ASHRAE 62.1 & 90.1 Compliance

Technical Report 1

Freetown Elementary School

Glen Burnie, MD

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Executive Summary

Applying ASHRAE Standard 62.1 and 90.1 to Freetown Elementary School in Glen Burnie, Maryland resulted in several findings. Analyzing Section 5 and 6 of ASHRAE Standard 62.1 resulted in discussions on natural ventilation, variable volume ability, system controls, particulate matter removal, and air classification. Analyzing ASHRAE Standard 90.1 resulted in an in-depth look at the building envelope, the HVAC systems, the hot water heating, the power, and the lighting.

The natural ventilation in Freetown Elementary School was found to comply completely and provides a good way to ventilate spaces on the perimeter of the building to save some energy when it can. Variable volume ability was found to allow different areas within a zone to be controlled at different temperatures pleasing the occupants using the space. Research into the system controls allows a better understanding of the two-pipe system used and how it is switched from heating to cooling mode and vice versa. Particulate matter removal enforces the need to clean the outside air coming into the building and stresses the importance of indoor air quality to the occupants of the building. The overall results of this analysis are that the building complies with the overall standard and is a healthy building for its occupants.

An in-depth procedure was used to analyze the ventilation rates in accordance with Standard 62.1 Section 6. This procedure resulted in compliance with the standard in all of the rooms supplied by the air handling units and the energy recovery units. The ventilation rates reached the minimum values to provide quality airflow throughout the building.

After I analyzed Standard 90.1, I came to the conclusion that Freetown Elementary School is in compliance with the standard. The building envelope meets the requirements for the climate zone except for the window glazing. However, the building is mostly brick and the glazing has a small effect on the building loads. The energy recovery units on the east and west classroom wings did not meet the requirements for efficiency mostly because their fans were overpowered because of the amount of air the supply fan has to accommodate compared to the other air handling units.

In conclusion, the building is mostly compliant with Standard 62.1 Section 5/Section 6 and Standard 90.1. Indoor air quality and sustainability is an important part of the design and should closely follow the ASHRAE standards to prove that the building is safe for its occupants.

ASHRAE 62.1 Section 5 Systems and Equipment

ASHRAE Standard 62.1 is a guideline to follow for improving the indoor air quality in a building through ventilation to make it acceptable for people occupying the building and to minimize health effects. Section 5 is based on the buildings systems and equipment that make the indoor air quality.

5.1 Natural Ventilation

Single hung operable windows in the first and second floor classrooms, second floor corridor, music room, media center, faculty lounge, and the conference room can be used for natural ventilation in conjunction with mechanical ventilation. These windows are readily accessible to building occupants whenever the space is occupied. Refer to the table below to see if the openings reach the minimum 4% of the net occupiable floor area.

Natural Ventilation Opening				
Room	Window Area	Floor Area	Percent	Acceptable
Typical Classroom	28	210	13%	Yes
Second Floor Corridor	42	108	39%	Yes
Music Room	28	108	26%	Yes
Media Center	42	728	6%	Yes
Faculty Lounge	28	144	19%	Yes
Conference Room	28	66	42%	Yes
Art Room	42	224	19%	Yes
Science Resource Room	14	210	7%	Yes
Principal's Office	28	48	58%	Yes
Asst. Principal's Office	14	30	47%	Yes
ELL	14	119	12%	Yes
Special Ed Resource Room	28	110	25%	Yes

5.2 Ventilation Air Distribution

Variable Volume/Variable Temperature control dampers provide the adjustment to at least the minimum ventilation airflow as required by Section 6 under any load condition. An analysis of this can be found under the ASHRAE Standard 62.1 Section 6 title.

5.3 Exhaust Duct Location

Exhaust Ducts are sealed with SMACNA Seal Class B, which seals all transverse joints and longitudinal seams. Since they are categorized by SMACNA as Class B, they are not an exempt and are negatively pressurized relative to the spaces they pass so exhaust air cannot leak into the occupied spaces.

5.4 Ventilation System Controls

Ventilation controls put the mechanical system in the following modes by the Direct Digital Control Panel: occupied cycle with heating mode or cooling mode, unoccupied cycle with heating or cooling mode, maintenance cycle, and safety and emergency controls. Whenever the space temperature sensor is calling for heating but the central controller is calling for cooling, the zone duct temperature sensor will modulate a 2-way heating control valve to maintain 90^{o} F. This temperature can be adjusted to the needs of the building.

When the building needs to switch from cooling to heating or vice versa, the central controller will monitor all space temperature sensors. Based on a number of calls for space heating or cooling, the changeover will occur when a maximum number of space heating requirements outnumber the cooling requirement by at least two zones. Time delays prevent changeover from occurring in less than five minutes, which can be adjusted.

5.5 Airstream Surfaces

Metal ducts contain a vapor barrier of polyethylene sheet which is 6 mils (0.15mm) conforming to federal specification UU-P-147 for permeability. Kitchen hood exhaust is fabricated with stainless steel all welded construction in accordance with NFPA 96, NFPA 90A/90B and SMACNA HVAC Duct Construction Standards.

5.6 Outdoor Air Intakes

Outdoor air intakes associated with potential outdoor contaminant sources shall be located a separation distance no less than the distance listed in Table 5-1 of the ASHRAE Standard. The table below shows all the exhaust fans and the distance away from the outdoor air intakes, whether it complies or not. The Kiln hood exhaust is located too close to Energy Recovery Unit 2. The standard requires a 30 foot separation distance.

Outdoor Air Intake Separation Distance				
Exhaust Fan	Location		Distance	Acceptable
EF-5	Food Prep Canopy	Contaminated	24 feet	Yes
EF-10	Treatment A-7	Contaminated	17 feet	Yes
EF-14	Kiln Hood	Contaminated	28 feet	No
Boiler Flue	Mechanical Room	Contaminated	20 feet	Yes

Outdoor air intakes are equipped with 0.5 inch mesh and 0.063 inch wire diameter bird screens, flashing, and a prefabricated roof curb to manage what goes into the mechanical system.

5.7 Local Capture of Contaminants

All harmful contaminants from noncombustion equipment is captured, ducted to the roof, and exhausted there.

5.8 Combustion Air

The two boilers, located in the mechanical room, are equipped with a set of 48 inches by 24 inches architectural louver to provide adequate air for combustion. The domestic water heater is also equipped with a pair of architectural louvers that are 12 inches by 12 inches.

5.9 Particulate Matter Removal

The two energy recovery units are equipped with a 2 inch MERV 7 pre-filter, a 4 inch MERV 11 outside air final filter and a 2 inch MERV 7 exhaust air filter. All other air handling units have a 2 inch MERV 7 pre-filter and 4 inch MERV 11 final filter. These filters comply with the standard of having a minimum efficiency reporting value of not less than 6.

5.10 Dehumidification Systems

The humidity is maintained at 50 % for summer conditions and 30 % for winter conditions, which is less than 65 % the standard calls for. The design minimum outdoor air intake shall also be greater than the design maximum exhaust airflow when the mechanical air conditioning systems are dehumidifying. The table below indicates that Freetown Elementary School complies with this exfiltration standard.

Exhaust	
Exhaust Fan	System (CFM)
EF-1	900
EF-2	150
EF-3	1300
EF-4	350
EF-5	2125
EF-6	550
EF-7	250
EF-8	375
EF-9	550
EF-10	750
EF-11	400
EF-12	1500
EF-13	1300
EF-14	400
EF-15	1150
EF-16	250
EF-17A	400
EF-18A	250
Total	12950

Outdoor Air Intake	
Unit	OA (CFM)
AHU-1	600
AHU-2	375
AHU-3	2000
AHU-4A	2500
AHU-5	700
AHU-6	1080
ERU-1	8100
ERU-2	9800
Total	25155

5.11 Drain Pans

For the air handling units, drain pains are specified to have a sealed, double wall, constructed from a minimum 18 gauge galvanized steel exterior and minimum 18 gauge stainless steel interior. The space between the exterior and interior walls is filled with insulation. Cooling coils have drain pans under the entire coil module.

The slope is in 2 planes no less than 0.25 inches in one foot which is better than the standard calling for 0.125 inches per foot. The drain outlet is located at the lowest point of the drain.

5.12 Finned-Tubed Coils and Heat Exchangers

Drain pans are in accordance with Section 5.11 for all dehumidifying cooling coil assemblies and all condensate-producing heat exchangers. Access panels on either side of the finned-tube coils are provided for cleaning.

5.13 Humidifiers and Water-Spray Systems

There is no steam and direct evaporation humidifiers, air washers, or other water-spray systems so this section does not apply.

5.14 Access for Inspection, Cleaning, and Maintenance

Access doors or panels are provided to all ventilation equipment and air distribution systems, providing adequate space for routine maintenance and inspection.

5.15 Building Envelope and Interior Surfaces

Atop of the gravel for the slab on grade, a polyethylene vapor barrier prevents vapor from penetrating its way into the building from the ground level. Through wall flashing and air cavity helps to prevent vapor penetration from the exterior to the interior horizontally. Built-up bituminous roofing provides a waterproof membrane for the roof layer, preventing vapor penetration from rain.

Pipes, ducts, and other surfaces within the building, whose surface temperatures are expected to fall below the dew-point temperature resulting in condensation, are correctly insulated to prevent condensation.

5.16 Buildings with Attached Parking Garages

Freetown Elementary School does not have an attached parking garage so this section does not apply.

5.17 Air Classification and Recirculation

According to Table 5-2 and Table 6-1 in the ASHRAE standard, almost all of the building air can be classified as Class 1, which can be recirculated. Kitchen exhaust is classified under Class 3 and the art kiln is classified under Class 4. The kitchen and kiln exhaust are ducted to the roof, therefore they are not recirculated.

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

Freetown Elementary School is a smoke-free facility therefore this section does not apply.

ASHRAE 62.1 Section 6 Procedures

ASHRAE Standard 62.1 is a guideline to follow for improving the indoor air quality in a building through ventilation to make it acceptable for people occupying the building and to minimize health effects. Section 6 focuses on the ventilation rate procedure.

Systems Analyzed

AHU-1 and AHU-2 serve the general music room and instrumental music room respectively. AHU-3 serves the cafeteria and AHU-4A serves the large gymnasium, collectively they both work together when the cafeteria and the gymnasium are opened up and joined without the separation of the wall. AHU-5 serves the administration offices and AHU-6 serves the media center. The energy recovery units, ERU-1 and ERU-2, serve the east classroom wing and west classroom wing respectively. The following calculations are outlined by the ASHRAE standard.

Calculation Variables and Assumptions

Breathing Zone Outdoor Airflow

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

A_z = zone floor area, which is the net occupiable floor area in the zone in square feet

P_z = zone population, which is the largest number of people expected to occupy the zone during normal usage

R_p = outdoor airflow rate required per person based on Table 6-1 from the ASHRAE standard

R_a = outdoor airflow rate required per unit area based on Table 6-1 from the ASHRAE standard

Zone Outdoor Airflow

$V_{oz} = V_{bz} / E_z$

V_{oz} = zone outdoor airflow, which is the outdoor airflow that must provide the zone by supply air distribution systems

E_z = zone air distribution effectiveness

Primary Outdoor Air Fraction

$Z_p = V_{oz} / V_{pz}$

V_{pz} = primary zone airflow

Uncorrected Outdoor Intake

$V_{ou} = D\sum(R_p \times P_z) + \sum(R_a \times A_z)$

Outdoor Air Intake

$V_{ot} = V_{ou} / E_v$

E_v = system ventilation efficiency

Appendix A shows the results and assumed values for each condition.

Discussion of Results

Overall, the ventilation rates were compliant with the design. Only a few of the rooms had a high Z_p value including: the Resource Room, the Special Ed Resource Room both on the second floor, and the Science Resource Room on the first floor. This was because the rooms were fairly small square footage with plenty of seating; therefore, a high ventilation rate is needed for all of the people in the room. The classrooms also had a high Z_p value because of the number of people in the rooms; however, with the use of the operable windows, natural ventilation will be a maximum in the seasonal months. The air handlers will not have to provide much mechanical input when the air temperatures are right for window use.

ASHRAE 90.1

ASHRAE Standard 90.1 goes in depth on the building envelope, the HVAC systems, equipment efficiencies, including electric motors, the buildings power and the buildings lighting design.

5. Building Envelope

5.1 General: Freetown Elementary School, located in Glen Burnie, MD, is in Climate Zone 4 according to the map in Appendix A of this report.

5.4 Mandatory Provisions: Fenestrations and door frames are sealed, caulked, gasketed, or weather-stripped to prevent infiltration and minimize air leakage. The vestibule located at the entrance of Freetown Elementary School complies with no less than 7 feet separation between the doors when closed as the standard calls for. The distance between the doors is 10.5 feet.

5.5 Prescriptive Building Envelope Option: According to Table 5.5-4 in the ASHRAE standard, the building should have maximum "U" values and minimum insulation "R" values under the non-residential class. Vertical glazing went over the maximum value but is not a huge part of the exterior façade so it has a small effect on building loads.

U Values					
	ASHRAE Assembly Maximum	Design Assembly Maximum	ASHRAE SHGC	Design	Compliance
Roof	U-0.048	U-0.033			Yes
Walls	U-0.104	U-0.083			Yes
Vertical Glazing	U-0.40	U-0.49	0.4	0.55	No/No

6. HVAC Systems

6.4 Mandatory Provisions: All equipment shall meet the minimum standard and efficiency at operating conditions specified in Table 6.8.1 in the ASHRAE standard. Mechanical equipment shall have a permanent label installed by the manufacturer stating that the equipment complies with the ASHRAE Standard 90.1. The supply of heating and cooling energy to each zone shall be individually controlled within the zone. For more information about controls, refer to Standard 62.1 Section 5.4 of this report. HVAC system insulation is in accordance of SMACNA standards and ducts are sealed according to the minimum duct seal level, Table 6.4.4.2A in the ASHRAE standard.

6.5 Prescriptive Path: The two-pipe changeover system that supplies both heated and chilled water is acceptable because it has a dead band of 15°F outdoor air temperature for changeover. The system also allows for operation of at least four hours before changing over to the other mode. Reset controls are provided to allow heating and cooling supply temperatures to be no greater than 30° F apart at changeover. Fan power limitations, listed on Table 6.5.3.1.1A of the ASHRAE standard, shall be in accordance with the designed horsepower. Exhaust fans 2 and 16 fall under the exception of motors with less than 1 horsepower; therefore, their non-compliance is okay for this standard.

Fan Power Limitations				
Fan Tag	Flow Rate (CFM)	ASHRAE HP	Actual HP	Compliance
EF-1	900	1.0	1/4	Yes
EF-2	150	0.2	1/4	No
EF-3	1300	1.4	1/2	Yes
EF-4	350	0.4	1/4	Yes
EF-5	2125	2.3	1	Yes
EF-6	550	0.6	1/4	Yes
EF-7	250	0.3	1/10	Yes
EF-8	375	0.4	1/4	Yes
EF-9	550	0.6	1/4	yes
EF-10	750	0.8	1/4	Yes
EF-11	400	0.4	1/4	Yes
EF-12	1500	1.7	1/3	Yes
EF-13	1300	1.4	1/4	Yes
EF-14	400	0.4	1/4	Yes
EF-15	1150	1.3	1/4	Yes
EF-16	250	0.3	1/3	No
EF-17A	400	0.4	1/4	Yes
EF-18A	250	0.3	1/10	Yes
RAHU-1	1530	1.7	1 1/2	Yes
RAHU-2	1530	1.7	1 1/2	Yes
RAHU-3	6000	6.6	5	Yes
RAHU-4A	7500	8.3	10	No
RAHU-5	3200	3.5	3	Yes
RAHU-6 Supply	4680	5.1	3	Yes
RAHU-6 Return	4200	4.6	1 1/2	Yes
ERU-1 Supply	8100	8.9	15	No
ERU-1 Return	7900	8.7	15	No
ERU-2 Supply	9800	10.8	5	Yes
ERU-2 Return	9450	10.4	7 1/2	Yes

Rooftop air handling unit 4A and both of the energy recovery units were not compliant. I believe they oversized the fans because the energy recovery units serve such a large area and contain a rather large movement of CFM compared to the other air handling units. Air handling unit 4A was oversized because it serves the gymnasium. The gymnasium is such a large area that it needs a large supply fan to meet the room loads.

6.8 Minimum Equipment Efficiency Tables: In this section, the air cooled chiller and the two boilers were analyzed to achieve the minimum efficiency by the ASHRAE standard in Table 6.8.1.

Equipment Efficiencies			
	ASHRAE Minimum Efficiency	Design Efficiency	Compliance
Air Cooled Chiller	2.8 COP	2.8 COP	Yes
Boilers	75%	79%	Yes

7. Service Water Heating

The 125 gallon domestic water heater in Freetown Elementary School is greater than 75,000 Btu/h so the standard calls for 80 % efficiency, according to table 7.8.

8. Power

Feeder conductors have a voltage drop of 2% at design load and branch circuit conductors have a maximum voltage drop of 3% at design load so it complies with the standard.

9. Lighting

9.4 Mandatory Provisions: An automatic control device manages the lighting throughout the day to comply with this section. Each space has at least one control device or switch to independently control the lighting within the space. All exit signs do not exceed 5W per face.

9.5 Building Area Method: According to Table 9.5.1 in the standard, the Lighting Power Density should be 1.2 W/ft^2. The gross lighted floor area of Freetown Elementary School is 81,000 ft^2. The total wattage is 75,000 with an assumed power factor of 0.6. Dividing the watts over the square footage of the building, a designed power density of 0.93 is achieved under the maximum for the standard.

Resources

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

ASHRAE, 2007, ANSI/ASHRAE, Standard 90.1 – 2007, Energy Standard for Buildings except Low-Rise Residential Buildings. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. Atlanta, GA. 2007.

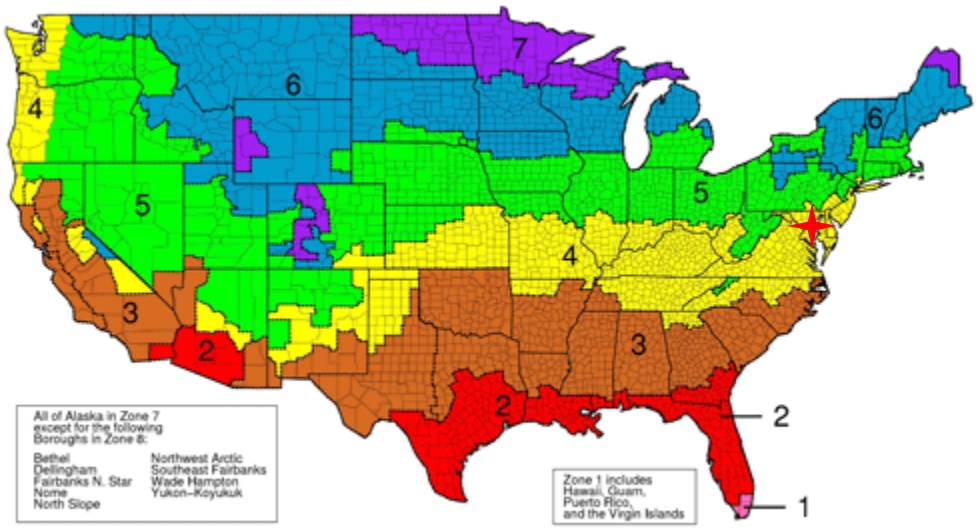
James Posey Associates. 2008. MEP Construction Documents. James Posey Associates, Baltimore, MD. 2008.

Rubeling Associates, Inc. 2008. Architectural Construction Documents. Rubeling Associates, Inc., Towson, MD. 2008.

Rubeling Associates, Inc. 2008. Specifications. Rubeling Associates, Inc., Towson, MD. 2008.

Appendix A

The red star indicates where Freetown Elementary School is located on the climate zone map taken from Appendix B of the ASHRAE standards.



Appendix B

AHU-1											
Room Number	Room Name	A_z	P_z	R_p	R_a	V_{bz}	E_z	V_{oz}	V_{pz}	Z_p	E_v
129	General Music	108	42	10	0.06	426	1	426	1350	0.32	0.8
C-10	Corridor	57	0	0	0.06	3	1	3	180	0.02	1.0
V_{ou}	430										
V_{ot}	537										

AHU-2											
Room Number	Room Name	A_z	P_z	R_p	R_a	V_{bz}	E_z	V_{oz}	V_{pz}	Z_p	E_v
130	Instrumental Music	432	19	10	0.06	215.9	1	215.9	900	0.24	0.9
C-10	Corridor	114	0	0	0.06	6.84	1	6.84	270	0.03	1.0
S-8	Storage	24	0	0	0.12	2.88	1	2.88	100	0.03	1.0
S-9	Interior Storage	52	0	0	0.12	6.24	1	6.24	260	0.02	1.0
V_{ou}	232										
V_{ot}	258										

AHU-3											
Room Number	Room Name	A_z	P_z	R_p	R_a	V_{bz}	E_z	V_{oz}	V_{pz}	Z_p	E_v
132	Cafeteria	1010	101	8	0.06	868.6	1	868.6	5700	0.15	1.0
C-5	Corridor	190	0	0	0.06	11.4	1	11.4	300	0.04	1.0
V_{ou}	880										
V_{ot}	880										

AHU-4A											
Room Number	Room Name	A_z	P_z	R_p	R_a	V_{bz}	E_z	V_{oz}	V_{pz}	Z_p	E_v
133	Gym	1456	146	8	0.06	1255	1	1255	7500	0.17	0.9
V_{ou}	1255										
V_{ot}	1395										

AHU-5											
Room Number	Room Name	A_z	P_z	R_p	R_a	V_{bz}	E_z	V_{oz}	V_{pz}	Z_p	E_v
A-1	Reception	136	8	5	0.06	48.16	1	48.16	450	0.11	1.0
A-2	File Room	20	1	5	0.06	6.2	1	6.2	75	0.08	1.0
A-3	Work Room	66	1	5	0.06	8.96	1	8.96	400	0.02	1.0
A-4	Principal's Office	48	7	5	0.06	37.88	1	37.88	350	0.11	1.0
A-5	Conference Room	66	8	5	0.06	43.96	1	43.96	350	0.13	1.0
A-6	Assistant Principal's Office	30	3	5	0.06	16.8	1	16.8	215	0.08	1.0
A-7 & A-8	Treatment & Rest Area	84	3	5	0.06	20.04	1	20.04	275	0.07	1.0
A-9	Nurse's Office	28	4	5	0.06	21.68	1	21.68	125	0.17	0.9
A-12	Guidance Office	64	7	5	0.06	38.84	1	38.84	200	0.19	0.9
A-14	PPW/ PSYCH	28	0	0	0.06	1.68	1	1.68	110	0.02	1.0
C-5 & C-4	Corridor & Lobby	392	0	0	0.06	23.52	1	23.52	400	0.06	1.0
C-3	Vestibule	80	0	0	0.06	4.8	1	4.8	150	0.03	1.0
C-2	Corridor	96	0	0	0.06	5.76	1	5.76	100	0.06	1.0

V_{ou}	278
V_{ot}	309

AHU-6											
Room Number	Room Name	A_z	P_z	R_p	R_a	V_{bz}	E_z	V_{oz}	V_{pz}	Z_p	E_v
127	Media Center	728	72	10	0.12	807.4	1	807.4	3630	0.22	0.9
128	Volunteer	20	0	0	0.06	1.2	1	1.2	185	0.01	1.0
A-15	Media Office	12	1	5	0.06	5.72	1	5.72	110	0.05	1.0
126	Material Prep	80	0	0	0.06	4.8	1	4.8	570	0.01	1.0
125	Material Storage	40	0	0	0.12	4.8	1	4.8	185	0.03	1.0

V_{ou}	824
V_{ot}	915

ERU-1											
Room Number	Room Name	A_z	P_z	R_p	R_a	V_{bz}	E_z	V_{oz}	V_{pz}	Z_p	E_v
201	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
202	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
203	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
204	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
217	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
218	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
219	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
220	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
S-1	General Storage	64	0	0	0.12	7.68	1	7.68	200	0.04	1.0
S-25	General Storage	45	0	0	0.12	5.4	1	5.4	200	0.03	1.0
C-12	Corridor	264	0	0	0.06	15.84	1	15.84	400	0.04	1.0
C-13	Corridor	248	0	0	0.06	14.88	1	14.88	800	0.02	1.0
103	ECC	252	29	10	0.12	320.2	1	320.2	1300	0.25	0.9
104	ECC	252	29	10	0.12	320.2	1	320.2	1300	0.25	0.9
105	ECC	252	29	10	0.12	320.2	1	320.2	1300	0.25	0.9
106	ECC	252	29	10	0.12	320.2	1	320.2	1300	0.25	0.9
107	ECC	252	29	10	0.12	320.2	1	320.2	1300	0.25	0.9
108	ECC	252	29	10	0.12	320.2	1	320.2	1300	0.25	0.9
109	Special ED	288	25	10	0.12	284.6	1	284.6	1300	0.22	0.9
111	Resource Level V	144	13	10	0.12	147.3	1	147.3	600	0.25	0.9
A-11	Faculty Lounge	144	8	5	0.06	48.64	1	48.64	600	0.08	1.0
C-2	Corridor	288	0	0	0.06	17.28	1	17.28	400	0.04	1.0

V_{ou}	4665
V_{ot}	5831

ERU-2											
Room Number	Room Name	A_z	P_z	R_p	R_a	V_{bz}	E_z	V_{oz}	V_{pz}	Z_p	E_v
205	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
206	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
207	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
208	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
209	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
210	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
211	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
216	Resouce Room	135	21	10	0.12	226.2	1	226.2	600	0.38	0.7
212	Classroom	224	25	10	0.12	276.9	1	276.9	1000	0.28	0.8
213	ELL	119	15	10	0.12	164.3	1	164.3	600	0.27	0.8
215	Special Ed Resource Room	110	15	10	0.12	163.2	1	163.2	450	0.36	0.7
C-11	Corridor	368	0	0	0.06	22.08	1	22.08	600	0.04	1.0
A-20	Special Ed Office	36	2	5	0.06	12.16	1	12.16	150	0.08	1.0
S-20	Storage	64	0	0	0.12	7.68	1	7.68	150	0.05	1.0
S-22	Storage	64	0	0	0.12	7.68	1	7.68	200	0.04	1.0
115	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
116	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
117	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
118	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
119	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
120	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
121	Science Resource	210	36	10	0.12	385.2	1	385.2	1000	0.39	0.7
122	Classroom	210	25	10	0.12	275.2	1	275.2	1000	0.28	0.8
123	Speech Resource	60	9	10	0.12	97.2	1	97.2	400	0.24	0.9
124	Art	224	34	10	0.18	380.3	1	380.3	1300	0.29	0.8
C-6	Corridor	368	0	0	0.06	22.08	1	22.08	600	0.04	1.0
S-4	Storage	64	0	0	0.12	7.68	1	7.68	200	0.04	1.0

V_{ou}	5625
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