2010|2011

Technical Report 3

Mechanical Systems Existing Conditions Evaluation

Duval County Unified Courthouse Facility

Jacksonville, Florida

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Mechanical

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Executive Summary

The Duval County Unified Courthouse Facility mechanical systems complete their objectives of providing ventilation air and maintaining thermal comfort levels for the occupants through a complex design. The systems meet most requirements of ASHRAE Standards 62.1 and 90.1 and define acceptable levels of indoor air quality and energy efficiency. An energy analysis has been completed to gain LEED Certification and to obtain load and energy use results. The energy model of the facility created for the purpose of this report and the previous report yields a total annual energy use of 45,268 MMBTU. No cost for the mechanical system has been supplied as of yet, however, this information is expected to do further analysis.

A rating from the Leadership in Energy and Environmental Design (LEED), which was created by the United States Green Building Council (USGBC) is a target for this project. The facility is currently on track to achieve LEED Certification for New Construction V2.2. It is possible that the building can acquire LEED Silver Certification. For the purpose of this report, only the areas in the Energy and Atmosphere and the Indoor Environmental Quality categories were examined due to the mechanical systems direct correlation with them. It should be mentioned, however, that the building is lacking in LEED credits in the Energy and Atmosphere section.

An overall system evaluation was conducted to critique the adequacy of the design. It has been determined that the system selections are adequate for the facility and project type, but there is room for improvement in certain areas like energy saving and load shedding. These changes will be investigated in later research.

Building Summary

The Duval County Unified Courthouse Facility is a 798,000 square feet, 7 level government building. The facility houses 51 total courtrooms, judicial offices, hearing spaces, and conference areas. It also includes parking areas, a detention zone, and building support areas on the first floor.

Its façade is predominantly precast limestone aggregate concrete panels and vertical spanning aluminum curtain wall vision glazing. Three large aluminum curtain walls with spandrel glazing also exist under the roofs to allow natural lighting into the front lobby and central atrium. The roof system is primarily a flat composite concrete insulated roof. Two sloped roofs exist over the lobby and central core of the building which use an insulated standing seam metal roof deck system.

Systems

Airside:

The Duval County Unified Courthouse Facility utilizes 25 Air Handling Units (AHU's) to distribute air throughout the building. The 51 courtrooms are served by 14 AHU's while the other 11 AHU's serve the remainder of the building. All AHU's are served with outdoor air by three Makeup Air Units (MAU's), two of which are heat recovery units from exhaust air. Most units are located on the

interior of the building in mechanical rooms or penthouses with the exception of two AHU's and two MAU's which are all located on the second floor roof.

Zone Conditioning:

Most areas are served by Variable Air Volume (VAV) AHU's with VAV boxes in the zones. The VAV boxes also utilize terminal reheat coils. The exceptions to VAV systems are the four courtrooms on the third and fourth floors at the northern side of the building. Each of these four courtrooms is served by its own Constant Air Volume (CAV) unit. Fan Coil Units (FCU) are also utilized in some corridors for additional conditioning.

Waterside:

Heating hot water used by AHU heating coils, terminal VAV boxes, and FCU's is generated by two natural gas boilers in a first floor mechanical room. Each boiler has an output of 13,390 MBH. Chilled water is supplied by J.E.A. Public Utility Company. The chilled water is pumped from a central pumping room to the AHU cooling coils and FCU's.

Mechanical System Description

Mechanical System Design Objectives and Requirements

The Duval County Unified Courthouse Facility is a very large judicial building that requires a system to handle such large floor area and volume of people. The building holds office space for administration and judges, courtrooms and hearing rooms, and a holding area. This being said, the mechanical system does not have to be complex to handle unique loads like laboratories or gymnasiums. The system has loads typical to that of a large office building. The system is designed to meet or exceed the minimum requirements of ASHRAE Standard 62.1 for ventilation and indoor air quality requirements. The system is also designed to meet most of the requirements in ASHRAE Standard 90.1 for energy efficiency. The building will obtain LEED Certification, and the mechanical systems' designs have been designed to earn the necessary LEED credits.

The facility operates on a weekday basis with typical government office building hours. Therefore, the mechanical systems have been designed with setbacks and optimal start and stop controls for higher efficiency and operate at a minimum rate for ventilation during unoccupied hours. Due to the building's location and climate in Florida, the mechanical systems have a large focus on the loads created by the weather. The mechanical system is primarily used for cooling and dehumidification. The facility's heating system is designed to handle the mild winter that the location experiences.

Energy Sources and Rates

The Duval County Unified Courthouse Facility energy is primarily served by the J.E.A. Public Utility Company. Possible utilities available in Jacksonville are electricity, natural gas, domestic water & sewage, and district chilled water. The J.E.A Public Utility Company provides electricity, domestic water & sewage, and district chilled water. Electric consumption and demand rates from J.E.A. are summarized in Table 1. The domestic and chilled water rates are summarized in Table 2. Natural gas is provided in the area by TECO-People's Gas. The natural gas rates are provided in Table 3.

J.E.A. Electric Rates	
January-December	Unit Cost
Electric Demand	$11.47/kW
Electric Consumption	$0.0662/kWh

Table 1

J.E.A. Water Rates	
Utility	Unit Cost
Domestic Water	$1.43/kgal
Chilled Water	$0.87416/therm

Table 2

TECO Natural Gas Rate	
Utility	Unit Cost
Natural Gas	$0.11321/therm

Table 3

In order to compare the energy costs, the rates of energy use have been converted to a cost per MBTU base. These prices are shown in Table 4. This shows that the least expensive source of energy is Natural Gas, and the most expensive energy to the site is Electricity.

Utility Rates	
Utility	Unit Cost
Electricity	$0.0194/MBTU
Natural Gas	$0.0011/MBTU
Chilled Water	$0.0087/MBTU

Table 4

Site and Cost Factors

No factors based on the building site have been noted that would influence the mechanical system design of the Duval County Unified Courthouse Facility.

No rebates or incentives have been noted that would influence the design of the facility, although rebates through the J.E.A. Public Utility Company are available through the implementation of energy efficient appliances and lighting.

Design Conditions

Outdoor design conditions for the site of the Duval County Unified Courthouse Facility were taken from the 2009 ASHRAE Handbook of Fundamentals. The values are used for Jacksonville NAS, FL, USA and are summarized in Table 5.

Outdoor Design Conditions		
Heating Conditions (99.6%)	Cooling Conditions (0.4%)	
OA Dry Bulb (°F)	OA Dry Bulb (°F)	OA Wet Bulb (°F)
32.2	95.5	77.2

Table 5

The indoor design conditions were taken from the design documents provided for the facility. The summer and winter conditions are summarized in Table 6 below.

Indoor Design Conditions	
Summer Design T (°F)	Winter Design T (°F)
75	70

Table 6

Design Ventilation Requirements

An analysis on the Duval County Unified Courthouse Facility using ASHRAE Standard 62.1 was performed to determine the minimum ventilation rates required for occupied spaces. The HVAC system designed for ventilation utilizes three Make-Up Air Units to supply outdoor air to the multiple Air Handling Units that distribute air throughout the building. A comparison of the calculated and design ventilation rates are summarized in Table 7. The calculated values are those generated in the energy model ventilation calculations using ASHRAE 62.1 minimum requirements from Technical Report 2.

Building Airflow Comparison				
	Total Airflow	Ventilation Airflow	Total Airflow per Unit Area	Ventilation Airflow per Unit Area
	(CFM)	(CFM)	(CFM/ft²)	(CFM/ft²)
Model	556,974	131,340	0.76	0.18
Design	585,600	133,535	0.80	0.18
% Deviation	**5%**	**2%**		

Table 7

Heating and Cooling Loads

The design loads were estimated using a load and energy simulation analysis tool. The software used for this process was Trane TRACE 700. The program performed an hourly analysis for one year to determine the loads and energy consumption for the building. Technical Report 2 provides more information on the energy analysis performed on the Duval County Unified Courthouse Facility.

An energy analysis for the facility was also performed by the design engineer in order to gain LEED Certification for the building. However, this information was not made available for a load comparison. The results of the block load analysis are summarized in Table 8 below.

Building Loads			
Cooling Load	Area/Cooling Load	Heating Load	Heating Load/Area
(Tons)	(ft²/Ton)	(MBH)	(BTUh/ft²)
1,971	365.68	9,761	13.54

Table 8

Annual Energy Use

The Trane TRACE model used to determine loads also performs an hourly energy consumption analysis of the building. The facility is modeled to use electricity for lighting and plug loads, and distribution equipment such as pumps and fans. It analyzes the chilled water consumption for cooling and natural gas consumption for heating. The equipment properties were those found in design documents. More information of the energy consumption of the Duval County Unified Courthouse Facility is in Technical Report 2. The annual energy consumptions are summarized in Table 9.

Energy Use Summary

Electric		Natural Gas		Chilled Water		Total
Consumption (kWh)	Peak Demand (kW)	Consumption (MCF)	Peak Demand (MCF/hr)	Consumption (kGal)	Peak Demand (Gal/hr)	Consumption (MMBTU)
3,755,927	1,919	1,687	7.2	287	221	45,268

Table 9

To easily understand and compare the percentages of all energy sources, all energy consumptions were converted to a MMBTU basis and compared to buildings total. The contribution of each type of energy consumption is shown in Chart 1.

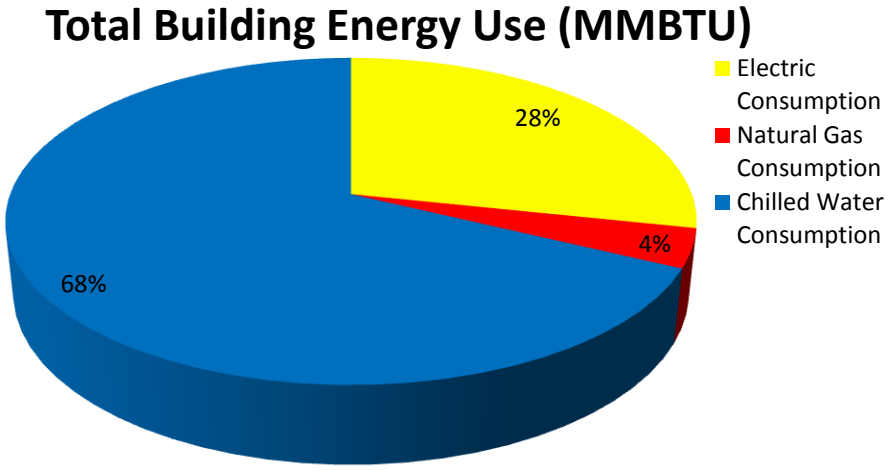

Chart 1

Mechanical Equipment Summary

The mechanical systems of The Duval County Unified Courthouse Facility utilize a hydronic system to condition air that is distributed throughout the building for heating, cooling, and ventilation. Three large Make-Up Air Units bring in the ventilation air for the building. This air is initially conditioned in these MAUs with air filters, heating coils, and a cooling coil. These MAUs are described in Table 10. Two of the three MAUs also utilize enthalpy wheels to exchange heat with the exhaust air passing through them. The enthalpy wheel properties are summarized in Table 11. This outdoor supply air is distributed to the 25 Air Handling Units around the building that mix the outdoor air with recirculated return air and further condition the air if needed. The AHUs distribute the air to the zones with terminal VAV boxes. Table 12 summarizes the 25 AHUs. The hydronic side of the system uses hot water from an on-site boiler for heating and purchased chilled water delivered to the site for cooling. The boiler properties are described in Table 13.

Make Up Air Unit Schedule

	Supply Fan		Exhaust Fan		Filter	Energy Wheel	Cooling Coil					Pre-Heat & Re-Heat Coils			
Name	OA Flow (cfm)	HP	EA Flow (cfm)	HP	Class	Eff.	Sens. MBH	Total MBH	EWT	LWT	Flow (gpm)	Total MBH	EWT	LWT	Flow (gpm)
MAU-2E-1	40,000	60	26,000	25	MERV 13	74%	1,866	3,688	46°F	62°F	461	868	180°F	150°F	58
MAU-2W-1	40,000	60	26,000	25	MERV 13	74%	1,866	3,688	46°F	62°F	461	868	180°F	150°F	58
MAU-7-1	40,000	50	N/A	N/A	MERV 13	N/A	1,866	3,688	46°F	62°F	461	868	180°F	150°F	58

Table 10

Energy Wheel Properties

	EA Dry Bulb	EA Wet Bulb	LA Dry Bulb	LA Wet Bulb
Summer	95	78	85	71
Winter	29	29	48	43

Table 11

Courtroom Air Handling Unit Schedule

Name	Airflows		Supply Fan	Filter	Cooling Coil					Heating Coil			
	OA (cfm)	Total (cfm)	HP	Class	Sens. MBH	Total MBH	EWT	LWT	Flow (gpm)	Total MBH	EWT	LWT	Flow (gpm)
AHU-2E-1	3,400	11,000	15	MERV 13	275	377	46 °F	62 °F	47	N/A	N/A	N/A	N/A
AHU-3E-1	5,290	14,100	20	MERV 13	352	483	46 °F	62 °F	60	N/A	N/A	N/A	N/A
AHU-3E-2	945	3,300	7.5	MERV 13	82	113	46 °F	62 °F	14	107	180 °F	150 °F	7
AHU-4E-1	5,290	14,100	20	MERV 13	352	483	46 °F	62 °F	60	N/A	N/A	N/A	N/A
AHU-4E-2	1,300	4,300	7.5	MERV 13	107	147	46 °F	62 °F	18	140	180 °F	150 °F	9
AHU-5E-1	5,290	14,100	20	MERV 13	352	483	46 °F	62 °F	60	N/A	N/A	N/A	N/A
AHU-6E-1	5,290	14,100	20	MERV 13	352	483	46 °F	62 °F	60	N/A	N/A	N/A	N/A
AHU-2W-1	3,400	11,000	15	MERV 13	275	377	46 °F	62 °F	47	N/A	N/A	N/A	N/A
AHU-3W-1	5,290	14,100	20	MERV 13	352	483	46 °F	62 °F	60	N/A	N/A	N/A	N/A
AHU-3W-2	945	3,300	7.5	MERV 13	82	113	46 °F	62 °F	14	107	180 °F	150 °F	7
AHU-4W-1	5,290	14,100	20	MERV 13	352	483	46 °F	62 °F	60	N/A	N/A	N/A	N/A
AHU-4W-2	1,300	4,300	7.5	MERV 13	107	147	46 °F	62 °F	18	140	180 °F	150 °F	9
AHU-5W-1	5,290	14,100	20	MERV 13	352	483	46 °F	62 °F	60	N/A	N/A	N/A	N/A
AHU-6W-1	5,290	14,100	20	MERV 13	352	483	46 °F	62 °F	60	N/A	N/A	N/A	N/A
AHU-2E-2	6,075	24,300	30	MERV 13	606	832	46 °F	62 °F	104	N/A	N/A	N/A	N/A
AHU-2E-3	12,500	50,000	75	MERV 13	1248	1712	46 °F	62 °F	214	N/A	N/A	N/A	N/A
AHU-7E-1	10,000	46,000	75	MERV 13	1148	1575	46 °F	62 °F	197	N/A	N/A	N/A	N/A
AHU-7E-2	5,000	46,000	75	MERV 13	1148	1575	46 °F	62 °F	197	N/A	N/A	N/A	N/A
AHU-7E-3	5,000	46,000	75	MERV 13	1148	1575	46 °F	62 °F	197	N/A	N/A	N/A	N/A
AHU-1W-1	12,500	50,000	75	MERV 13	1248	1712	46 °F	62 °F	214	N/A	N/A	N/A	N/A
AHU-2W-2	4,700	18,800	25	MERV 13	469	644	46 °F	62 °F	80	N/A	N/A	N/A	N/A
AHU-2W-3	4,150	16,500	20	MERV 13	412	565	46 °F	62 °F	71	N/A	N/A	N/A	N/A
AHU-7W-1	10,000	46,000	75	MERV 13	1148	1575	46 °F	62 °F	197	N/A	N/A	N/A	N/A
AHU-7W-2	5,000	46,000	75	MERV 13	1148	1575	46 °F	62 °F	197	N/A	N/A	N/A	N/A
AHU-7W-3	5,000	46,000	75	MERV 13	1148	1575	46 °F	62 °F	197	N/A	N/A	N/A	N/A

Table 12

Boiler Schedule					
Name	Fuel Type	Size (BHP)	Input Capacity (MBH)	Output Capacity (MBH)	Turndown
B-1	Nat. Gas	400	16,330	13,390	10:01
B-2	Nat. Gas	400	16,330	13,390	10:01

Table 13

Schedules were also created for the other major equipment such as pumps and fans not included in the air handling units. Table 14 summarizes the facility's pumps and Table 15 summarizes exhaust and other fans in the building.

Pump Schedule					
Name	System	Flow (gpm)	Type	Efficiency	HP
CHWP-1	Ch. Water	2,200	HSC	80%	200
CHWP-1	Ch. Water	2,200	HSC	80%	200
PHWP-1	Boiler	35	HSC	83%	15
PHWP-2	Boiler	35	HSC	83%	15
SHWP-1	Hot Water	175	HSC	80%	100
SHWP-2	Hot Water	175	HSC	80%	100
P-2W-1	MAU Circ.	25	Inline	63%	1
P-2E-1	MAU Circ.	25	Inline	63%	1
P-7-1	MAU Circ.	25	Inline	63%	1

Table 14

Auxiliary Fan Schedule				
Name	Service	Air Flow (cfm)	Type	HP
EF-1E-1	Fume Exhaust	11,250	Inline	2
EF-1E-2	General Exhaust	3030	Inline	1
EF-1E-3	Custodial Exhaust	1310	Inline	1/3
EF-1E-4	Garage Exhaust	18770	Inline	5
EF-2E-1	General Exhaust	10050	Roof Downblast	5
EF-5E-1	Server Room Purge	3300	Inline	3/4

EF-7E-1	General Exhaust	5000	Inline	3
EF-7E-2	Pressure Relief	20000	Inline	3
SF-E-1	Boiler Room Supply	8000	Wall Prop	1 1/2
EF-1W-1	Garage Exhaust	18770	Inline	5
EF-1W-2	Custodial Exhaust	1900	Inline	1/2
EF-1W-3	General Exhaust	3200	Inline	1
EF-2W-1	General Exhaust	9085	Roof Downblast	3
EF-2W-2	Server Room Purge	2000	Roof Downblast	3/4
EF-7W-1	General Exhaust	5000	Inline	3

Table 15

Mechanical System Cost

Currently, no bidding documents for the mechanical systems have been made available yet by the design engineers or construction management company. Therefore, the mechanical system first cost is unknown for this part of the report. The price information is still being waited on from the construction manager, and once received this part shall be updated.

Mechanical System Space Requirements

The total space allocated for mechanical system components is outlined in Table 16 below. The spaces include rooms dedicated to air handlers and fans, pumps, boilers, and also shaft and duct riser spaces. Areas such as ceiling plenums that house some major HVAC equipment were not included in this summation because they do not contribute to actual lost floor space. Some AHUs are located on exterior roofs and these areas were also excluded from the total. Only actual usable floor areas utilized for mechanical equipment are those included in this take-off.

Mechanical System Floor Space	
Level	Area (ft^2)
Floor 1	5,160
Floor 2	2,349
Floor 3	2,329
Floor 4	2,350

Floor 5	2,302
Floor 6	2,323
Floor 7	454
Total	**17,267**

Table 16

Operating History

The Duval County Unified Courthouse Facility is currently under construction. Therefore, no system operating history or utility bills are available.

System Operations and Schematics

Airside Operations

The Duval County Unified Courthouse Facility is served with outdoor air by three Make-Up Air Units. These MAUs distribute the ventilation air to 25 other Air Handling Units in the building based on the need for fresh outdoor air. The AHUs use CO2 sensors in the return air to determine the necessary ventilation air to be delivered to that unit. The AHUs mix the return air and ventilation air, and send it out to its served zones in the building. The units utilize optimum start and techniques to get the space to its ideal comfort level for the start of occupancy. The AHUs will remain off during unoccupied periods and only cycle on to main an unoccupied setback temperature. The MAUs are to remain operating 24/7 to dilute space air of CO2 and maintain building pressurization. The variable air volume from the MAUs is controlled via a Variable Frequency Drive on its supply fan. The MAUs that utilize energy recovery use an exhaust fan that is also equipped with a VFD. The supply air temperature and humidity from the MAUs is controlled by the enthalpy wheel, a pre-heating coil, a cooling coil, and re-heat coil. Pre-heat coils are utilized when the ambient outdoor air temperature drops too low to prevent freezing on the chilled water coil.

All AHUs utilize VFD's on the supply fan for variable air volume supply. The temperature in these units is controlled by the modulation of the valve for the chilled water coil. If extra heating is needed, it is done in either the terminal VAV boxes or inside the unit with its own re-heat coil. Only four of these units have their own re-heat coil. These are the units that server their own courtrooms at the north end of the building. Humidity control is modulated with a sensor in the return air. If the humidity rises above 60%, the cooling coil will lower its set point to dehumidify.

Airside Schematics

The following figures are schematics of the airside systems. Figures 1 and 2 are the two types of MAUs (with energy recovery and without energy recovery). The schedule shown above in Table 10

lists which MAUs are equipped with energy recovery. Figures 3 and 4 are the two types of AHUs (with re-heat coil and without re-heat coil). The distribution of each MAU to its respected AHUs is also shown in Figures 5, 6, and 7. The schedule shown above in Table 12 lists which AHUs are equipped with a heating coil.

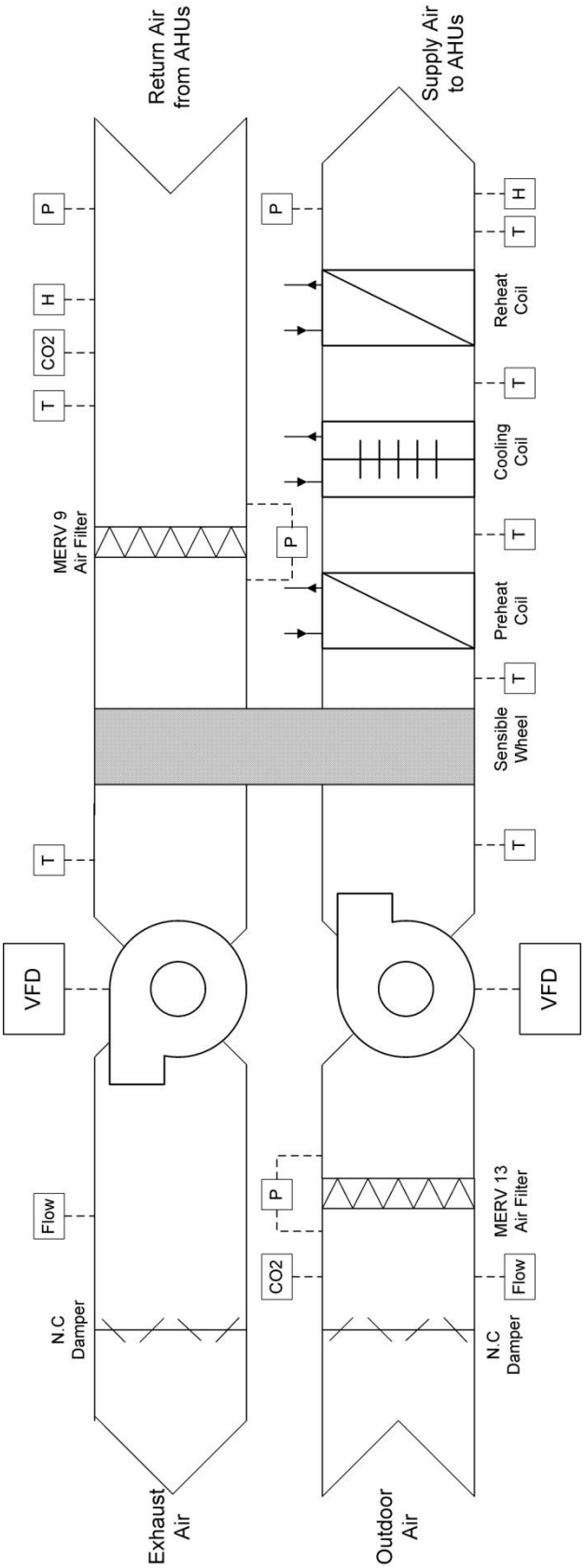

Figure 1: MAU with Energy Recovery

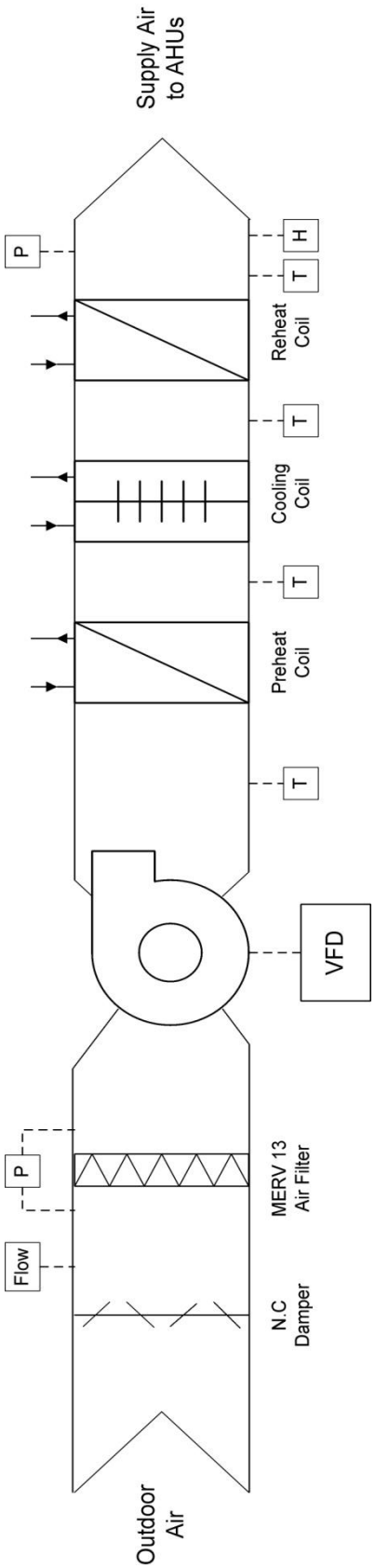

Figure 2: MAU without Energy Recovery

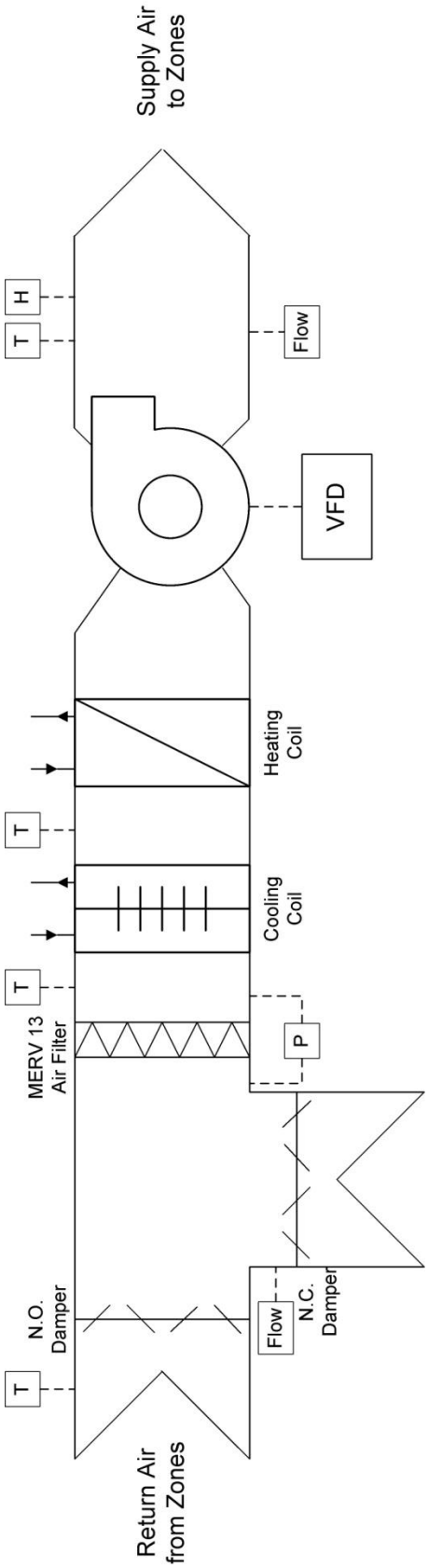

Figure 3: Courtroom AHU with Re-Heat Coil

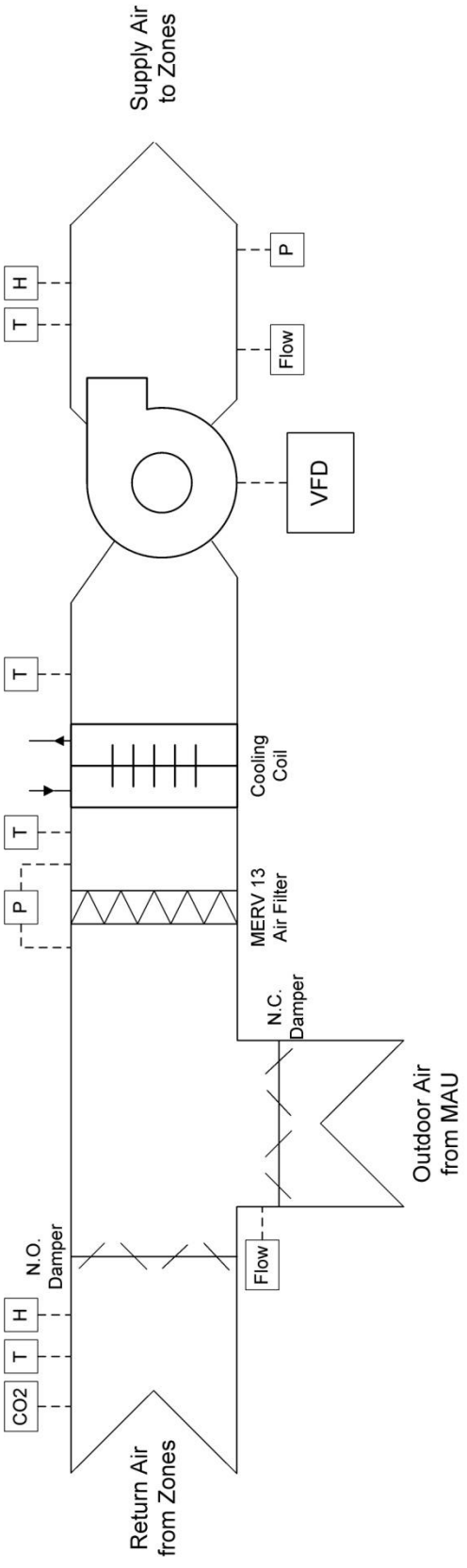

Figure 4: Typical AHU without Re-Heat Coil

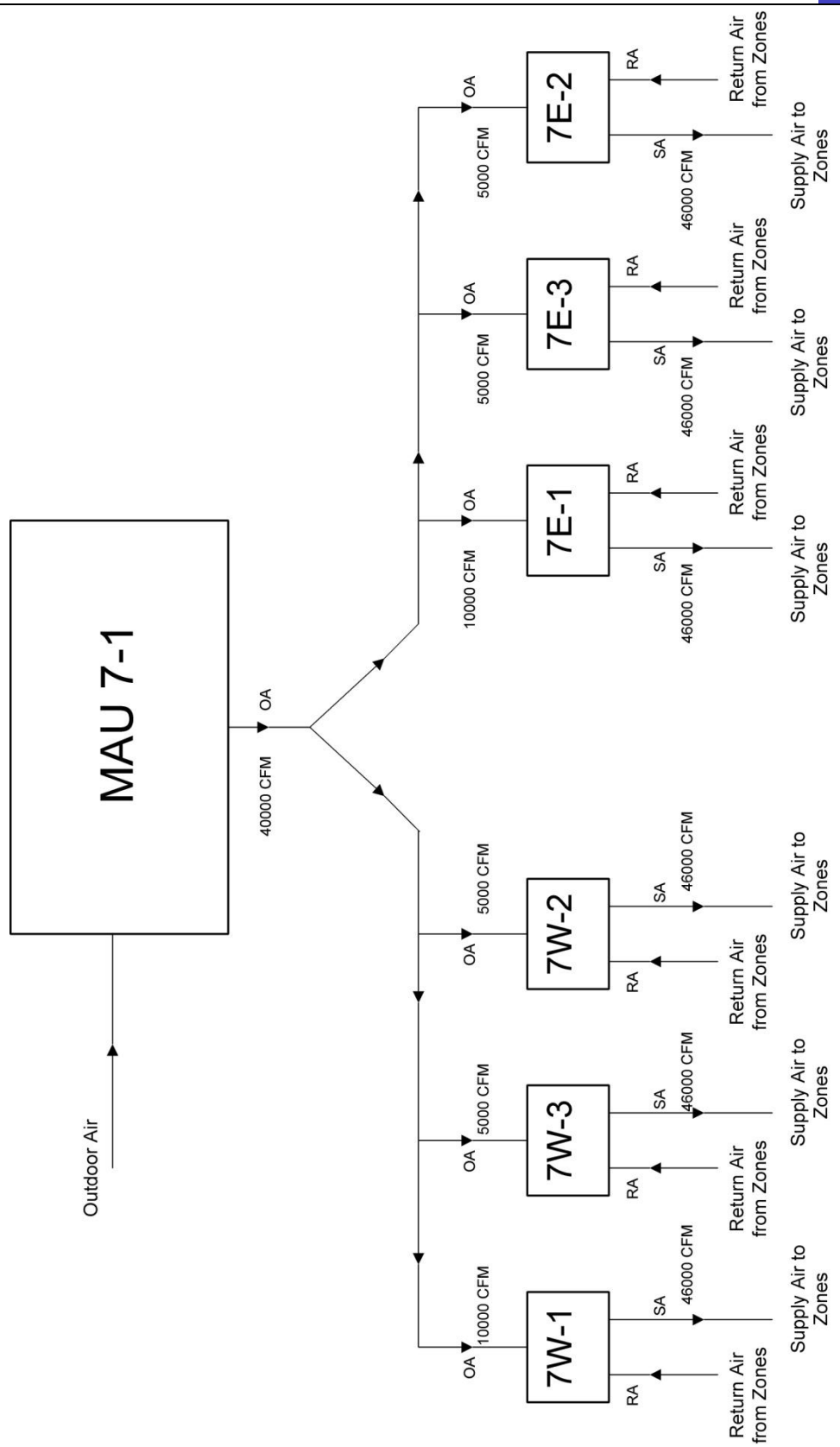

Figure 5: MAU 7-1 Air Distribution

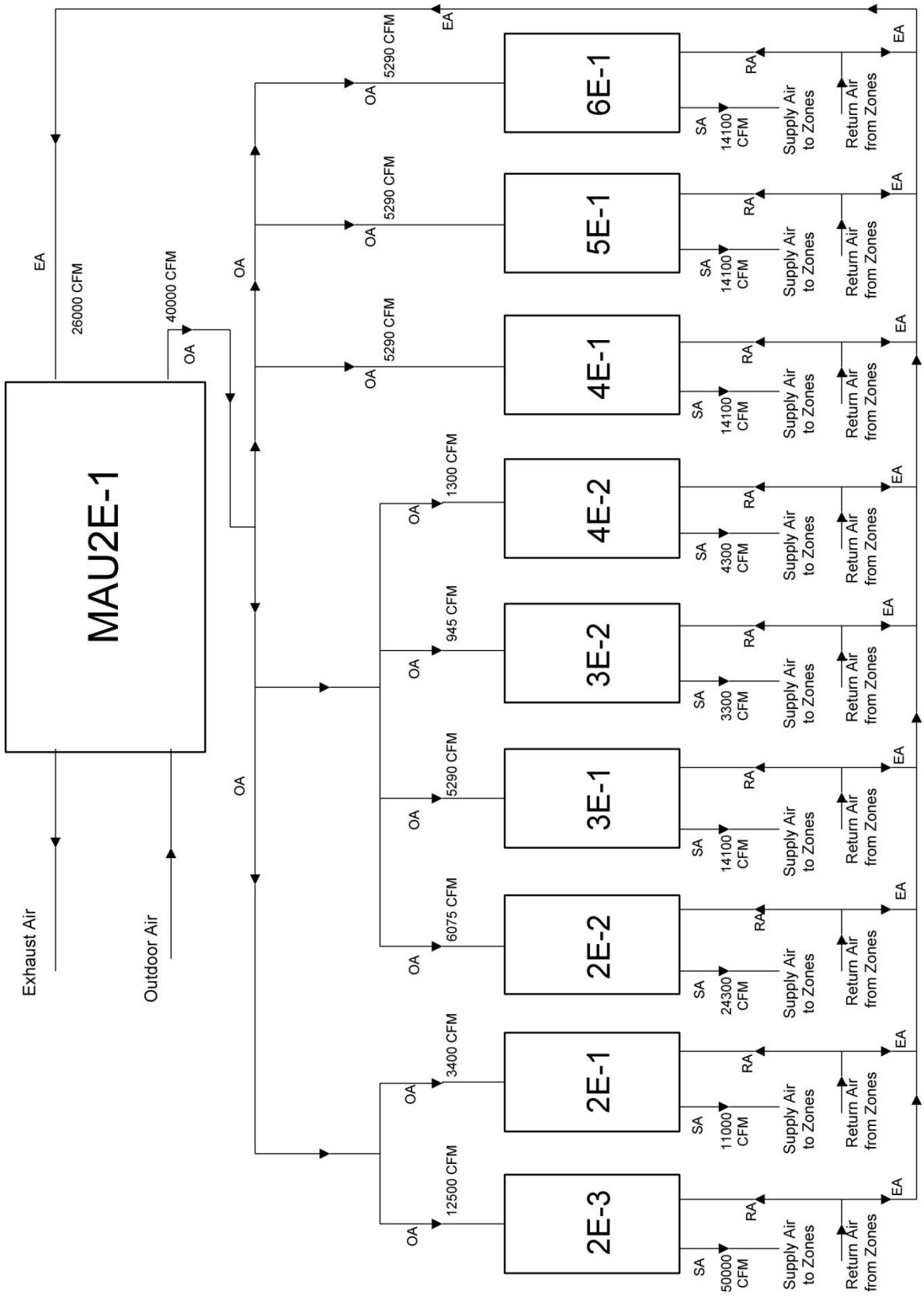

Figure 6: MAU 2E-1 Air Distribution

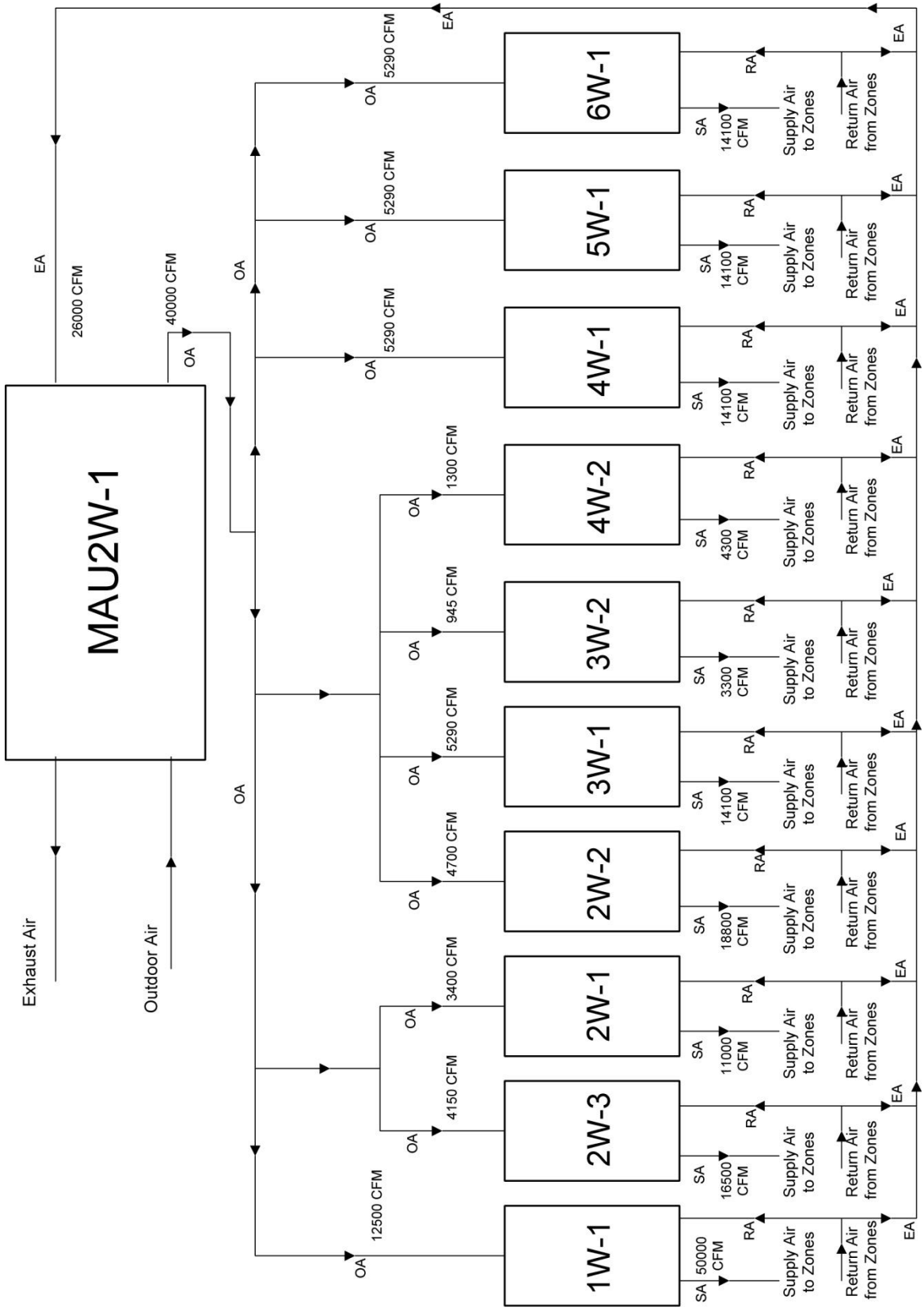

Figure 7: MAU 2W-1 Air Distribution

Waterside Operations

The hot water boilers provides heating services for the Duval County Unified Courthouse Facility through the use of heating coils in the Make-Up Air Units, Air Handling Units, and Terminal VAV Boxes. The boilers maintain a constant output temperature of 180 °F. Each boiler has two burners and two stages of firing per burner. Primary hot water is circulated through the boilers by two constant-speed pumps. Hot water is delivered to the loads by two secondary pumps controlled by Variable Frequency Drives. Most heating coils are controlled with two-way valves. Depending on humidity control requirements, one boiler may be shut off during intermediate seasons. When the occupancy schedule or optimum start dictates the heating system be enabled, the lead boiler will start with both burners operating at the high firing rate. As the water temperature reaches the low limit set point of 160 °F, the burners drop in firing rates as needed. As temperature drops to a 10 °F differential from the set point, the burners step back up. When the OA temperature is less than 65 °F, or if de-humidification requires re-heat, the lead boiler and its pumps will start. The lag boiler and its pumps will start when the OA temperature is less than 45 °F or if the return supply temperature cannot be maintained. The boiler will cycle on and off during unoccupied periods with the AHUs to maintain the night low limit set point.

Cooling for the facility is provided by purchased chilled water delivered to the site from the J.E.A Public Utility Company. Chilled water is distributed throughout the building through two variable flow chilled water pumps using VFDs. The pumps operate on an optimum start schedule related to the AHU schedules. The two pumps are sequenced to alternate the start and stop of the pumps based on chilled water demand. The chilled water supplied by the utility is normally 42 °F. The chilled water differential temperature (T_{CHWR}-T_{CHWS}) should be no less than 15.5 °F. If the supply water temperature is less than 44 °F and the temperature rise is less than 15 °F, the bypass valve will be modulated to mix and raise the supply temperature to no more than 44 °F.

Domestic cold water is provided by the J.E.A. Public Utility Company. This water enters a Triplex Pumping System to distribute domestic cold water throughout the building. At any point-of-use where hot water is required, an Instantaneous Electric Water Heater (IEW) is utilized.

Waterside Schematics

The waterside schematics are shown in the following figures. Figure 8 illustrates the heating hot water provided by the boiler system. Figure 9 shows the pumping arrangement for the chilled water pumping system. Figure 10 is a general schematic of how the domestic water is distributed.

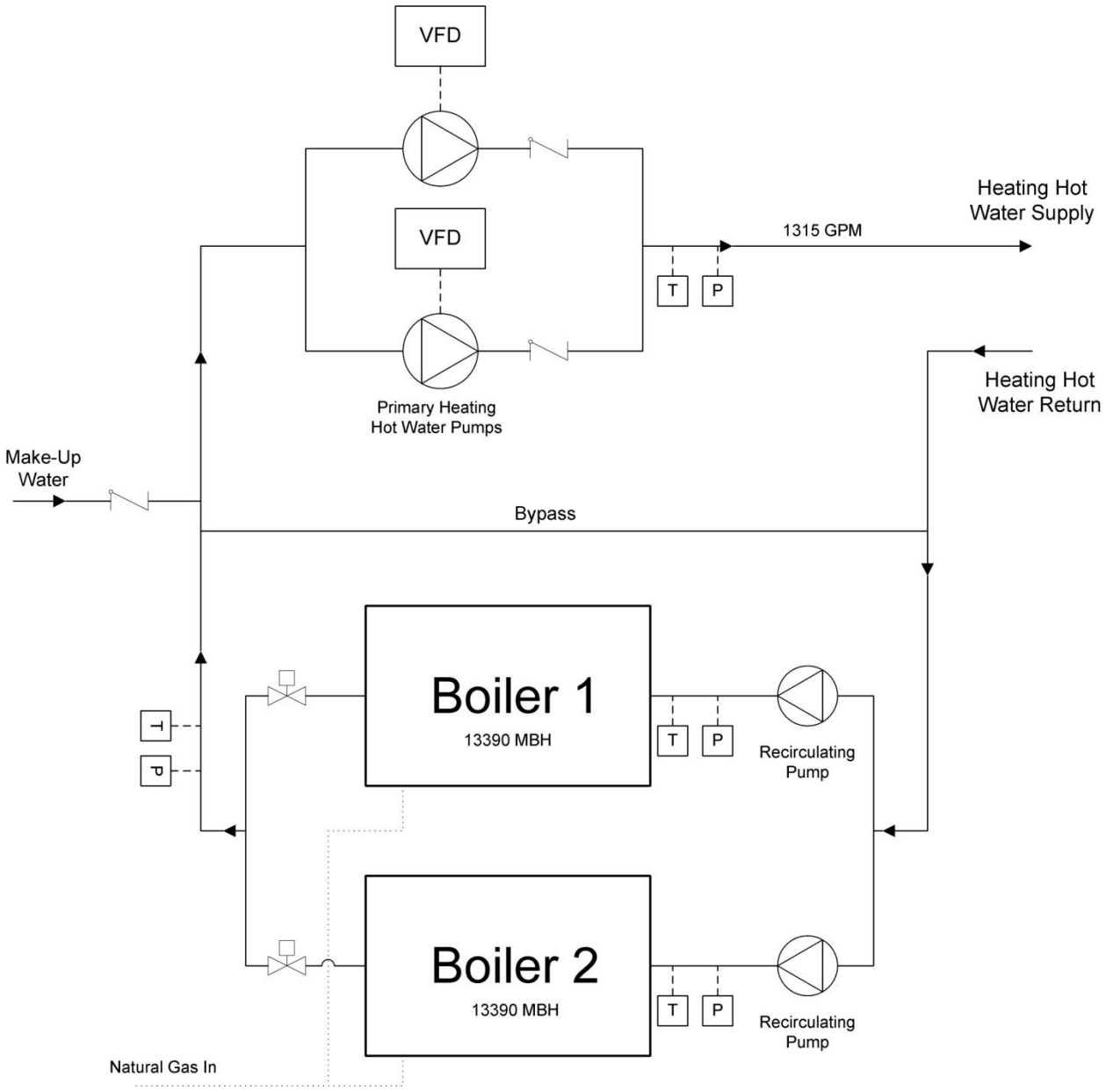

Figure 8: Heating Hot Water Schematic

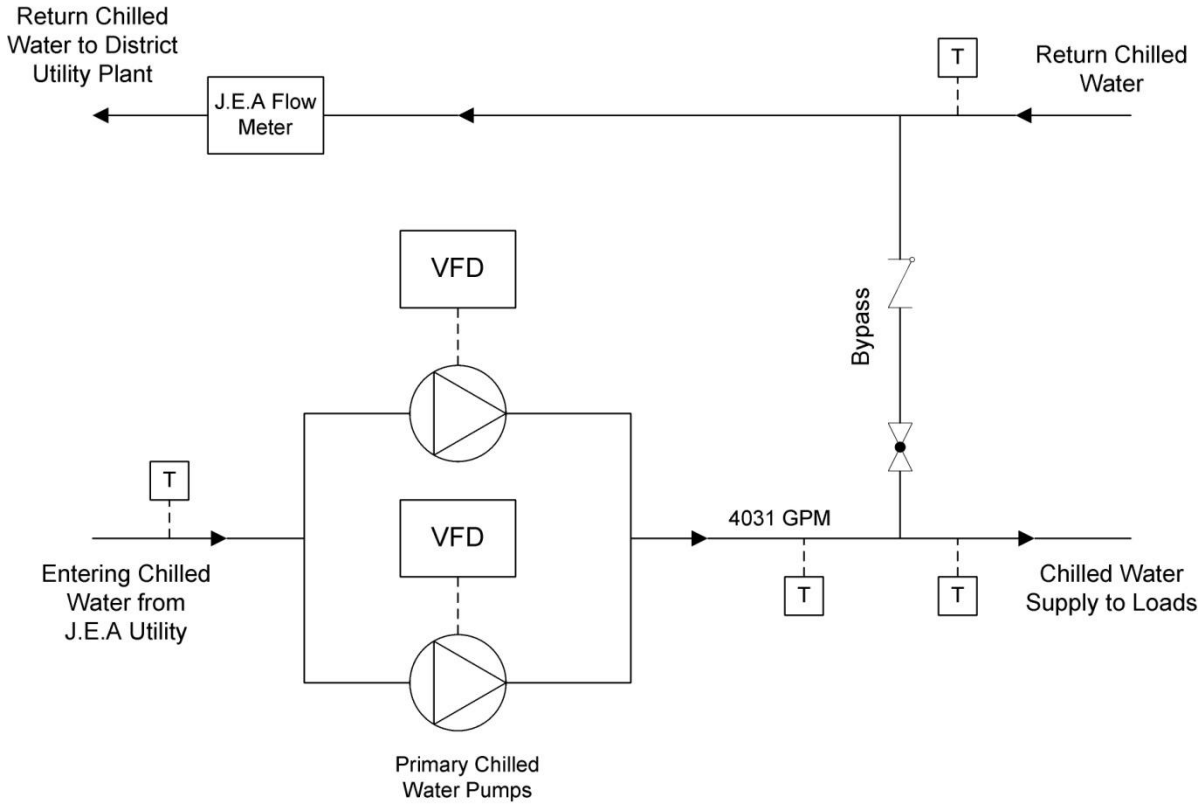

Figure 9: Chilled Water Pumping Schematic

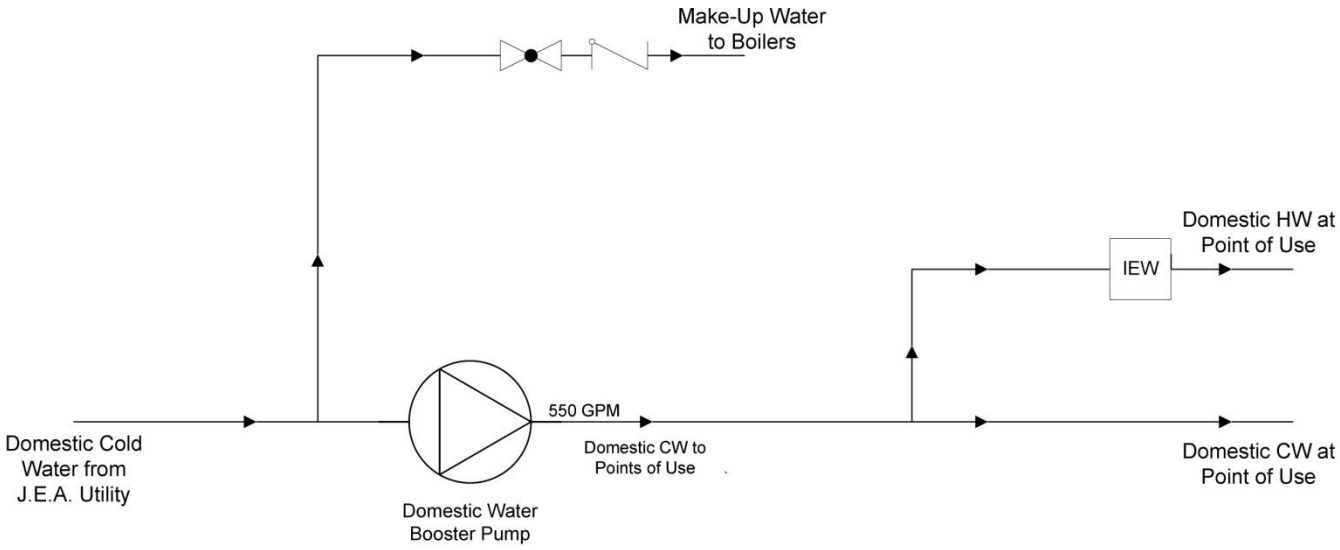

Figure 10: Domestic Water Schematic

LEED Analysis

The Leadership in Energy and Environmental Design (LEED) was formed by the United States Green Building Council to help building owners and design teams utilize energy efficient and environmentally friendly construction practices. LEED has two categories that are directly influenced by the mechanical design team. These categories are Energy and Atmosphere (EA) and Indoor Environmental Quality (EQ). The Duval County Unified Courthouse Facility is currently on track to obtain LEED certification through the LEED for New Construction V2.2 with 32 points approved. However, some extra points are still under delegation and LEED Silver Certification under V2.2 is a possibility. For the purpose of the analysis on the Duval County Unified Courthouse Facility (DCUCF), only credits from the two aforementioned categories are being studied.

Energy & Atmosphere

EA Prerequisite 1: Fundamental Commissioning of the Building Energy Systems - Yes

Intent: Verify that the building's energy related systems are installed, calibrated and perform according to the owner's project requirements, basis of design, and construction documents.

DCUCF:A Commissioning Authority (CxA) has been designated to review and oversee the commissioning process. The owner has documented their Owner's Project Requirements (OPR) and the design team has developed their Basis of Design (BOD). The CxA has reviewed both the OPR and BOD. Upon completion, a commissioning report shall be completed and delivered to the owner.

EA Prerequisite 2: Minimum Energy Performance – Yes

Intent: Establish the minimum level of energy efficiency for the building and systems.

DCUCF:The facility is in compliance with the required mandatory provisions of ASHRAE Standard 90.1 and meets the performance requirements outlined in Section 11 of the standard based on the prescriptive requirements for this credit.

EA Prerequisite 3: Fundamental Refrigerant Management– Yes

Intent: Reduce ozone depletion through reduction of CFC-based refrigerants.

DCUCF: No chiller system is on site, therefore no refrigerants are used.

EA Credit 1: Optimize Energy Performance – Yes

Intent: Achieve higher levels of energy efficiency for the building above the prerequisite for the building and its systems to further reduce environmental and economical impacts of excessive energy use.

DCUCF:The design team of the facility utilized a Whole Building Energy Simulation to keep track of this credit. The building was compared to the baseline building of ASHRAE Standard 90.1 with the Building Performance Rating Method of Appendix G in the standard. The building was analyzed using a software tool known as VisualDOE. The building achieved a 14% energy savings over the baseline building and received 2 points in this category.

EA Credit 2: On-Site Renewable Energy – No

Intent: Increase levels of on-site renewable energy to reduce environmental and economical impacts from fossil fuel energy use.

DCUCF:The design team did not incorporate any On-Site Renewable energy for the project.

EA Credit 3: Enhanced Commissioning – No

Intent: Begin commissioning process early and continue after design is complete for performance verification testing.

DCUCF:The scope of the project did not include enhanced commissioning, only Fundamental Commissioning Authority.

EA Credit 4: Enhanced Refrigerant Management –Yes

Intent: Reduce ozone depletion and support the Montreal Protocol.

DCUCF:The facility does not use refrigerants, therefore the point for this credit is applied.

EA Credit 5: Measurement and Verification – Maybe

Intent: Provide accountability for the energy use of the building over time.

DCUCF:The design team is currently developing a M&V Plan for post-construction. No further information has been provided on their strategy, but the credit is pending.

EA Credit 6: Green Power – No

Intent: Encourage use of renewable energy sources purchased from the electric grid.

DCUCF:The facility will not be purchasing any renewable energy through its grid.

Indoor Environmental Quality

EQ Prerequisite 1: Minimum IAQ Performance - Yes

Intent: Enhance indoor air quality by establishing a minimum IAQ performance and contribute to the comfort and well-being of occupants.

DCUCF:The facility meets the minimum requirements of Sections 4 through 7 of ASHRAE Standard 62.1 and all ventilation systems have been designed using the Ventilation Rate Procedure.

EQ Prerequisite 2: Environmental Tobacco Smoke Control – Yes

Intent: Minimize exposure of building occupants, indoor surfaces and ventilation air to Environmental Tobacco Smoke

DCUCF:Smoking is prohibited in the building. Therefore the facility automatically applies to this prerequisite.

EQ Credit 1: Outdoor Air Delivery Monitoring – Yes

Intent: Provide monitoring of the ventilation system to sustain occupant comfort and well-being.

DCUCF:Carbon Dioxide concentrations are monitored and outdoor air flow rates are measured to verify that the adequate amount is being supplied according to ASHRAE Standard 62.1.

EQ Credit 2: Increased Ventilation – No

Intent: Provide additional outdoor air ventilation to improve the indoor air quality.

DCUCF:The project team chose not to obtain this credit due to the large amount of air it must bring in due to its occupancy and size.

EQ Credit 3.1: Construction IAQ Management Plan; During Construction – Yes

Intent: Reduce IAQ problems resulting from construction processes to sustain the comfort and well-being of the construction workers and future occupants.

DCUCF:Turner Construction, the construction management team, is currently implementing an construction IAQ plan. All measures being implemented are being photographed and documented. The construction plan includes the use of temporary filtration media and duct sealing and protection.

EQ Credit 3.2: Construction IAQ Management Plan; Before Occupancy – No

Intent: Reduce IAQ problems resulting from construction processes to sustain the comfort and well-being of the construction workers and future occupants.

DCUCF:The design team is not currently pursuing this credit.

EQ Credit 4.1: Low-Emitting Materials; Adhesives & Sealants – Yes

Intent: Reduce indoor air contaminants from materials that are harmful to the comfort or well-being of installers and occupants.

DCUCF: All sealants and adhesives used comply with the maximum VOC limits stated in this section.

EQ Credit 4.2: Low-Emitting Materials; Paints & Coatings – Yes

Intent: Reduce indoor air contaminants from materials that are harmful to the comfort or well-being of installers and occupants.

DCUCF:All paints and coatings used comply with the maximum VOC limits stated in this section.

EQ Credit 4.3: Low-Emitting Materials; Carpet Systems – Yes

Intent: Reduce indoor air contaminants from materials that are harmful to the comfort or well-being of installers and occupants.

DCUCF: All carpet systems installed comply with the maximum VOC limit stated in this section, as well as meet the required testing and product requirements of this section.

EQ Credit 4.4: Low-Emitting Materials; Composite Wood & Agrifiber Products – Yes

Intent: Reduce indoor air contaminants from materials that are harmful to the comfort or well-being of installers and occupants.

DCUCF:All composite wood and agrifiber products or laminating adhesives used in the facility contain no added urea-formaldehyde resins.

EQ Credit 5: Indoor Chemical & Pollutant Source Control – Yes

Intent: Minimize exposure of building occupants to hazardous particulates and chemical pollutants.

DCUCF:The entryways of the facility comply with the requirements of this section to capture dirt and particulates from entering the building from outdoors. The indoor parking garage exhaust rate is in compliance with this section to expel any harmful pollutants generated in the area. The filtration devices used in all air handlers comply with the Minimum Efficiency Reporting Value of MERV 13.

EQ Credit 6.1: Controllability of Systems; Lighting – Maybe

Intent: Provide high levels of lighting system control by individual occupants to promote the productivity, comfort, and well-being of occupants.

DCUCF:This credit is being pursued, however, no updates have been made on this credit and it has been deferred until further notice.

EQ Credit 6.2: Controllability of Systems; Thermal Comfort – No

Intent: Provide high levels of thermal comfort system control by individual occupants to promote the productivity, comfort, and well-being of occupants.

DCUCF:The design team is not pursuing this credit through individual controls for the building thermal comfort systems.

EQ Credit 7.1: Thermal Comfort; Design – Yes

Intent: Provide a comfortable thermal environment to support the productivity and well-being of occupants.

DCUCF:The HVAC system and building envelope of the facility have been designed to meet the requirements of ASHRAE Standard 55 for Thermal Comfort.

EQ Credit 7.2: Thermal Comfort; Verification – Maybe

Intent: Provide assessment of the building's thermal comfort over time.

DCUCF: The design team is pursuing this credit through the use of a thermal comfort survey. However, this credit has been deferred until further notice.

EQ Credit 8.1: Daylight & Views; Daylight 75% of Spaces – No

Intent: Provide a connection between indoor spaces and outdoors through the introduction of daylight and views.

DCUCF: The facility is not applicable for this credit due to its large size and large interior floor area that has no access to windows.

EQ Credit 8.2: Daylight & Views; Views for 90% of Spaces – No

Intent: Provide a connection between indoor spaces and outdoors through the introduction of daylight and views.

DCUCF: The facility is not applicable for this credit due to its large size and large interior floor area that has no access to windows.

Overall System Evaluation

Due to the large size of the facility, the mechanical system needed to provide a large amount of air throughout the building for ventilation. It did this through selecting three large Make-Up Air Units to distribute air to smaller Air Handling Units that mix and condition the air and send it to the spaces. The design team took advantage of the district chilled water and decided to purchase chilled water instead of operating a chiller plant and generating its own chilled water. The design team has mentioned that the cost of chilled water is expensive in Florida, however. According to utility analysis in the previous section, electricity costs more per unit of energy than chilled water. An option that was considered was to create a chiller plant for the single facility that could more efficiently create chilled water. This could only be feasible, however, by dramatically reducing the cooling loads on the building. The buildings large size, large building envelope area, and large area of fenestration increase the cooling load of the building considerably due to its climate. If these cooling loads can be reduced, the installation of a chiller plant could be practical. Another consideration that could be looked into is moving away from the all air system that is currently utilized. The building uses a total of 28 air handlers to move and condition a massive amount of air. This contributes to a very large amount of electricity being used on fans.

The facility does not lose much usable floor space due to dedicated mechanical spaces. However, the building has very large plenums, most likely due to the ductwork required for the system. The

plenums range in size from five to nine feet high. If the plenum sizes can be reduced by using less ductwork in them, a dramatic construction cost could be mitigated.

The facility has attained LEED Certification and can possibly acquire LEED Silver Certification. Most of these credits, however, do not apply to the mechanical systems categories mentioned before. The facility only receives 3 out of the possible 17 points in Energy & Atmosphere. The mechanical systems leave room for energy efficiency improvement. On-site renewable such as solar are also a possibility that can be looked at due to the location's amount of solar gain.

References

ASHRAE Handbook of Fundamentals

ASHRAE Handbook of HVAC Systems and Equipment

ASHRAE Handbook of HVAC Applications

ASHRAE Standard 62.1 – 2007

ASHRAE Standard 90.1 – 2007

TLC Engineering for Architecture, Inc. *Duval County Unified Courthouse Facility Mechanical Drawings and Specifications*

United States Green Building Council, LEED V.2.2