Technical Assignment 1

ASHRAE 62.1: Ventilation and Standard 90.1: Energy Design Evaluations

Compliance Analysis

Slippery Rock University Student Union

Slippery Rock, PA

Table of Contents

Executive Summary

The Slippery University Rock Student Union is now underway in Slippery Rock, Pa, estimated to be completed at the end of November in 2011. It is designed to achieve LEED Silver Certification standing three levels above ground and will help to start the revolution of green building and sustainability at the university.

This report contains information, calculations, and results from the SRU Student Union that complies with the requirements of ASHRAE Standard 62.1 and Standard 90.1. The building uses five energy recovery units as its primary means to heat, cool, and ventilate the spaces with auxiliary backup sources for extreme winter and summer conditions.

The calculations used to determine compliance can be found throughout the document and the results found in Appendix B. Each section gives a brief conclusion to whether or not the requirement is satisfied. The SRU Student Union consists of mostly offices, conference rooms, and student lounges. It also has a cafeteria with several dining spaces, a bookstore, a theater, and a ballroom.

After several calculations and further analysis, the conclusion was met that the Slippery Rock Student Union does comply with the requirements state in ASHRAE Standard 62.1 and ASHRAE Standard 90.1. A summary of compliance can be found at the end of each section with evidence supporting what was determined.

Mechanical Summary

The Slippery Rock University Student Union will use highly efficient mechanical systems to ventilate, heat, and air condition the spaces in order to provide a comfortable environment for its occupants. The basis of the system contains three major components that allow for the system as a whole to run effectively.

First, the heat pump water transfer system allows for energy to be transferred between spaces for simultaneous heating and cooling throughout the year. This allows for direct heat exchange between the five different energy recovery units without the cost and consumption of energy associated with producing or removing that heat. The heat pumps are equipped to run with variable frequency drives in order to increase efficiency and reduce speed when the building loads are low. Due to the nature of the building, this is one of several key elements that will help to improve efficiency and cut energy costs and consumption.

The second component that enables the system to run so well is the use of energy wheels in the energy recovery units. There are five energy recovery units, each containing an energy wheel that captures otherwise wasted exhaust energy and transfers it to the incoming air that is used to supply the building with 100 percent outdoor air. This decreases the load on the need to heat or cool the new supply air therefore needing less auxiliary power to heat or condition the air.

Last, the use of the variable air volume fans allow to change the speed of the fan based on the conditions of the space. Each space has a temperature control and an allotted variable volume box with hot water coils in order to allow for occupants comfort and control. This helps to save on electrical costs by decreasing the energy output when internal loads are low.

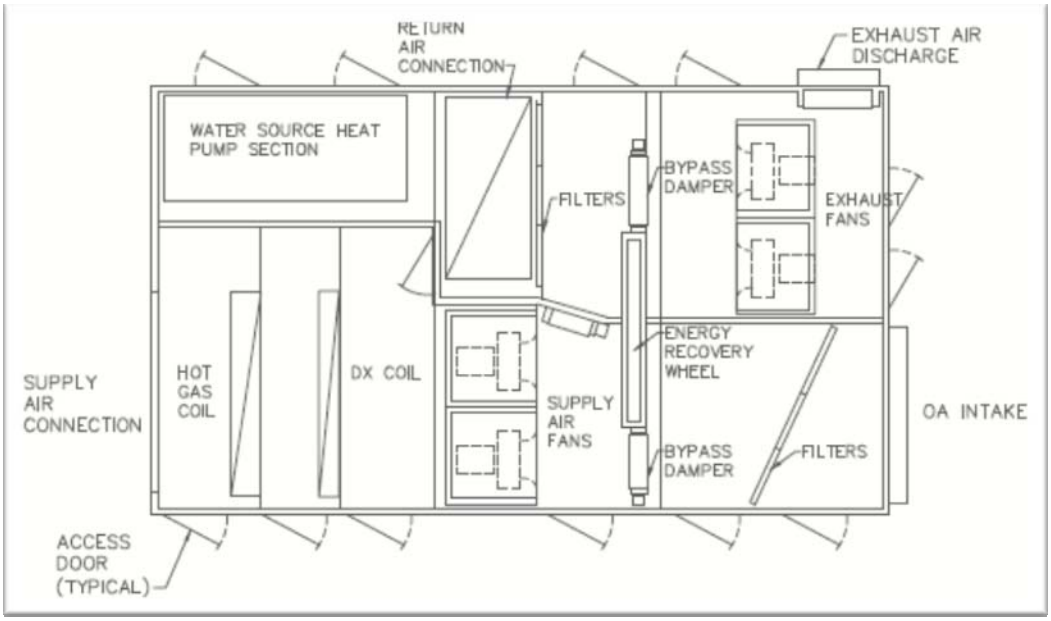

Figure 1: Energy Recovery Unit Plan

As shown in the diagram, each ERU is equipped with prefilters and MERV 15 filters, an energy recovery wheel, supply and exhaust fans, variable frequency drives, a water source heat pump section and various controls.

Five energy recovery units are used to serve all the ventilation requirements in the building. Four of which are located on the roof with the remaining energy recovery unit located indoors on the first floor servicing the bookstore, bookstore storage, and bookstore offices. There are also three make-up air units located on the roof to account for the kitchen hood exhausts. The electrical and mechanical rooms are serviced using a ductless split system.

The use of other auxiliary systems allows the building to maintain occupant comfort and wellbeing during the extreme and peak load conditions. The use of the nearby university steam plant is used for heating during peak loads in the winter. With the use of shell and tube heat exchangers, the steam is converted into water transferring heat to the water source transfer system. During peak cooling loads, the use of two cooling towers will assist in allowing heat to escape from the water transfer system.

ASHRAE Standard 62.1 – 2007 Compliance Analysis

ASHRAE 62.1: SECTION 5 – Systems and Equipment

Section 5.1: Natural Ventilation

- The building allows the windows and doors to open with a 75,000 variable volume exhaust fan in the atrium that allows for natural ventilation when conditions are suitable.

Section 5.2: Ventilation Air Distribution

- The design conditions ensure compliance in order to achieve at least the minimum ventilation airflow requirements in all occupied spaces. Section 230593 – Testing, Adjusting, and Balancing for HVAC ensures that the building has the proper ventilation rates, stating assumptions made.

Section 5.3: Exhaust Duct Location

- All exhaust ducts are negatively pressurized with respect to the zones they pass through allowing no exhaust air contaminates the surrounding spaces. All the main exhaust ducts exit from the roof, with a few exiting directly from the mechanical room.

Section 5.4: Ventilation System Controls

- The mechanical system utilizes both manual and automatic controls to ensure that each space is being properly ventilated during occupancy. Each VAV has a minimum supply airflow quantity in order to satisfy the minimum ventilation requirements.

Section 5.5: Air Stream Surfaces

- Most of the HVAC system consists of sheet metal using flex duct in accordance with the UL 181 erosion test wherever needed. Flex duct is not used in the exhaust ductwork to ensure it does not leak into surrounding spaces on its way to the roof. Sound attenuators are used at transitions along with the entrance and exits of the units.

Section 5.6: Outdoor Intakes

- With only a small amount of roof space to hold the air handlers due to the green roof, it was a potential problem to ensure that no air handler intake was too close to an exhaust. Special consideration was taken when placing the make-up air units along with the energy recovery units to verify that the air intakes are no less than 15 feet away from any exhaust. All other minimum separation distances are satisfied with no complications.
- All air handler specifications comply with the requirements stated in ASHRAE 62.1 dealing with rain entrainment, rain intrusion, snow entrainment and bird screens.
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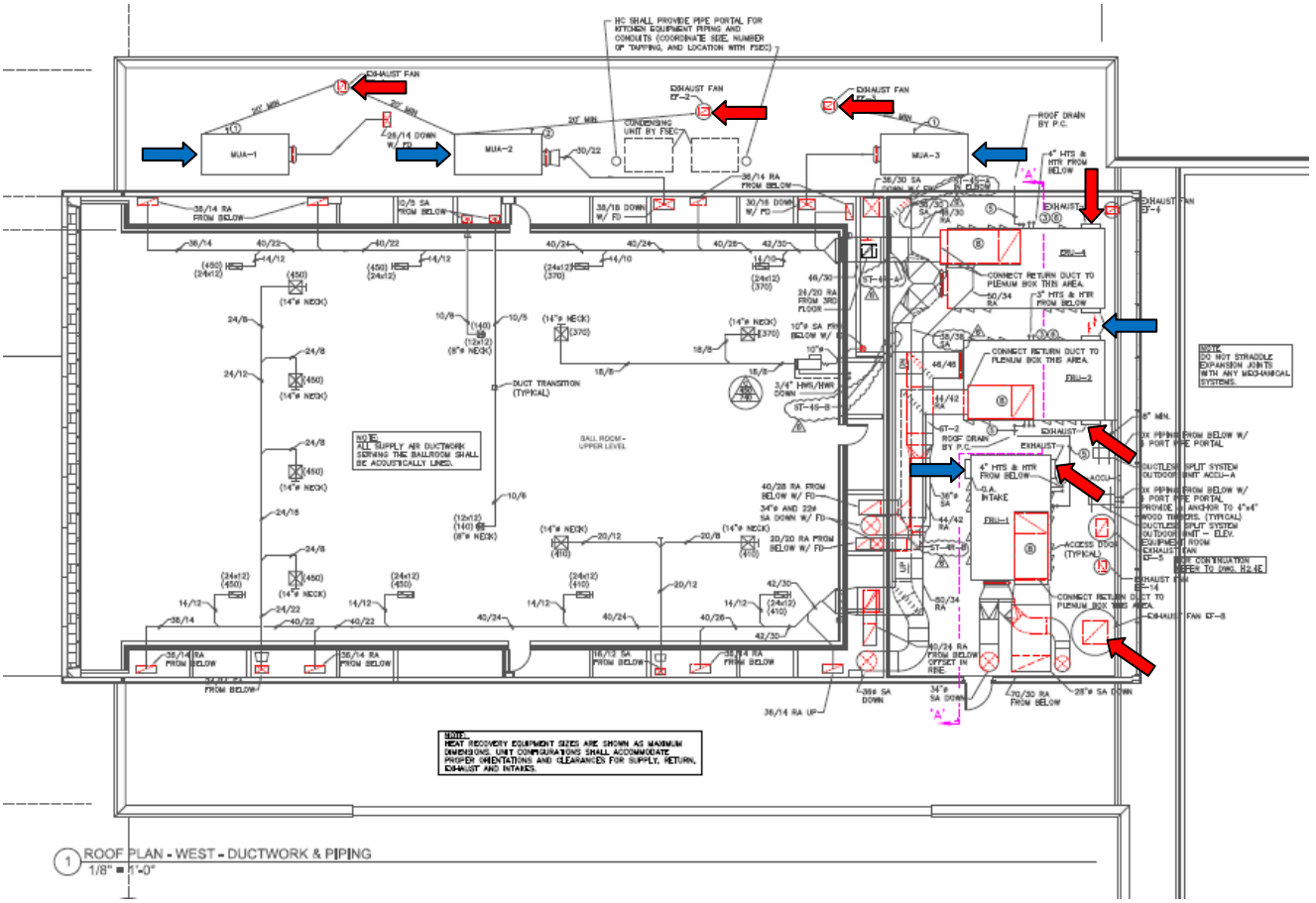


Indicates Outdoor Air Intake
Indicates Exhaust Air Outlet

Figure 2: Roof Plan with Air Intakes and Exhausts

Section 5.7: Local Capture of Contaminates

- The SRU Student Union does not have equipment that produces harmful contaminates. The kitchen exhaust hoods are exhaust directly to the roof with independent make-up rooftop units providing adequate make-up air

Section 5.8: Combustion Air

- All sources of combustion are properly vented with enough air according to the manufacturer's specifications and directly exhausted to the roof.

Section 5.9: Particulate Matter Removal

- All Energy recovery units are equipped with both prefilters along with MERV 13 filters. The remaining air handlers are required to have MERV 6 filters or higher as specified in sections 237433- Packaged Makeup Air-Conditioners and 238126- Split-System Air-Conditioners.

Section 5.10: Dehumidification Systems

- The maximum relative humidity is designed to not exceed 50% per request from owner, satisfying the maximum 65% stated in ASHRAE 62.1.

Section 5.11: Drain Pans

- All drain pans comply with a minimum slope of .125" per foot with the outlet present at the lowest point of the slope.

Section 5.12: Finned-Tubed Coils and Heat Exchangers

- The minimum distance between coils is no less than 18 inches and has a drip pan provided therefore complying with the requirements of ASHRAE 62.1.

Section 5.13: Humidifiers and Water-Spray Systems

- Humidifiers and Water-Spray Systems are not used therefore do not apply to the building

Section 5.14: Access for Inspection, Cleaning, and Maintenance

- Equipment access doors are located and sized such that there is sufficient space provided for easy access to the equipment for inspection, cleaning, and maintenance through removable panels per specifications satisfying the ASHRAE 62.1 requirements.

Section 5.15: Building Envelope and Interior Spaces

- The building envelope is equipped with a vapor barrier to prevent unwanted water penetration. All piping and ductwork in areas vulnerable to reaching temperatures below the surrounding dew-point will be provided with sufficient insulation to prevent condensation from occurring per specification 230700-HVAC Insulation.

Section 5.16: Buildings with Attached Parking Garages

- The SRU Student Union has no attached parking garage therefore this section is not applicable.

Section 5.17: Air Classification and Recirculation

- All spaces are Class 1 with low contaminate content. The air handlers use 100 percent outdoor air therefore no recirculation occurs. The kitchen hoods are directly exhausted from the building from the roof.

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

- The SRU Student Union is a non-smoking facility therefore this section is not applicable.

ASHRAE 62.1: SECTION 6 – Procedures

For these calculations, Energy Recovery Units 1-5 are selected to be completed for the analysis. They are responsible for providing a sufficient amount of supply air to the entire building except to the mechanical and electrical rooms, along with make-up air provided for the kitchen hoods.

Zone Breathing Outdoor Airflow:
The outdoor air for the SRU Student Union design can be calculated by the following equation from ASHRAE 62.1.

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

$\mathbf{A_z}$ = zone floor area: the net occupiable floor area of the zone (ft^2)

$\mathbf{P_z}$ = zone population: the largest number of people expected to occupy the zone during typical usage. If the number of people expected to occupy the zone fluctuates, P_z may be estimaked based on averageing approaches

$\mathbf{R_p}$ = outdoor airflow rate required per person

$\mathbf{R_a}$ = outdoor airflow rate required per unit area

Zone Air Distribution Effectiveness:
According to Table 6-2 in ASHRAE 62.1, the Zone Air Distribution Effectiveness falls into the category of: ceiling supply of cool air. It therefore has effectiveness: $E_z = 1.0$

Therefore, $V_{oz} = V_{bz}$

Zone Outdoor Airflow:
$V_{ot} = \Sigma_{\text{all zones}} V_{oz}$

Due to the fact that the building is 100 percent outdoor air, all the minimum outdoor air ventilation rates are satisfied and require no calculation.

The following chart shows the first floor minimum ventilation rates required by ASHRAE 62.1.

SRU Student Union First Floor Ventilation Rates vs. Design							
Room #	Space Name	A_Z	R_a	R_P	P_z	Vbz=Voz	Designed CFM
101	East Entry	220	0.06	0	0	13.2	100
102	Corridor	2518	0.06	0	0	151.08	1000
150	Bookstore	7277	0.15	15	70	2141.55	11520
149	Dressing room	38	0.12	0	0	4.56	110
140	Storage	4828	0.12	0	0	579.36	5620
142	Accounts	115	0.12	10	2	33.8	150
144	Store manager	103	0.12	10	2	32.36	150
146	Employee Lounge	211	0.12	10	5	75.32	250
145	IT/Copy	130	0.06	0	0	7.8	50
141	Utility	40	0.12	0	0	4.8	50
135	Corridor	361	0.12	0	0	43.32	225
138	UPS	1916	0.12	0	0	229.92	1200
137	Café Storage	302	0.12	0	0	36.24	400
136	Café	1255	0.18	10	50	725.9	850
104	Entry Lobby	1717	0.06	5	5	128.02	1450
103	Entry Vestibule	275	0.06	0	0	16.5	50
106	Corridor	713	0.06	0	0	42.78	400
139	Bank	782	0.06	10	8	126.92	620
118	Conference	227	0.12	10	15	177.24	410
119	Directory	112	0.12	10	4	53.44	190
120	VP assistant	112	0.12	10	2	33.44	240
121	Univ UN Oper	938	0.12	10	2	132.56	960
117	Work/Storage	157	0.12	0	0	18.84	200
116	Building Manager	109	0.12	10	2	33.08	100
113	Office	107	0.12	10	1	22.84	100
114	Office	113	0.12	10	1	23.56	100
124	Coop Act	309	0.12	10	1	47.08	265
128	Mech Room	470	0.06	0	0	28.2	100
122	Storage	61	0.12	0	0	7.32	50
125	Dir Coop	93	0.12	10	1	21.16	90
126	Stor/Server	81	0.12	10	1	19.72	200
109	Womens Toilet	211		0	0	0	60
110	Mens Toilet	211		0	0	0	60
130	IT	125	0.12	0	0	15	100
129	Mech Room	1391	0.06	0	0	83.46	75

SRU Student Union First Floor Ventilation Rates vs. Design Continued							
Room #	Space Name	A_Z	R_a	R_P	P_z	Vbz=Voz	Designed CFM
127	Ftn Pump Rm	265	0.12	0	0	31.8	50
143	Accounts Receivable	110	0.12	10	2	33.2	150
133	Corridor	1416	0.06	0	0	84.96	530
108	Utility	35	0.12	0	0	4.2	50
148	Vestibule	76	0.06	0	0	4.56	50
131	Electrical	198	0.06	0	0	11.88	50
128	Mechanical Corridor	470	0.06	0	0	28.2	100
104	Storage	81	0.12	0	0	9.72	100
149	Storage	38	0.12	0	0	4.56	100

Table 1: Required Ventilation Rates vs. Design Ventilation Rates

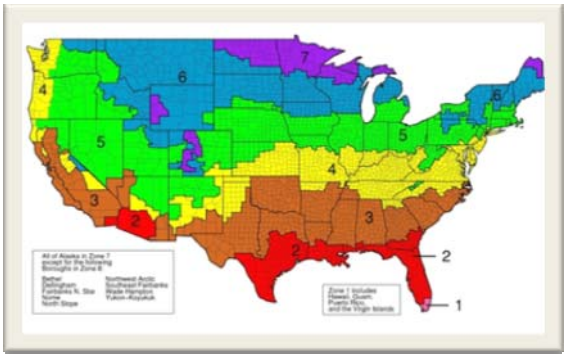
As shown in the table above and Appendix B at the end of the text, all spaces meet the ventilation requirements set forth by ASHRAE 62.1. Overall, most spaces are provided with much more air than needed ensuring a clean and comfortable environment for its occupants.

62.1 Conclusions

Overall, the 62.1 code compliance portion of this assignment was an overall success. As presented above, all of the information was found by searching through various documents such as drawings, specifications and other relevant pieces of information. These calculations and analyses prove that the building is compliant with Sections 5: Systems and Equipment, and Section 6: Procedures, of the ASHRAE Standard 62.1. In most cases the building far exceeds the requirements, which will aid in what hopes to be a LEED Silver Rated building.

ASHRAE Standard 90.1 – 2007 Energy Design Evaluations Compliance Analysis

ASHRAE 90.1: Section 5 – Building Envelope



The United States are divided into 7 different zones based on the climate. The climate zone map to the left was used to determine that Slippery Rock, Pa is located in Zone 5. Once the zone is found, the use of Table 5.5-5 can be used to determine suitable U-values for the roof, walls, floors, slab-on-grade, doors and windows.

Figure 3: Climate Zone Map

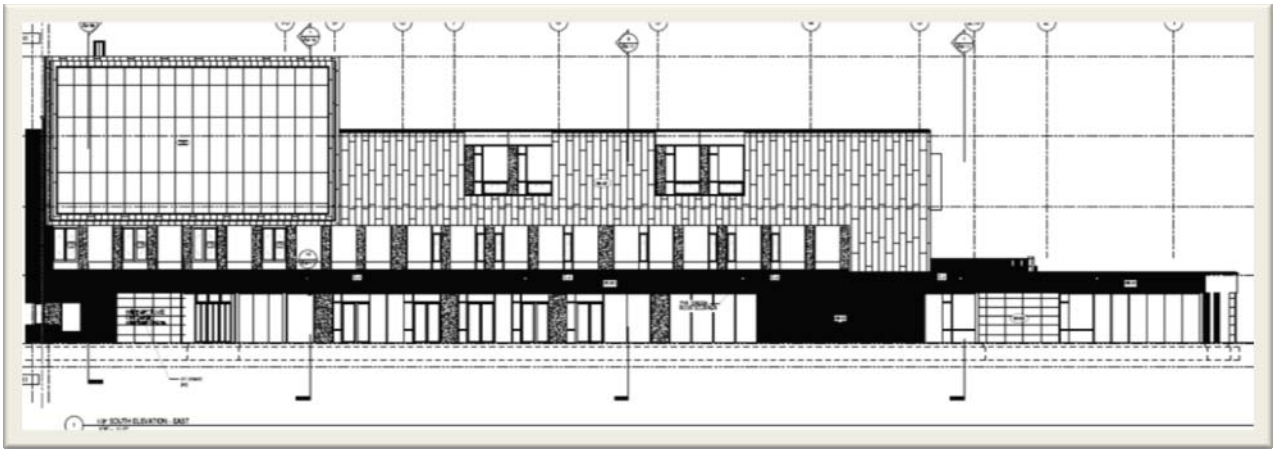


Figure 4: South Elevation

This illustration shows that the southern facade has a large amount of glass that could potentially cause a problem with percent of exterior glass. The following calculations will show exactly how much glass is contained on the exterior facades.

Fenestration Area and Compliance				
Building Face	Glass Area (ft^2)	Wall Area (ft^2)	% Glass	Compliant
North	2100	17280	0.122	Yes
South	7800	22900	0.341	Yes
East	1738	9100	0.191	Yes
West	3010	8240	0.365	Yes
Total	14648	57520	0.255	Yes

Table 2: Fenestration Areas

The maximum amount of the building exterior that can be glass in Zone 5 according to ASHRAE 90.1 is 40%. The building therefore complies with the code.

ASHRAE 90.1 Compliance Baseline Building:

U-Values (Btu/hr-ft^2-F)

- Roof 0.065 (R-19 equivalent)
- Walls 0.090 (R-11 equivalent)
- Slab 0.730 (No insulation required)
- Glass 0.55 (Double glazed)

ASHRAE 90.1 Proposed Building Design:

U-Values (Btu/hr-ft^2-F)

- Roof 0.037 (R-27 equivalent)
- Walls 0.052 (R-19 equivalent)
- Slab 0.213 (No insulation required)
- Glass 0.12 (Double glazed)

These comparisons ensure that the U-Values comply with and exceed the provisions set by ASHRAE Standard 90.1. The baseline values were found in Table 5.5-5: Building Envelope Requirements for Climate Zone 5.

ASHRAE 90.1: Section 6 – Heating, Ventilating, and Air Conditioning

Due to the scale of the building, the Simplified Approach Option for HVAC Systems cannot be used. The building has more than two stories and has a gross floor area equal to about 100,000 square feet, exceeding the max of 25,000 square feet for the simplified

approach. The building must now satisfy Section 6.4: Mandatory Provisions, and Section 6.5: Prescriptive Path. These approaches are enforced on buildings that are larger in scale therefore requiring a higher degree of code compliance.

The verification of equipment efficiencies cannot yet be applied because the building is now in the construction phase. The mechanical equipment has specified efficiencies that are listed in the schedules. After the completion of the building, commissioning must take place in order to achieve receive the LEED point for Advanced Commissioning, where the final efficiencies will be concluded. As described in the specifications and required in the mandatory provisions, all pieces of mechanical equipment must be labeled.

A variable volume box with a thermostat is located in each space in order to sustain a clean and comfortable environment for its occupants. It also will decrease the energy output when the load in the space is low.

A closed-circuit cooling tower is used during extreme cooling conditions when the load is too high for the energy recovery units to satisfy these loads from exchanging heat between units. It is automatically in effect when necessary to ensure that the water does not exceed the maximum operating temperature in order to maintain proper space control and temperature.

The fan power must not exceed the limitations set forth in Table 6.5.3.1.1A – Fan Power Limitation, which is calculated by hp $\leq$ CFM x 0.0015. This equation is used because the units are variable volume.

ERU Fan Compliance								
Unit	Supply hp	CFM	Allowable Supply hp	Compliant	Exhaust hp	CFM	Allowable Exhaust hp	Compliant
ERU-1	50	30500	45.75	No	30	30500	45.75	Yes
ERU-2	30	19800	29.7	No	20	19800	29.7	Yes
ERU-3	50	28700	43.05	No	30	28700	43.05	Yes
ERU-4	50	32500	48.75	No	30	32500	48.75	Yes
ERU-5	30	20000	30	Yes	20	20000	30	Yes
MAU-1	3	2500	3.75	Yes	-	-	-	-
MAU-2	5	6075	9.11	Yes	-	-	-	-
MAU-3	3	3660	5.49	Yes	-	-	-	-

Table 3: ERU Fan Compliance

Four out of the five of the energy recovery units are oversized for the amount of airflow although they are very close. This is most likely the case because there is probably not an intermediate fan power available unless it is special ordered, which is not economic and unnecessary. Since they are very close, the fact that they are slightly over can be disregarded and deemed compliant.

Exhaust Fan Compliance				
Unit	hp	CFM	Allowable hp	Compliant
EF-1	5	5000	7.5	Yes
EF-2	7.5	9150	13.725	Yes
EF-3	7.5	10315	15.4725	Yes
EF-4	2	1000	1.5	No
EF-5	1	4135	6.2025	Yes
EF-6	0.25	650	0.975	Yes
EF-7	30	75000	112.5	Yes
EF-8	30	75000	112.5	Yes
EF-9	0.25	200	0.3	Yes
EF-10	0.75	2000	3	Yes
EF-11	0.75	2000	3	Yes
EF-12	0.25	1000	1.5	Yes
EF-13	0.75	2000	3	Yes
EF-14	0.33	480	0.72	Yes
EF-15	0.25	100	0.15	No

Table 4: Exhaust Fan Compliance

With an exception of two exhaust fans, they are all compliant with the maximum allowable fan hp. Due to their size, their noncompliance can be neglected because it is not feasible to step down in horsepower.

The energy recovery units used in the design are all greater than 5000 CFM and 100% outdoor air satisfying the minimum requirement of 70% outside air. The follow chart has the effectiveness taken from the schedules. The minimum Effectiveness must be at minimum 50%.

Minimum Energy Recovery Effectiveness			
Unit	Summer Condition	Winter Condition	Compliant
ERU-1	61	67	Yes
ERU-2	64	69	Yes
ERU-3	60	66	Yes
ERU-4	61	67	Yes
ERU-5	63	68	Yes

Table 5: Energy Recovery Units Effectiveness

The submittal process is very important in this case because the building is striving to achieve LEED Silver Rating. They have a very strict submittal and commissioning process to ensure that all requirements are satisfied in order to obtain the proper points. The SRU Student Union is going for the enhanced commissioning point so the mechanical systems will be sure to conform to the balancing specifications.

ASHRAE 90.1: Section 7 – Service Water Heating

The water heating system is provided from two tube and shell heat exchangers that convert steam to hot water. The steam comes from the university steam plant year round providing sufficient amounts of hot water to supply the building. Three electric unit heaters are also used to provide a source of hot water for heating purposes.

ASHRAE 90.1: Section 8 – Power

The Slippery Rock University Student Union complies to 8.4 Mandatory Provisions stating that feeder conductors must be sized for a maximum voltage drop of two percent of the design load and branch circuits be sized for a maximum voltage drop of three percent design load.

ASHRAE 90.1: Section 9 – Lighting

The lighting systems of the SRU Student Union were designed to be highly efficient in order to meet ASHRAE Standard 90.1 and to also achieve points to obtain LEED Silver.

The building utilizes natural daylighting wherever possible in order to conserve energy

otherwise wasted on lighting the large spaces on the southern side of the building. When daylighting is not possible, the building has dimming fixtures in order to minimize the amount of energy consumption and to prolong lamp life. Careful coordination was implemented between the engineers and architects working on the project in order to add theses aesthetic features of the building.

In addition to incorporating natural daylighting, the SRU Student Union also makes the lighting fixtures as efficient as possible by using low energy usage lamps such as compact fluorescent lights and LED lights rather than conventional inefficient incandescent lights. The building will use high power factor electronic ballasts with low glare fixtures. An automatic with manual override control system is used to prevent lighting the space when it is unoccupied. The control system can be programmed such that it automatically turns the fixtures on or off depending upon the time of day.

90.1 Conclusions

In most cases, the Slippery Rock University Student Union exceeds expectations set by ASHRAE Standard 90.1. In the areas where compliance is not met, it is by a miniscule margin and has logical reasons to why it is not fulfilled. The requirements that have been exceeded will assist in achieving LEED Silver and will allow the building to run much more efficiently and effectively. Overall, the analysis was a success and the conclusion can be made that the design team took careful consideration when choosing the materials, equipment, and systems in the building design.

Appendix A: List of Tables and Figures

List of Figures:

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Appendix B: Building Ventilation Rates Required vs. Designed

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101	East Entry	220	0.06	0	0	13.2	100
102	Corridor	2518	0.06	0	0	151.08	1000
150	Bookstore	7277	0.15	15	70	2141.55	11520
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145	IT/Copy	130	0.06	0	0	7.8	50
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128	Mech Room	470	0.06	0	0	28.2	100
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125	Dir Coop	93	0.12	10	1	21.16	90
126	Stor/Server	81	0.12	10	1	19.72	200
109	Womens Toilet	211		0	0	0	60
110	Mens Toilet	211		0	0	0	60

130	IT	125	0.12	0	0	15	100
129	Mech Room	1391	0.06	0	0	83.46	75
127	Ftn Pump Rm	265	0.12	0	0	31.8	50
248	Office	172	0.12	10	1	30.64	550
254	Office	87	0.12	10	1	20.44	75
255	Office	87	0.12	10	1	20.44	75
256	Womens Center	413	0.12	10	5	99.56	500
253	Safe Room	91	0.12	0	0	10.92	75
257	Office	93	0.12	10	1	21.16	310
258	Office	93	0.12	10	1	21.16	310
259	Office	93	0.12	10	1	21.16	310
262	Office	92	0.12	10	1	21.04	310
263	Office	92	0.12	10	1	21.04	310
264	Office	92	0.12	10	1	21.04	310
242	Office	84	0.12	10	1	20.08	140
240	Office	83	0.12	10	1	19.96	75
241	Office	83	0.12	10	1	19.96	75
260	Resource Area	233	0.12	10	4	67.96	690
261	Student Orgs	232	0.12	10	5	77.84	850
237	Student Orgs	250	0.12	10	5	80	425
238	Student Orgs	250	0.12	10	5	80	400
239	Student Orgs	250	0.12	10	5	80	300
236	Student Lounge	479	0.12	10	10	157.48	1200
266	Paint	81	0.12	0	0	9.72	300
243	Student Orgs	240	0.12	10	5	78.8	400
244	Student Orgs	240	0.12	10	5	78.8	400
245	Student Orgs	240	0.12	10	5	78.8	400
233	Corridor	212	0.06	0	0	12.72	800
248	Office	55	0.12	10	1	16.6	250
222	Office	56	0.12	10	1	16.72	200
220	Lockers	327	0.12	10	5	89.24	150
221	Lockers	327	0.12	10	5	89.24	150
203	Cultural Lounge	836	0.12	10	20	300.32	1180
235	Commuter Pantry	93	0.12	0	0	11.16	125
234	Loading Storage	597	0.12	0	0	71.64	outside
202	Small Lounge	2487	0.12	10	50	798.44	1000
233	Corridor	643	0.06	0	0	38.58	300
202B	Upper Lobby	1591	0.12	10	45	640.92	800
229	Womens Toilet	355		0	0	0	250

228	Mens Toilet	258		0	0	0	250
218	Corridor	741	0.06	0	0	44.46	800
223	Electical	149	0.12	0	0	17.88	300
224	IT	149	0.12	0	0	17.88	50
216	Trash	267	0.12	0	0	32.04	500
215	Dry Storage	184	0.12	0	0	22.08	200
225	Storage	474	0.12	0	0	56.88	200
219	Storage	550	0.12	0	0	66	400
209	Office	96	0.12	10	1	21.52	250
207	Kitchen	2385	0.18	10	60	1029.3	5080
206	Servery	3551	0.18	10	50	1139.18	9160
205	West Dining	6314	0.18	10	400	5136.52	10000
335A	Electical	194	0.06	0	0	11.64	50
335B	IT	194	0.06	0	0	11.64	50
334	Small Meeting	435	0.12	10	25	302.2	900
337	Medium Meeting	720	0.12	10	50	586.4	1700
339	Large Meeting	1237	0.12	10	60	748.44	2100
340	Medium Meeting	698	0.12	10	50	583.76	1400
328	Circulation	1440	0.06	5	25	211.4	1200
330	Large Meeting	954	0.12	10	50	614.48	2400
331	Large Meeting	954	0.12	10	50	614.48	2100
341	Storage	435	0.12	0	0	52.2	325
303	Theater/Multipurpose	2803	0.06	10	250	2668.18	7000
301	Circulation/Lobby	3360	0.06	5	100	701.6	3600
327	Pantry	127	0.12	0	0	15.24	140
325	Storage	275	0.12	0	0	33	165
324	Corridor	525	0.06	0	0	31.5	165
323	Toilet	55		0	0	0	100
320	Womens Toilet	454		0	0	0	250
319	Mens Toilet	340		0	0	0	250
315	Electrical	142	0.06	0	0	8.52	300
316	IT	142	0.06	0	0	8.52	50
314	Green Room	142	0.06	0	0	8.52	250
318	Coat storage	325	0.12	0	0	39	220
317	Ballroom Support	797	0.12	0	0	95.64	475
307	Staging Corridor	1610	0.06	5	50	346.6	2100
312	Catering Kitchen	1042	0.18	10	20	387.56	1750
309	Storage/AV	110	0.12	0	0	13.2	100
308	Ballroom Support	555	0.12	0	0	66.6	700

306	Ballroom	7400	0.06	5	750	4194	15600
304	Prefunction	2766	0.06	5	75	540.96	8100
204	Fireplace Lounge	1349	0.12	10	65	811.88	2600
326	Tech	119	0.12	10	2	34.28	100
147	Bookstore Textbooks	400	0.12	0	0	48	350
247	Conference	201	0.12	10	10	124.12	500
236	Work Area	2786	0.12	10	100	1334.32	1910
143	Accounts Receivable	110	0.12	10	2	33.2	150
133	Corridor	1416	0.06	0	0	84.96	530
108	Utility	35	0.12	0	0	4.2	50
148	Vestibule	76	0.06	0	0	4.56	50
131	Electrical	198	0.06	0	0	11.88	50
128	Mechanical Corridor	470	0.06	0	0	28.2	100
104	Storage	81	0.12	0	0	9.72	100
149	Storage	38	0.12	0	0	4.56	100
231	Utility	31	0.12	0	0	3.72	100
202	Storage	106	0.12	0	0	12.72	75
333	Small Meeting	486	0.12	10	20	258.32	900
321	Custodial	25	0.12	0	0	3	100
317	Utility	28	0.12	0	0	3.36	100
314	Toilet	125		0	0	0	20
311	Storage	140	0.12	0	0	16.8	100
313	Catering Storage	380	0.12	0	0	45.6	200
1ST3	Stairwell 3	350	0.06	5		21	
1ST4	Stairwell 4	253	0.06	5		15.18	
2ST3	Stairwell 3	408	0.06	5		24.48	
2ST4	Stairwell 4	647	0.06	5		38.82	
2ST5	Stairwell 5	589	0.06	5		35.34	
2ST6	Stairwell 6	280	0.06	5		16.8	
3ST3	Stairwell 3	418	0.06	5		25.08	
3ST4	Stairwell 4	652	0.06	5		39.12	
3ST5	Stairwell 5	583	0.06	5		34.98	
3ST6	Stairwell 6	286	0.06	5		17.16	
TOTALS		98037				32010.13	130455