Airstream Surfaces

Resistance to Mold Growth and Erosion: The ducts for the system are made of sheet metal, galvanized steel(ASTM A 653/A 653M FS Type B, with G60/Z180 coating). An air duct connected to AHU-1,2,3, and 4 is exposed to the outdoors. This will be made of an aluminum sheet metal (ASTM B 209, alloy 3003-H14). The system will have aluminum fasteners(alloy 6061-T651). These are considered to be mold and erosion resistant materials by the"Mold Growth and Humidity Test" and the "Erosion Test".

5.5 Outdoor Air Intakes

Location: The DOAS's return air, including that from the restrooms and from the classrooms, is used within the DOAS for heat recovery. It is then exhausted out of the system near the outside air intake. Since restroom exhaust is considered a Class 2 exhaust, it is allowed to be recirculated into the system. The AHU supplying the cafeteria and support area is placed at least 18 feet away from the kitchen exhaust. This is more than the 15 feet required for a Class 3 exhaust.

Rain Entrainment and Intrusion: The specifications insist that air inlets shall be protected from water entry by hoods, louvers, mist eliminators or connected duct work according in accordance with AMCA 500-L.

Snow Entrainment: There is a roof hatch which allows access to the rooftop equipment for adequate clearing of snow and roof drains to disperse any melted snow.

Bird Screens: The rooftop units shall have louvers of galvanized steel with 0.04 inch galvanized wire bird screen in aluminum frame, and bearing AMCA Certified Ratings Seal in accordance with AMCA 500-L.

5.6 Local Capture of Contaminants

The Kitchen will have specific exhausts to the rooftop. Because of this, there is a kitchen makeup air unit.

5.7 Combustion Air

Both, an 8 inch air inlet and an 8 inch flue for the combustion air, are supplied to the hot water boiler. Also the hot water boiler will have a combustion chamber, which will withstand service temperatures to 2100 degrees F.

5.8 Particulate Matter Removal

The DOASs will have disposable filters with MERV 13 minimum efficiency minimum as rated by ASHRAE Test Standard 52-76. The supply filter is upstream of the enthalpy wheel and the DX cooling coil. There is another filter on the exhaust side of the unit right before the enthalpy wheel. Both the supply and reactivation air stream shall be completely filtered.

AHU-1,2,3, and 4 will have filters that are UL 900 listed, Class I or Class II. These must be approved by local authorities.

5.9 Dehumidification Systems

Relative Humidity: During the summer days, the indoor air is designed to be 75°F and the relative humidity will be limited to 60%. There is a humidity sensor in the return air. If it senses there is more than 60% relative humidity, the cooling valve will open for dehumidification and the heating valve shall be modulated to maintain constant supply air temperature. The winter indoor air is designed to be 72°F at a minimum of 20% relative humidity, however, there is no requirement that a minimum relative humidity should be met.

Exfiltration: The maximum OA entering the building should be more than the exhaust air leaving. This means, on average, the building is pressurized. After balancing, this requirement is attainable.

5.10 Drain Pans

Drain Pan Slope: All rooftop units and condensate producing heat exchangers will have a condensate drain trap. The condensate drain line will be sloped away from the drain seal at least 1/8 inch per foot all the way to the floor or roof drain or any other condensate removal place.

Drain Outlet: The condensate removal system shall be made to ensure that condensate collected in the drain pan flows freely and unimpeded to an outlet.

Drain Seal: The drain seal to be installed is the CostGuardTM Condensate Drain Seal. The standard condensate P-trap configuration for a drain seal is not considered suitable for this project.

Size: The pan will extend a foot downstream of the coil.

5.11 Finned-Tube Coils and Heat Exchangers

Drain Pans: There are two heat exchangers in this project. One of those two is located within the finned-tubed water boiler. This heat exchanger will have the required drain pan as noted in 5.10. The other is a plate and frame type.

Finned-Tubed Coil Selection for Cleaning The heat exchanger will be finned copper tubing with stainless steel baffles and sealed into bronze, steel or or cast iron headers with silicone O-ring gaskets. This comes with the boiler and has no selection options.

5.12 Humidifiers and Water Spray Systems

Water Quality: There is to be one electrode steam humidifier. The water used is the city water supply. This is adequate drinking water, therefore it is good enough quality for the humidifier.

Obstructions: It has yet to be decided where the humidifier will go. It will either go into the duct or be installed into the AHU. Since this hasn't been decided, it cannot be determined if this requirement is met.

5.13 Access For Inspection, Cleaning, and Maintenance

Equipment Clearance All installed equipment including; outdoor air intake, drain pans, drain seals, fans, DOADs, and AHUs, have sufficient area for access.

Ventilation Equipment Access: Systems used within this project have been made with maintenance in mind. they have access doors installed.

Air Distribution System: Duct work at certain areas will be made specifically accessible. Duct access doors will be provided for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and combination fire and smoke dampers.

5.14 Building Envelope and Interior Surfaces

Building Envelope: There will be a vapor retarder sheet with a permeability of 0.1 perm and a coating with a permeability of 0.2 perm. On these following surfaces, a certain type of vapor retarder will be installed:

- On inside face of studs of exterior walls, under cladding, use mechanically fastened vapor retarder sheet.
- On bottom face of rafters, under cladding, use mechanically fastened vapor retarder sheet.
- On inside face of masonry and concrete walls use vapor retarder coating.
- On elevated floors over enclosed soffit space use vapor retarder coating.
- On elevated floors over crawl space use vapor retarder coating.

Condensation on Interior Surfaces: The HVAC system and sub systems will be adequately insulated in order to prevent condensation

5.15 Building With Attached Parking Garages:

Does not apply.

5.16 Air Classification and Recirculation

Classification: Mainly the building's exhaust will comprise of Class 1 air classification. The bathrooms and other like areas are considered to be Class 2. However the kitchen's exhaust will be that of Class 3.

Redesignation: There will not be any mixing of the different air classes.

Recirculation Limitations: The areas considered to be class 2 will be directly vented to the roof. Either the air will be taken through an exhaust fan or through the DOASs for heat recovery.

Documentation: Locations in the school building are explained by ASHRAE; there is no need to create a classification for any space.

5.17 Requirements for Buildings Containing ETS Areas and ETS-Free Areas:

Does not apply.

Summary of 62.1 Compliance

The Twin Rivers Project is very much in compliance with ASHRAE Standard 62.1-2010. The only thing that may not be is the Humidifier section. This is unknown as of now due to lack of information within the drawings.

Ventilation Rate Procedure Analysis

Ventilation calculation is performed in order to determine outdoor air intake flow for optimal ventilation system for breathing zone. The ventilation airflow rates depend on type of space, occupancy level, space orientation, and area of the space.

The Breathing Zone Outdoor Airflow (V_{bz})

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

$$A_z = the\ net\ occupiable\ floor\ area\ of\ thezone\ (ft^2)$$

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

$$R_p = outdoor\ airflow\ rate\ required\ per\ person\ as\ determined\ from\ Table\ 6-1$$

$$R_a = outdoor\ airflow\ rate\ required\ per\ unit\ area\ as\ determined\ from\ Table\ 6-1$$

R_p and R_a can be found within table 6-1 of ASHRAE 60.1

Zone Outdoor Airflow (V_{oz})

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

For this building, most of the rooms have ceiling supplied within a normal temperature range of the space temperature(less than 15° warmer). There will be ceiling return vents. This means that the Zone air Distribution Effectiveness, E_z, is equal to one.

Since $E_z = 1.0$, $V_{oz} = V_{bz}$

100% Outdoor Air Systems (V_{ot})

$V_{ot} = \Sigma(all\ zones)Voz$

This equation will apply to the project because there are two DOASs within the ventilation system.

After reviewing the building, it seems that the ventilation system in place greatly exceeds the breathing zone outdoor airflow.

please see Appendix for detailed calculations

ASHRAE 90.1-2010

Standard Compliance

5 Building Envelope

5.1 Scope: Twin Rivers Elementary/Intermediate is in Mckeesport, PA. This is less than 20 miles from downtown Pittsburgh, PA. The climate that the school is located in is zone 5A according to 90.1's table B-1. Type A is considered to be very humid in the summers, where the OA needs to be air conditioned to be considered comfortable

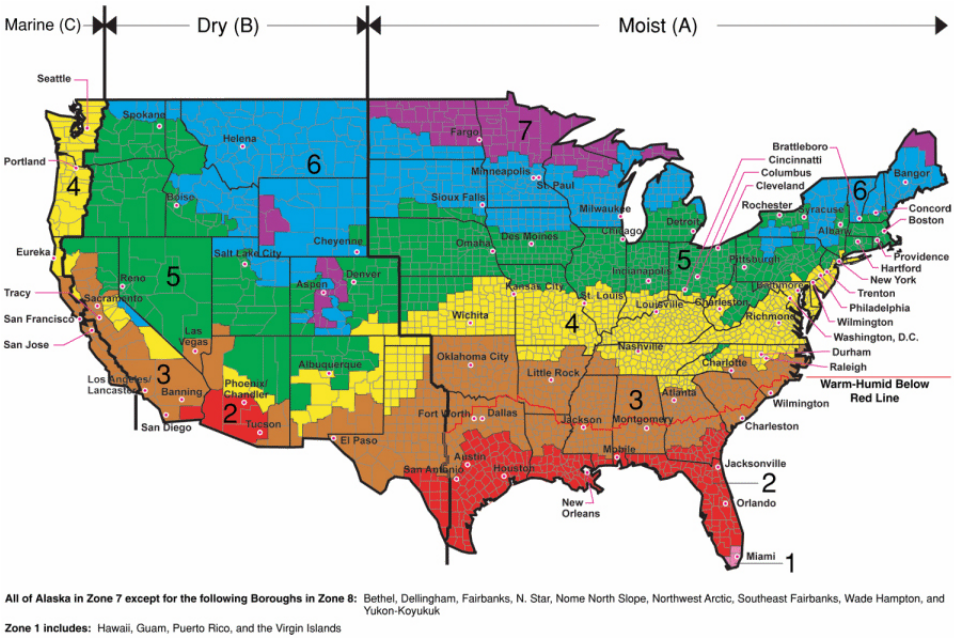

Figure 2: US Climate Zones

5.4 and 5.8 Mandatory Provisions: The building is designed so that the least amount of conditioned air escapes. At every entrance to the building, there is an enclosed vestibule. The exterior walls all have appropriate appliance of caulking and sealant to prevent air leakage. Some

5.5 Prescriptive Option: The typical exterior is of a metal stud cavity wall construction. This wall consists of:

- 6 metal stud backup
- $\frac{5}{8}$ " exterior sheeting

- 2 of rigid insulation
- air-infiltration barrier
- 2 airspace
- 3 $\frac{5}{8}$ " brick

The wall will be about 14 $\frac{1}{2}$" in thickness with 2" of interior spray insulation. This will have an R-value of 20. This is more than the required 13 R-value for above grade steel framed walls , so the requirement is met.

The vertical fenestration must meet the requirements of 5.5.4. This states that the maximum fenestration (such as windows, doors, and vents) shall not be more that 40% of the gross wall area. Twin Rivers meets this requirement. Note that there are no skylights in the project.

Building Face	total Area	Fenestration	% Fenestration	Comply (Y/N)
East	15020	3100	20.64%	Y
South	26200	7400	28.24%	Y
West	14030	2400	17.11%	Y
North	26050	6880	26.41%	Y
Total	**81300**	**19780**	**24.33%**	**Y**

Table 1: Vertical Fenestration

6 HVAC systems

6.2 Compliance Paths: The building is around 125,900 ft^2, this means using the Simplified Approach Option for HVAC Systems specified in 6.3 does not apply. The requirements of 6.4 and 6.5 must be met instead.

6.4 Mandatory Provisions: Zone isolation may be a good thing to do with this building but it seems that there is no intention to use only one of the AHUs or DOASs at a time. Meaning, they will all constantly be simultaneously running. In the summer, when just administration and maintenance are working, it would save money to shut down isolated zones.

6.5 Prescriptive Path: The minimum thermal effectiveness of the enthalpy wheel is to be 75%. Section 6.5.6.1 (Exhaust Air Energy Recovery) has a minimum requirement of 50%. The DOASs will work well within the constrictions of the standard.

7 Service Water Heating

The building will be using a geothermal system for heating and cooling. After the water is pumped through the field it comes into a pump room. Most rooms have a water to air heat pump. This provides the room with heating. All of the equipment is up to the standards ASHRAE requires.

8 Power

Twin Rivers primary power will be from a $208/120V$, 3ϕ distribution system. There will be a standby diesel generator. This will protect the school from any power outages, which can be disastrous with kinder gardeners to 6th graders within the building.

The building's electrical design will greatly exceed the requirements of ASHRAE 90.1 section 8.

9 Lighting

Building Area Method of Interior Lighting Power Allowance: Table 9.5.1 states that overall it is considered a School/University. This means that the Lighting Power Density (LPD) is .99 $\frac{W}{ft^2}$. The gross lighted floor area is 125,900 ft^2.

$$Interior\ Lighting\ Power\ Allowance = LPD(A_{total})$$

$$Interior\ Lighting\ Power\ Allowance = .99(125,900)$$

$$Interior\ Lighting\ Power\ Allowance = 124,641$$

However this is a very simple calculation. Many more building area types should be used.

10 Other Equipment

All installed Motors will have a efficiency surpassing that listed in Table 10.8.

Summary of Standard 90.1-2010

While Sections 5 through 7 were fairly involved, the other sections lacked very intensive requirements. ASHRAE is mainly used for HVAC systems so it makes sense that it glosses over the electrical and plumming side of a building's makeup. So, as for exceeding the requirements, many of the systems not described in 5-7 were robust for the standard. The HVAC systems seem to be up to code but not completely surpassing the requirements be large amounts.

Appendix

Ventilation Rate Procedure Calculations

$E_z = 1$

DOAS-1

Room	Description	R_p	P_z	R_a	A_z (ft^2)	V_bz (cfm)
101	5TH SCIENCE ACADEMY	10	30	0.12	980	417.6
102	CORRIDOR	0	8	0.06	3500	210
102B	JANITOR CLOSET	5	1	0.12	30	8.6
103	SGI	10	20	0.12	440	252.8
104	6TH SCIENCE ACADEMY	10	30	0.12	1030	423.6
105	4TH SCIENCE ACADEMY	10	30	0.12	1040	424.8
106	STORAGE	5	1	0.06	61	8.66
110	4TH CLASSROOM	10	30	0.12	820	398.4
111	4TH CLASSROOM	10	30	0.12	800	396
112	5TH CLASSROOM	10	30	0.12	780	393.6
113	5TH CLASSROOM	10	30	0.12	785	394.2
114	5TH CLASSROOM	10	30	0.12	875	405
115	5TH CLASSROOM	10	30	0.12	900	408
116	4TH CLASSROOM	10	30	0.12	860	403.2
117	4TH CLASSROOM	10	30	0.12	815	397.8
118	INT. LEARNING SUPPORT	10	30	0.12	870	404.4
119	INT. COMPUTER LAB	10	30	0.12	1300	456
121	AV/MDF	10	15	0.12	310	187.2
121A	COMPUTER WORK ROOM	10	30	0.12	145	317.4
122	CORRIDOR	0	8	0.06	1500	90
135	CORRIDOR	0	8	0.06	1400	84
201	MATH RESOURCE ROOM	10	30	0.12	870	404.4
202	CORRIDOR	0	8	0.06	3500	210
202A	JANITOR CLOSET	5	1	0.12	30	8.6
203	READING RESOURCE ROOM	10	30	0.12	800	396
204	INTERMEDIATE ART	10	30	0.18	1070	492.6
205	SGI	10	20	0.12	305	236.6
206	ART STORAGE	5	2	0.12	165	29.8
207	FACULTY LOUNGE	5	10	0.06	465	77.9
208	STORAGE	5	2	0.12	75	19
212	INT. LEARNING SUPPORT	10	30	0.12	810	397.2
213	INT. LEARNING SUPPORT	10	30	0.12	780	393.6
214	6TH CLASSROOM	10	30	0.12	800	396
215	6TH CLASSROOM	10	30	0.12	785	394.2
216	6TH CLASSROOM	10	30	0.12	880	405.6
217	6TH CLASSROOM	10	30	0.12	895	407.4

DOAS-2

Room	Description	R_p	P_z	R_a	A_z (ft^2)	V_bz (cfm)
140	CORRIDOR COMMONS	0	8	0.06	1548	92.88
150A	STORAGE ROOM	5	1	0.06	145	13.7
152	INT. ORCHESTRA	10	50	0.12	1138	636.56
153	ELEM. COMPUTER LAB	10	30	0.12	1130	435.6
154	INTERMEDIATE BAND	10	50	0.12	1103	632.36
155	ELEM. ART	10	30	0.12	1060	427.2
155A	ART STORAGE	5	2	0.12	190	32.8
156	ELEM. MUSIC	10	30	0.12	1080	429.6
157	FACULTY LOUNGE	5	10	0.06	500	80
159	CORRIDOR COMMONS	0	8	0.06	2100	126
159B	STORAGE ROOM	5	1	0.06	140	13.4
161	1ST CLASSROOM	10	30	0.12	880	405.6
162	1ST CLASSROOM	10	30	0.12	860	403.2
163	1ST CLASSROOM	10	30	0.12	780	393.6
164	1ST CLASSROOM	10	30	0.12	790	394.8
165	AUTISTIC SUPPORT ROOM	10	30	0.12	640	376.8
165C	OBSERVATION ROOM	5	4	0.06	60	23.6
166	1ST CLASSROOM	10	30	0.12	800	396
171	SGI	10	20	0.12	445	253.4
172	CORRIDOR	0	8	0.06	4500	270
173	PART TIME CLASSROOM	10	30	0.12	540	364.8
174	KG CLASSROOM	10	30	0.12	960	415.2
175	KG CLASSROOM	10	30	0.12	870	404.4
176	KG CLASSROOM	10	30	0.12	860	403.2
179	PK CLASSROOM	10	30	0.12	900	408
180	PK CLASSROOM	10	30	0.12	900	408
218	2ND CLASSROOM	10	30	0.12	860	403.2
219	2ND CLASSROOM	10	30	0.12	880	405.6
220	2ND CLASSROOM	10	30	0.12	790	394.8
221	2ND CLASSROOM	10	30	0.12	785	394.2
222	2ND CLASSROOM	10	30	0.12	800	396
223	LIFE SKILLS ROOM	10	20	0.12	640	276.8
223C	OBSERVATION ROOM	5	4	0.06	60	23.6
225	STORAGE ROOM	5	1	0.06	110	11.6
226	CORRIDOR	0	8	0.06	4500	270
226A	JANITOR CLOSET	5	1	0.12	30	8.6
229	ELEM. COMPUTER LAB	10	30	0.12	1065	427.8
230	ELEM. SCIENCE LAB	10	30	0.18	980	476.4
231	SGI	10	20	0.12	370	244.4
232	SGI	10	20	0.12	370	244.4
233	3RD CLASSROOM	10	30	0.12	775	393
234	ELEM. LEARNING SUPPORT	10	30	0.12	802	396.24
235	3RD CLASSROOM	10	30	0.12	790	394.8
236	3RD CLASSROOM	10	30	0.12	790	394.8
237	3RD CLASSROOM	10	30	0.12	870	404.4

AHU-1 Cafeteria

Room	Description	R_p	P_z	R_a	A_z (ft^2)	V_bz (cfm)
143	FACULTY DINING	7.5	20	0.18	500	240
145	CAFETERIA	7.5	650	0.18	3210	5452.8
147	CAFÉ STORAGE	5	3	0.06	275	31.5
145A	SNACK ROOM	7.5	2	0.18	100	33
149	KITCHEN	7.5	15	0.12	1220	258.9
149A	SERVICE	7.5	8	0.18	660	178.8
149B	DISH WASH	7.5	4	0.12	260	61.2
149C	JANITOR CLOSET	5	1	0.12	65	12.8
149D	KITCHEN OFFICE	5	2	0.06	72	14.32
149E	DRY STORAGE	5	4	0.06	570	54.2

AHU-2 Library

Room	Description	R_p	P_z	R_a	A_z (ft^2)	V_bz (cfm)
123	FACULTY PLANNING	5	20	0.06	225	113.5
123A	COPY	10	5	0.12	130	65.6
125	WORK ROOM	5	10	0.06	290	67.4
125B	LIBRARIAN OFFICE	5	3	0.06	53	18.18
127	PROFESSIONAL LIBRARY	5	40	0.12	181	221.72
129	LIBRARY/MEDIA CENTER	10	60	0.12	2865	943.8
129A	STORY ROOM	5	20	0.12	440	152.8
131	CONFERENCE ROOM	5	15	0.06	370	97.2
133	COMMUNITY ROOM	10	30	0.12	1215	445.8
137	SGI	10	10	0.12	155	118.6

AHU-3 Gymnasium

Room	Description	R_p	P_z	R_a	A_z (ft^2)	V_bz (cfm)
141	CORRIDOR	0	8	0.06	1670	100.2
142	GYMNASIUM	0	30	0.3	5600	1680
142E	STORAGE	5	2	0.06	50	13
144	PLATFORM	10	30	0.06	1255	375.3
144A	STORAGE	5	2	0.06	190	21.4
144B	STORAGE	5	2	0.06	200	22
144C	STORAGE	5	2	0.06	20	11.2
144D	STORAGE	5	2	0.06	30	11.8
146	GYM STORAGE	5	2	0.06	550	43
148	GYM OFFICE	5	2	0.06	78	14.68

AHU-4 Offices

Room	Description	R_p	P_z	R_a	A_z (ft^2)	V_bz (cfm)
124	INT. ADMINISTRATION	5	3	0.06	635	53.1
124A	INT. SECRETARY	5	1	0.06	153	14.18
124B	INT. PRINCIPAL	5	3	0.06	290	32.4
126	FILE ROOM	5	1	0.06	107	11.42
128	CONFERENCE ROOM	5	15	0.06	370	97.2
130	SGI	10	10	0.12	111	113.32
132	GUIDANCE WAITING	5	4	0.06	160	29.6
132A	GUIDANCE OFFICE	5	3	0.06	141	23.46
132B	GROUP GUIDANCE ROOM	5	10	0.06	280	66.8
132C	TESTING ROOM	5	4	0.06	100	26
134	MAIL ROOM	5	3	0.06	152	24.12
135B	JANITOR CLOSET	5	1	0.12	60	12.2
136	HEALTH SUITE	10	10	0.18	690	224.2
136A	EXAM ROOM	10	2	0.18	77	33.86
136D	NURSES OFFICE	5	2	0.06	115	16.9
158	ELEM. ADMINISTRATION	5	3	0.06	555	48.3
158A	ELEM. SECRETARY	5	1	0.06	115	11.9
158B	ELEM. PRINCIPAL	5	3	0.06	300	33
160	CONFERENCE ROOM	5	15	0.06	300	93

$V_{bz} = V_{oz}\ V_{ot} = \Sigma V_{oz}\ \therefore 1 \neq 2$