Technical Report 1

ASHRAE Standards 62.1 & 90.1

September 18, 2014

NEIU El Centro
Chicago, IL

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Executive Summary

The purpose of this report is to determine if Northeastern Illinois University's new constructed educational facility called El Centro in Chicago, Illinois is in compliance with ASHRAE Standard 62.1 (2013), Sections 5 and 6, and Standard 90.1 (2013) Sections 5, 6, 7, 8, 9, and 10.

ASHRAE Standard 62.1 specifies minimum ventilation rates and other requirements to minimize the possibility of adverse health effects for occupants and provide an acceptable indoor air quality. The building is in compliance with all of the requirements specified in Section 5 of the standard. The building significantly exceeds the requirements for Section 6 of the standard and these results are discussed in detail in the report.

The purpose of ASHRAE Standard 90.1 is to establish minimum energy efficiency requirements of buildings except low rise residential buildings for the utilization of on-site, renewable energy sources and for the design, construction, and a plan for operation and maintenance of the systems. El Centro meets most of the requirements set forth by Standard 90.1 but a few of the exhaust fans do not meet the required efficiencies.

The report begins with a building overview of the type of building and architecture associated with this project. It is going to be a multipurpose educational facility for NEIU's new campus. The next section is a simple mechanical system overview for the building. A detailed analysis is then carried out to determine the compliance with the standards followed by references and an appendix.

Building Overview

Northeastern Illinois University (NEIU) El Centro is a new educational facility that is being built in the northwest side of Chicago, Illinois. It is located along Kennedy Expressway and will be passed by an estimated 400,000 vehicles per day. The building is set to be completed September 2014, in time for Fall Semester classes. It is a 55,000 square foot building with three stories; there is no basement in El Centro. The building will include classrooms, art studios, computer rooms, lecture halls, music studios, wet labs, damp labs, a library, student lounges, resource rooms, administrative space, and offices.

Nearly the entire building is enveloped in a curtain wall façade. The curtain wall features fins that are designed to limit solar gains on the building and to control the amount of natural daylight into the building. The fins will appear gold when driving into the city, and blue when leaving the city, reflecting the school colors as can be seen in the rendering below (courtesy of JGMA). Photovoltaic panels are mounted to the majority of the roof area. Other green initiatives include low flow plumbing fixtures, high-efficiency equipment, and creative lighting that have made this project eligible for a LEED gold rating.

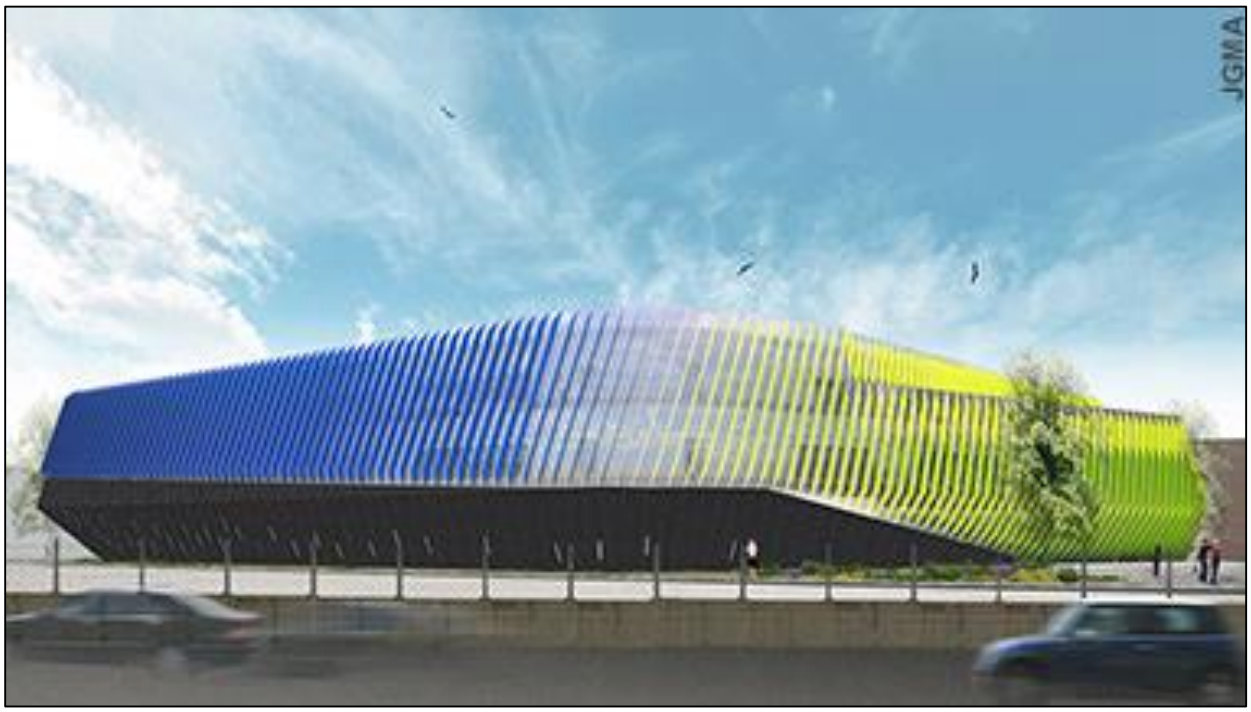
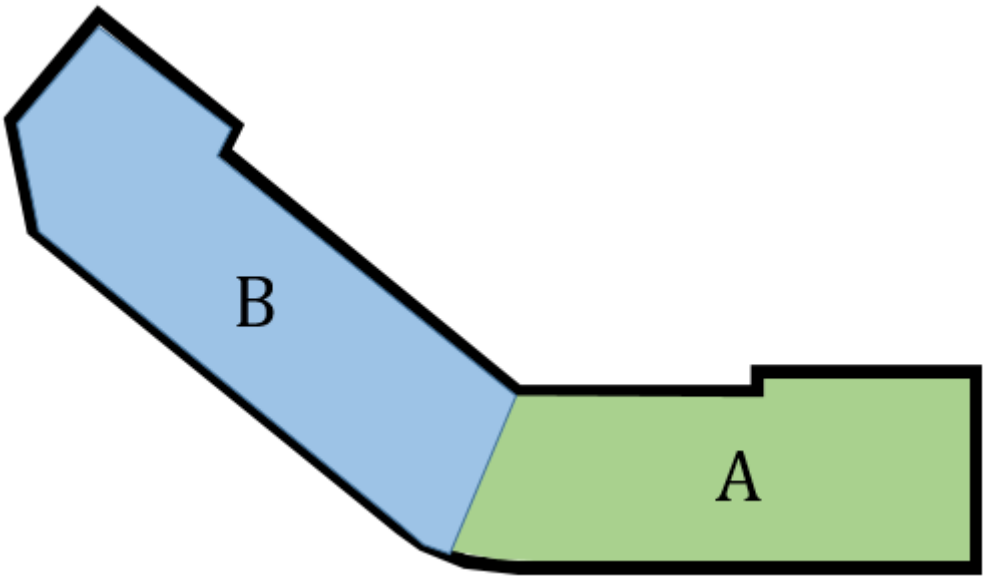


Image 1 – Showing El Centro's curtain wall and unique dual coloring of the fins

Mechanical Systems Overview

Roof Top Air Handling Units

There are two identical packaged air handling units located on the roof called RTU-1 and RTU-2 respectively. They will serve all of the ventilation and cooling requirements of the building year round. They each comprise of: (in order of airflow) return fan, economizer, filter, cooling coil, supply fan, indirect gas fired furnace, sound attenuator, and discharge plenum. RTU-1 and RTU-2 are both served by separate air cooled condensing units, also located on the roof. Architecturally and mechanically, the building is split up into two distinct zones: A and B. See the simplified floor plan sketch below. RTU-1 serves all of the first floor, and zone B on the second floor. RTU-2 serves zone B on the second floor and all of the third floor.



Simplified Typical Floor Plan Sketch

VAV Boxes

El Centro is served by 71 variable air volume boxes. The VAV boxes have reheat coils that are served by two boilers

Boilers

The buildings heating loads are served by two identical 750 MBH natural gas fired hot water boilers. A corridor wraps around the entire perimeter of the building to shield the classrooms from the noisy Kennedy Expressway. This leads to no heating loads in any of the rooms except the corridor. The boilers serve hot water radiant finned tubes that run the length of the perimeter of the building in the corridor. The boilers also serve the heating coils located in all of the VAV boxes in each space. A separate natural gas water heater is used for domestic hot water.

ASHRAE Standard 62.1 Compliance

5. Systems and Equipment

5.1 Ventilation Air Distribution

The ventilation air distribution system has a set minimum ventilation airflow rate and is in compliance. A return plenum is not used on this project. All returns are ducted back to the two air handling units. The design documents specify minimum requirements for air balance testing by referring to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

5.2 Exhaust Duct Locations

Exhaust ducts carrying potentially harmful substances are negatively pressurized through the spaces from which they pass in compliance with this section.

5.3 Ventilation System Controls

A fully integrated BAS system is used to control the mechanical systems in El Centro. During times of the day when the building is occupied, the RTU's will maintain the set point. During times when the building is not occupied, the RTU will enter a cool-down mode and will warm up again before the next occupied time is.

5.4 Airstream Surfaces

All duct is required to comply with UL 181, including resistance to mold growth and resistance to erosion, in compliance with this section.

5.5 Outdoor Air Intakes

All outdoor air intakes are required to be 15'-0" from any contaminant source as per the drawings in compliance with this section. Water penetration is limited to values set forth in this section. Outdoor units and duct work are required to have rain and snow drains per the specifications. Outdoor intakes shall also include bird screens and is in compliance with this section.

5.6 Local Capture of Contaminants

Exhaust ducts are located in areas where contaminants are produced including restrooms, showers, laboratories, etc. These ducts are negatively pressurized by exhaust fans located on the roof.

5.7 Combustion Air

The boilers on the first floor are provided with 1500 CFM of outside air for combustion and removes combustion products in accordance with manufacturer instructions.

5.8 Particulate Matter Removal

Equipment is specified to have a prefilter of MERV 7 and a final filter of MERV 13 for credit EQ5 of LEED and is in compliance with this section which requires MERV 8.

5.9 Dehumidification System

The building is specified to have a maximum relative humidity of 65%. The building will be positively pressurized ensuring that the volume of outside air entering in is always more than the volume of air being exhausted.

5.10 Drain Pans

The drain pan slopes are in compliance with this section. The drain pan outlet is located at the lowest point of the drain pan. Drain pans are located under all devices capable of producing water and have sufficient widths to collect this water in compliance with this section.

5.11 Finned-Tube

Drain pans are required for the two roof top units per the specifications, therefore the building is in compliance with this section.

5.12 Humidifiers and Water-Spray Systems

NEIU El Centro does not employ humidifiers or water-spray systems, therefore this section does not apply.

5.13 Access for Inspection, Cleaning, and Maintenance

The roof top units are installed with sufficient access for inspection, cleaning, and maintenance. Access doors are provided for duct work, dampers, and other equipment throughout the building in compliance with this section.

5.14 Building Envelope and Interior Surfaces

A fluid-applied membrane vapor-retarder air barrier is used throughout the building envelope. Nearly the entire façade is a curtain wall with exterior fins. A sealant is used at exterior joints to limit air leakage into the building. All HVAC ducts and pipes with potential for condensation in the building are insulated in compliance with this section.

5.15 Buildings with Attached Parking Garages

NEIU El Centro does not have an attached parking garage, therefore this section does not apply.

5.16 Air Classification and Recirculation

The air in most of the building is classified as Type 1 and can be recirculated throughout the building. The air in all of the restrooms is directly exhausted to the outdoors with ducts and exhaust fans located on the roof. There is one wet and one dry lab in El Centro and the air is classified as Type 4. This air is recirculated into RTU-2 and is not in compliance with this section.

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

This section does not apply to El Centro.

6. Procedures

Ventilation Rate Procedure

Breathing Zone Outdoor Airflow (V_{bz})

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

Where R_p = outdoor airflow rate per person (CFM/person)
P_z = zone population (person)
R_a = outdoor airflow rate required per unit area (CFM/ft^2)
A_z = zone floor area (ft^2)

Zone Air Distribution Effectiveness (E_z)

E_z is determined from table 6.2.2.2.
For this project: E_z = 1.0 (Ceiling supply of cool air).

Zone Outdoor Airflow (V_{oz})

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

Primary Outdoor Air Fraction (Z_{pz})

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

Where V_{pz} = zone primary airflow
This is a VAV system so V_{pz} is the lowest zone primary airflow value.

System Ventilation Efficiency (E_v)

E_v is determined from Table 6.2.5.2.
For this project E_v = 1.

Occupant Diversity (D)

This was not taken into account because this is an educational building and is expected to be fully occupied during the peak times of the day.

Ventilation Analysis

This building has two roof top air handling units that handle all of the ventilation for the building. El Centro contains no operable windows for ventilation. The building is relatively small at 55,000 square feet so both roof top air handling units were analyzed in this study. In Appendix A, a spread sheet can be found with detailed calculations of the results.

El Centro exceeds the required outdoor air volume by a significant margin. See the table below for a summary of these results. This could be because of a number of reasons. The systems in this building were designed using the Chicago Building Code (CBC) 2012. This code may have more stringent standards than ASHRAE 62.1. The building enclosure is also almost entirely a curtain wall that will result in high cooling loads during the summer months. This will require a high volume of air to cool the building and increased the intake of the outdoor air. The design engineer also could have

	Design OA CFM	Required OA CFM	Compliance
RTU-1 Total	37,920	7,487	Y
RTU-2 Total	52,085	7,780	Y

Table 1 – Ventilation Requirement Summary

Exhaust Analysis

Table 6.5 in ASHRAE 62.1 outlines minimum exhaust rates for types of spaces. The table below summarizes the exhaust analysis results of El Centro. All of the exhaust fans were found to be in compliance.

Exhaust Fan	Area Served	# of Units	CFM/Unit	SF	CFM/SF	Standard 62.1	Design	COMPLI-ANCE
						Min Airflow (CFM)	Airflow (CFM)	
EF-1	ART RM. A304	-	-	900	0.7	630	1450	Y
EF-2	WET LAB B304	-	-	1368	1	1368	3635	Y
EF-3	PREP. RM. B302	-	-	333	1.5	500	1250	Y
EF-4	NOT USED	-	-	-	-	-	NOT USED	-
EF-5	IT ROOM A211	-	-	412	0.5	206	420	Y
EF-6	SHOWER RM B128	-	-	47	0.5	24	100	Y
EF-7	RECYCLING B126	-	-	439	1	439	450	Y
EF-8	HAZ. WASTE B131	-	-	11	1.5	17	50	Y
EF-9	WORK RM. A115/ BREAK RM. A109	-	-	288	0.3	86	700	Y
EF-10	CYLINDER STOR. B129	-	-	18	1.5	27	50	Y
TEF-1	M & W TOILET	46	70	1788	-	3220	3640	Y
TEF-2	FAMILY ROOMS, JC-B120,B210,B312	3	70	175	1	385	800	Y

Table 2 – Exhaust Analysis Results

ASHRAE Standard 90.1 Compliance

5. Building Envelope

5.1 General

NEIU El Centro is located in Chicago which is climate zone 5A as determined in Figure B1-1 in appendix B of ASHRAE Standard 90.1. Climate zone 5A is described as moist and humid and has moderately hot summers and cold winters.

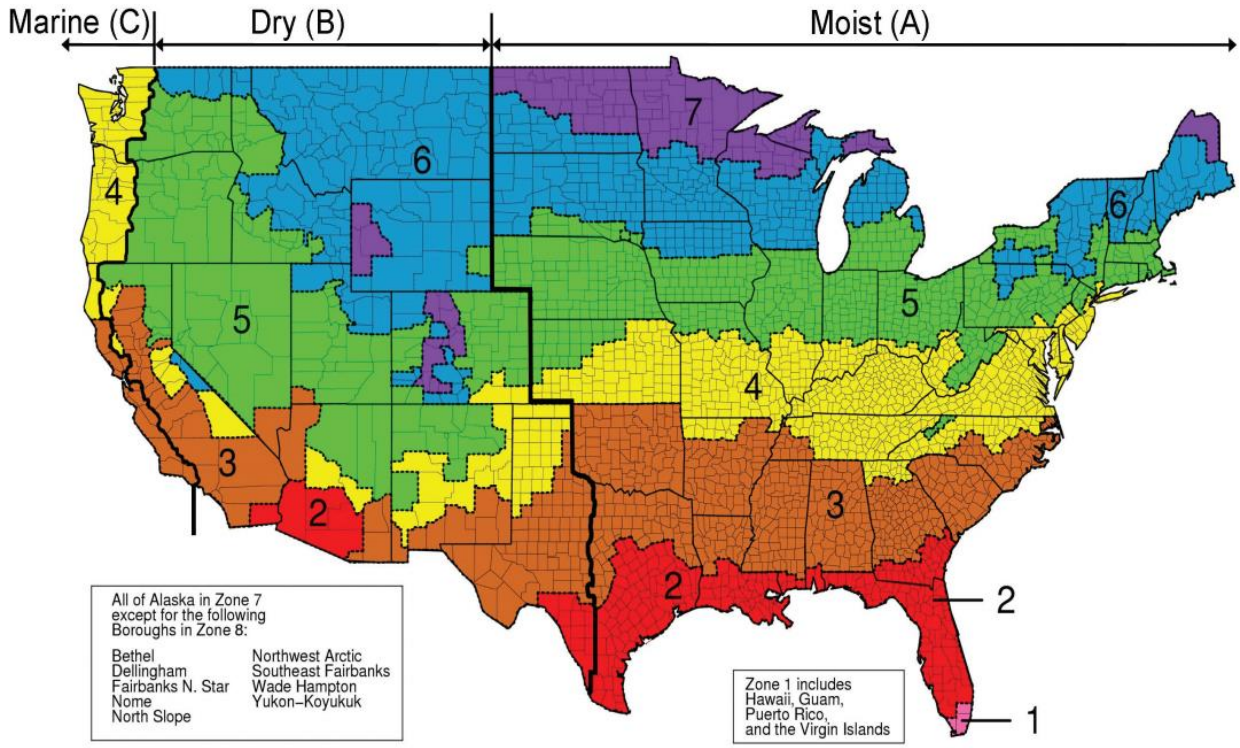


Figure B1-1 U.S. climate zone map (*ASHRAE Transactions*, Briggs et al., 2003).

Figure 1 – ASHRAE 90.1 (2013) Climate Zone Map

5.4 Mandatory Provisions

The fenestration product information shall be determined by an accredited laboratory and shall be labelled correctly. Air leakage is avoided by having the entire building envelope designed and constructed with a continuous air barrier as noted on the construction documents. The building entrance has a vestibule that separates conditioned space from the exterior. The exterior doors are located about 12 feet from the interior doors and is in compliance with this section.

5.5. Prescriptive Building Envelope Option

El Centro is enclosed almost entirely by a curtain wall. The curtain wall has solar fins on it to limit natural daylight into the building. The total square footage of the exterior walls of the building is about 42,000 SF, while the total area of glazing is about 28,000. El Centro comprises of about 68% vertical glazing on the exterior

walls, well above the 40% required for the Prescriptive Building Method provided by ASHRAE 90.1. Therefore the building does not comply with this section.

5.6 Building Envelope Trade-Off Option

The building is deemed in compliance with this standard if it meets the criteria set forth in Sections 5.1, 5.4, 5.7 and 5.8. Submittal documentation that labels of space conditioning categories are required as well as correct labelling of all product information and installation requirements in compliance with this section, therefore in compliance with this standard.

6. Heating, Ventilation, and Air Conditioning

6.1 Building Envelope Trade-Off Option

El Centro is a new building and must comply with the requirements set forth in Section 6.2.

6.2 Compliance Paths

The building must comply with sections 6.1 "General", Section 6.7 "Submittals", Section 6.8 "Minimum Equipment Efficiency Tables" and Section 6.4 "Mandatory Provisions" to be in compliance with this standard.

6.3 Simplified Approach Option for HVAC Systems

This building has a gross square footage of 55,000 SF which is over 25,000 SF so this section does not apply.

6.4 Mandatory Provisions

ASHRAE Standard 90.1 lists equipment minimum efficiencies in tables in Section 6.8. Electrically operated condensing units, electrically operated heat pumps, electrically operated packaged terminal air conditioners, and gas fired boilers apply to this project. In the construction documents, efficiencies can only be found for the two natural gas fired hot water boilers and the two roof top condensing units. In Table 3 below, a summary of these results can be found

Equipment Type	Size Cateogry	Standard 90.1 Minimum Efficiency	Design Minimum Efficiency	Standard 90.1 Compliance
Air Cooled Condensing Units	≥135,000 Btu/h	10.5 EER	11.3 EER	Y
(2) HW Boiler, Gas Fired	≥300,000 Btu/h and ≤2,500,000 Btu/h	80% E_t	88% E_t	Y

Table 3 – Equipment Efficiencies

All efficiencies are to be certified by a recognized certification board. All mechanical equipment shall have nameplates that are clearly labelled. Load calculations were made using the Chicago Building Code (CBC) which references ASHRAE standards. The supply of heating and cooling energy to each zone are controlled individually by thermostats which control the VAV boxes. Morning warm up, night cool down, and unoccupied control modes are specified in the sequence of operation to save energy when students are not in the building in compliance with this section. All dampers in the building will automatically shut when their respective system is not in service.

6.5 Prescriptive Path

Both roof top air handling units have economizers that are capable of modulating outdoor air and return air dampers to provide up to 100% of the design supply air quantity as outdoor air for cooling to their respective zones. Humidifiers cannot be found anywhere in the construction documents. Below is a table of allowable horsepowers for the fans throughout the building. Each RTU has (2) 30 hp fans that are not in compliance with this section. Exhaust fans 8 & 10 are also not in compliance.

Unit	Allow. nameplate motor hp	CFM	VAV cfm *0.0015	Compliance hp ≤ cfm*0.0015
RTU-1 (2)	30	17100	25.65	N
RTU-2 (2)	30	17100	25.65	N
EF-1	3/4	1450	2.175	Y
EF-2	5	3635	5.4525	Y
EF-3	1/4	1250	1.875	Y
EF-4	NOT USED	-	-	N/A
EF-5	1/4	420	0.63	Y
EF-6	N/A	100	N/A	N/A
EF-7	1/6	450	0.675	Y
EF-8	1/4	50	0.075	N
EF-9	1/4	700	1.05	Y
EF-10	1/4	50	0.075	N
TEF-1	1 1/2	3640	5.46	Y
TEF-2	1/4	800	1.2	Y

Table 4 – Allowable Horsepower

6.7 Submittals

Construction documents of the actual systems installed in the building are to be submitted to the owner within 90 days after system acceptance. El Centro is scheduled to be completed in September of 2014 and the as-built drawings have not been submitted to date.

7. Service Water Heating

El Centro has one gas fired domestic water heater that is a high efficiency condensing type. It has two 750 MBH boilers that are also gas fired. All of this equipment is located in the mechanical room on the first floor. Below is a table that summarizes the data of the two boilers which displays their compliance.

Standard 90.1			Design			
Equipment Type	**Subcategory**	**Performance Required**	**Equipment Tag**	**Rating Btu/h**	**Min. Thermal Efficiency**	**Compliance**
Hot-water supply boilers, gas	≥4000 (Btu/h)/gal and ≥ 10 gal	80% E_t	B-1	750	88%	Y
Hot-water supply boilers, gas	≥4000 (Btu/h)/gal and ≥ 10 gal	80% E_t	B-2	750	88%	Y

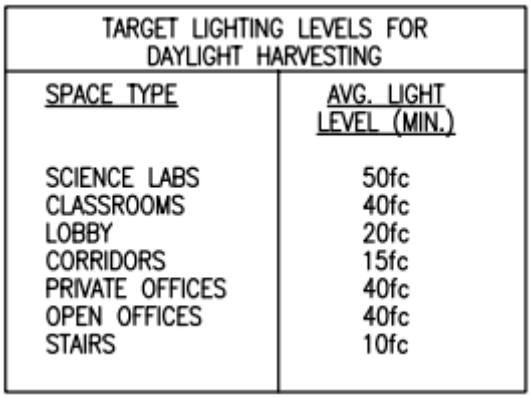
Table 5 – Hot Water Equipment Efficiencies

8. Power

El Centro complies with standards set by the National Electric Code (NEC), therefore all feeder conductors are sized for a maximum voltage drop of 2% at design load, and branch circuits are sized for a maximum voltage drop of 3% at design load. Power plans and riser diagrams are also provided in the construction documents. This project also complies with the Energy Conservation of the Municipal Code of Chicago which references ASHRAE 90.1.

9. Lighting

The building area method was used to determine the lighting power compliance with Section 9. Table 9.5.1 lists the lighting power density (LPD) for schools and universities at 0.87 W/ft^2. The building uses energy efficient fluorescent fixtures and nearly the entire façade of the building is a curtain wall and interior partitions with glazing allow natural daylight to enter the classrooms resulting in a lower LPD then required. Most spaces contain occupancy sensors and when a space is not occupied all lights shall be turned off. When the vacancy or occupancy sensor is triggered, the daylight harvesting feature will determine the lighting level based on photocell readings. Minimum light levels for all spaces are listed in the figure below (courtesy of the construction documents).



TARGET LIGHTING LEVELS FOR DAYLIGHT HARVESTING	
SPACE TYPE	AVG. LIGHT LEVEL (MIN.)
SCIENCE LABS	50fc
CLASSROOMS	40fc
LOBBY	20fc
CORRIDORS	15fc
PRIVATE OFFICES	40fc
OPEN OFFICES	40fc
STAIRS	10fc

Figure 2 – Target Lighting Levels for Daylight Harvesting

10. Other Equipment

The boilers and hot water system is served by two pumps located on the first floor of the mechanical room. Efficiencies could not be found for the pumps anywhere in the construction documents but a summary of the pumps can be found in the table below.

Pump	System Served	RPM	HP	Efficiency	Min. Efficiency	Compliance
HWP-1	Hot Water	1750	5	N/A	89.5%	N/A
HWP-2	Hot Water	1750	5	N/A	89.5%	N/A

Table 6 – Target Lighting Levels for Daylight Harvesting

90.1 Compliance Summary

El Centro exceeds most of the requirements set forth by ASHRAE Standard 90.1. The building contains over 40% vertical glazing on the exterior walls, therefore it may have to comply with other sections of 90.1 that are beyond the scope of this report. The two roof top air handling units (RTU-1 & RTU-2) return fans do not meet the required efficiencies set forth by 90.1. A more detailed look at these results is required to inquire why this is the case. Two of the exhaust fans (EF-8 & EF-10) do not comply with the required efficiencies as well. It is possible that he fans are oversized because they serve very small storage or waste rooms and a smaller size fan may have been unavailable.

References

ANSI/ASHRAE. (2013). Standard 62.1 – 2013, Ventilation for Acceptable Indoor Air Quality. Atlanta, GA: American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc.

ANSI/ASHRAE. (2013). Standard 90.1 – 2013, Energy Standard for Buildings Except Low-Rise Residential Buildings. Atlanta, GA: American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc.

Primera Engineers Ltd., Construction Documents, John Palasz and Lindsay Bose, Primera Engineers, Chicago, Illinois.

Appendix A

Exhaust Unit	Room #	Room Name	Occupancy Type	ASHRAE 62.1 SECTION 6.2						Design OA (CFM)	Compl-iance
				A_z Floor Area ft^2	R_a CFM/ft^2	Pop. Dens. pers./ft^2	P_z Zone Pop.	R_p CFM/pers.	TOTAL OA (CFM)		
-	A101	VESTIBLE	CORRIDOR	300						0	
RTU-1	A102	LOBBY	BREAK ROOM	2695	0.12	150	67.38	5.00	2345	5700	Y
RTU-1	A103	RECEPTION	OFFICE	246	0.06	30.00	7.38	5.00	52	300	Y
RTU-1	A104	RECEPTION OFFICE	OFFICE	100	0.06	5.00	0.50	5.00	9	150	Y
-	ST001	STAIR	STAIR	271						0	
RTU-1	A106	COMPUTER LAB	COMPUTER ROOM	1089	0.06	4.00	4.36	20.00	152	2100	Y
RTU-1	A107	CORRIDOR	CORRIDOR	1364	0.06	0.00	0.00	0.00	82	320	Y
RTU-1	A108	RESOURCE ROOM	LIBRARY	1097	0.06	10.00	10.97	5.00	121	1600	Y
RTU-1	A109	BREAK ROOM	BREAK ROOM	134	0.12	25.00	3.35	7.00	40	250	Y
RTU-1	A111	STORAGE	STORAGE INACTIVE	96						65	
TEF-1	A112	MEN'S TOILET	TOILET ROOM	245						0	
TEF-1	A113	WOMEN'S TOILET	TOILET ROOM	245						0	
EF-9	A114	ELEC RM	STORAGE INACTIVE	45						400	
RTU-1	A115	WORK ROOM	LIBRARY	154	0.12	10.00	1.54	17.00	45	450	Y
RTU-1	A116	STORAGE	STORAGE INACTIVE	222						50	
-	ST003	STAIR	STAIR	313						0	
RTU-1	B101	CONSULTATION ROOM	OFFICE	59	0.06	5.00	0.30	5.00	5	75	Y
RTU-1	B102	CONSULTATION ROOM	OFFICE	59	0.06	5.00	0.30	5.00	5	75	Y

RTU-1	B103	CONSULTATION ROOM	OFFICE	55	0.06	5.00	0.28	5.00	5	75	Y
RTU-1	B104	CONSULTATION ROOM	OFFICE	59	0.06	5.00	0.30	5.00	5	75	Y
RTU-1	B105	CONSULTATION ROOM	OFFICE	65	0.06	5.00	0.33	5.00	6	75	Y
RTU-1	B106	FACULTY ROOM	OFFICE	2223	0.06	5.00	11.12	5.00	189	2750	Y
RTU-1	B107	PRIVATE OFFICE	OFFICE	110	0.06	5.00	0.55	5.00	9	75	Y
RTU-1	B108	PRIVATE OFFICE	OFFICE	110	0.06	5.00	0.55	5.00	9	75	Y
RTU-1	B109	PRIVATE OFFICE	OFFICE	110	0.06	5.00	0.55	5.00	9	75	Y
RTU-1	B110	PRIVATE OFFICE	OFFICE	110	0.06	5.00	0.55	5.00	9	75	Y
RTU-1	B111	PRIVATE OFFICE	OFFICE	110	0.06	5.00	0.55	5.00	9	75	Y
RTU-1	B113	PRIVATE OFFICE	OFFICE	131	0.06	5.00	0.66	5.00	11	200	Y
RTU-1	B114	PRIVATE OFFICE	OFFICE	106	0.06	5.00	0.53	5.00	9	75	Y
RTU-1	B115	PRIVATE OFFICE	OFFICE	106	0.06	5.00	0.53	5.00	9	75	Y
RTU-1	B116	PRIVATE OFFICE	OFFICE	106	0.06	5.00	0.53	5.00	9	75	Y
RTU-1	B117	CORRIDOR	CORRIDOR	1078	0.06	0.00	0.00	0.00	65	400	Y
-	B118	MECHANICAL ROOM	STORAGE INACTIVE	652						0	
TEF-2	B119	FAMILY RESTROOM	TOILET ROOM	60						0	
TEF-2	B120	JC	JANITOR'S CLOSET	53						0	
RTU-1	B121	CLOSET	STORAGE INACTIVE	44						50	
RTU-1	B122	CORRIDOR	CORRIDOR	518	0.06	0.00	0.00	0.00	31	50	Y
-	ST002	STAIR	STAIR	271	0.00	0.00	0.00	0.00		0	Y
RTU-1	B123	RESOURCE CENTER	LIBRARY	1171	0.12	10.00	11.71	17.00	340	1650	Y
RTU-1	B124	BIKE ROOM	STORAGE INACTIVE	115						100	Y
RTU-1	B125	FIRE PUMP	STORAGE INACTIVE	115						50	Y
EF-7	B126	RECYCLING ROOM	STORAGE ACTIVE	439	0.12	0.00	0.00	0.00	53	300	Y

-	B127	ELEC RM	STORAGE INACTIVE	276						240	
EF-6	B128	SHOWER	SHOWER ROOM	47						0	
EF-10	B129	CYLINDER STORAGE	STORAGE INACTIVE	18						0	
-	B130	WATER METER VAULT	STORAGE INACTIVE	37						0	
RTU-2	A201	LECTURE ROOM	CLASSROOM	1491	0.06	65.00	96.92	7.50	816	2500	Y
RTU-2	A202	CLASSROOM II	CLASSROOM	728	0.06	65.00	47.32	7.50	399	2100	Y
RTU-2	A203	LOBBY	CORRIDOR	1096	0.06	0.00	0.00	0.00	66	1400	Y
-	ST001	STAIR	STAIR	271						0	Y
RTU-2	A204	CLASSROOM II	CLASSROOM	905	0.06	65.00	58.83	7.50	495	2330	Y
RTU-2	A205	CLASSROOM II	CLASSROOM	873	0.06	65.00	56.75	7.50	478	2330	Y
RTU-1	A206	CORRIDOR	CORRIDOR	932	0.06	0.00	0.00	0.00	56	500	Y
RTU-2	A207	CLASSROOM III	CLASSROOM	675	0.06	65.00	43.88	7.50	370	1800	Y
RTU-2	A208	CLASSROOM III	CLASSROOM	652	0.06	65.00	42.38	7.50	357	1800	Y
RTU-1	A209	CORRIDOR	CORRIDOR	917	0.06	0.00	0.00	0.00	55	2150	Y
RTU-2	A210	ELEC. RM	STORAGE INACTIVE	96						200	
EF-5	A211	IT ROOM	STORAGE INACTIVE	412						370	
TEF-1	A212	MEN'S TOILET	TOILET ROOM	322						0	
TEF-1	A213	WOMEN'S TOILET	TOILET ROOM	327						0	
-	ST003	STAIR	STAIR	218						0	
RTU-1	B201	CLASSROOM II	CLASSROOM	896	0.06	65.00	58.24	7.50	491	1690	Y
RTU-1	B202	CLASSROOM II	CLASSROOM	896	0.06	65.00	58.24	7.50	491	1690	Y
RTU-1	B203	CORRIDOR	CORRIDOR	1061	0.06	0.00	0.00	0.00	64	1350	Y
RTU-1	B204	CLASSROOM II	CLASSROOM	906	0.06	65.00	58.89	7.50	496	1700	Y
RTU-1	B205	CLASSROOM II	CLASSROOM	906	0.06	65.00	58.89	7.50	496	1700	Y
RTU-1	B206	CORRIDOR	CORRIDOR	1170	0.06	0.00	0.00	0.00	70	1950	Y
RTU-1	B207	CLASSROOM III	CLASSROOM	747	0.06	65.00	48.56	7.50	409	1150	Y

RTU-1	B208	CLASSROOM III	CLASSROOM	747	0.06	65.00	48.56	7.50	409	1150	Y
TEF-2	B209	FAMILY RESTROOM	TOILET ROOM	60						0	Y
TEF-2	B210	JC	JANITOR'S CLOSET	61						0	Y
RTU-1	B211	CLOSET	STORAGE INACTIVE	128						50	Y
RTU-1	B212	CORRIDOR	CORRIDOR	623	0.06	0.00	0.00	0.00	37	150	Y
-	ST002	STAIR	STAIR	271						0	Y
RTU-1	B213	CLASSROOM II	CLASSROOM	975	0.06	65.00	63.38	7.50	534	1890	Y
RTU-1	B214	TUTORING ROOM	OFFICE	76	0.06	5.00	0.38	5.00	6	350	Y
RTU-1	B215	TUTORING ROOM	OFFICE	81	0.06	5.00	0.41	5.00	7	100	Y
RTU-1	B216	TUTORING ROOM	OFFICE	82	0.06	5.00	0.41	5.00	7	100	Y
RTU-1	B217	RESOURCE CENTER	LIBRARY	787	0.12	10.00	7.87	17.00	228	2100	Y
RTU-2	A301	SEMINAR	OFFICE	421	0.06	5.00	2.11	5.00	36	850	Y
RTU-2	A302	SEMINAR	OFFICE	430	0.06	5.00	2.15	5.00	37	1650	Y
RTU-2	A303	STUDENT LOUNGE	BREAK ROOM	1952	0.06	25.00	48.80	5.00	361	3600	Y
RTU-2	ST001	STAIR	STAIR	271	0.00	0.00	0.00	0.00		0	Y
RTU-2/EF-1	A304	ART CLASSROOM	CLASSROOM	900	0.18	20.00	18.00	0.18	165	2000	Y
RTU-2	A305	VENDING	STORAGE ACTIVE	505	0.12	0.00	0.00	0.00	61	1260	Y
RTU-2	A306	CORRIDOR	CORRIDOR	712	0.06	0.00	0.00	0.00	43	380	Y
RTU-2	A307	MUSIC ROOM	CLASSROOM	631	0.06	65.00	41.02	7.50	345	1520	Y
RTU-2	A308	CLASSROOM III	CLASSROOM	608	0.06	65.00	39.52	7.50	333	1600	Y
RTU-2	A309	CORRIDOR	CORRIDOR	676	0.06	0.00	0.00	0.00	41	2250	Y
RTU-2	A310	ELEC. RM	STORAGE INACTIVE	90						130	
RTU-2	A311	CLOSET	STORAGE INACTIVE	346						130	
TEF-1	A312	MEN'S TOILET	TOILET ROOM	322						0	
TEF-1	A313	WOMEN'S TOILET	TOILET ROOM	327						0	
RTU-2	ST003	STAIR	STAIR	217						0	

RTU-2	A314	SEMINAR	STORAGE INACTIVE	278						650	
RTU-2	A316	ELEV CLOSET	STORAGE INACTIVE	20						0	
EF-4	B301	CHEM CLOSET	STORAGE INACTIVE	127						50	
EF-3	B302	PREP ROOM	STORAGE INACTIVE	333						785	
RTU-2	B303	EQUIPMENT CLOSET	STORAGE ACTIVE	116	0.12	0.00	0.00	0.00	14	50	Y
RTU-2/EF-2	B304	WET LAB	LABORATORY	1368	0.18	25.00	34.20	10.00	588	2650	Y
RTU-2	B305	DAMP LAB	LABORATORY	1121	0.18	25.00	28.03	10.00	482	2400	Y
RTU-2	B306	CORRIDOR	CORRIDOR	1061	0.06	0.00	0.00	0.00	64	1600	Y
RTU-2	B307	CLASSROOM II	CLASSROOM	896	0.06	65.00	58.24	7.50	491	2320	Y
RTU-2	B308	CLASSROOM II	CLASSROOM	896	0.06	65.00	58.24	7.50	491	2320	Y
RTU-2	B309	CORRIDOR	CORRIDOR	1183	0.06	0.00	0.00	0.00	71	2450	Y
RTU-2	B310	STORAGE	STORAGE INACTIVE	337						60	
TEF-2	B311	FAMILY RESTROOM	TOILET ROOM	60						0	
TEF-2	B312	JC	TOILET ROOM	61						0	
RTU-2	ST002	STAIR	STAIR	271						0	
RTU-2	B314	CORRIDOR	CORRIDOR	628	0.06	0.00	0.00	0.00	38	400	Y
RTU-2	B315	CLASSROOM	CLASSROOM	862	0.06	65.00	56.03	7.50	472	2525	Y
RTU-2	B316	CLASSROOM I	CLASSROOM	1221	0.06	65.00	79.37	7.50	668	3375	Y
RTU-2	B316	ELEV CLOSET	STORAGE INACTIVE	20						0	Y
RTU-2	B319	CLOSET	STORAGE INACTIVE	208						250	Y