CAMI VR Lab HVAC Design

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FAA MIKE MONRONEY AERONAUTICAL CENTER

GALLOGLY COLLEGE OF ENGINEERING
SCHOOL OF AEROSPACE AND MECHANICAL ENGINEERING
The UNIVERSITY *of* OKLAHOMA

Problem Background

The **FAA Mike Monroney Aeronautical Center** is renovating a portion of the Civil Aeronautical Medical Institute (CAMI) building to install a **VR lab** in the old pool room. The space will have four new rooms, the **VR lab**, **electrical room**, **observation room**, and **equipment room.**

The new space requires **a new HVAC system** to support the equipment. The energy analysis for the space was conducted in eQUEST.

Project Deliverables

ASHRAE 90.1/62.1 Baseline eQUEST Model

Three Proposed System Models

System Plans and Equipment Schedules Drawn in AutoCAD

Codes and Constraints

ASHRAE 90.1 *Energy Standard for Buildings Except Low-Rise Residential Buildings*

- Energy Standards
- Lighting Loads
- Occupancy Loads

ASHRAE 62.1 *Ventilation and Acceptable Indoor Air Quality*

- Outside Air Requirements
- Exhaust Requirements

- Create energy analysis models to show overall reduction of energy consumption in comparison to the baseline model.
- Maintain temperatures of 70°F in the winter (60°F at night) and 72°F in the summer (80°F at night).
- Equipment loads of 7,200W in the VR Lab, 960W in the Observation Room, 1,500W in the Electrical Room, & 10kW in the Equipment Room.
- Evaluate lighting loads at a 30% below ASHRAE 90.1 values.
- Chilled water enters at 56°F and leaves at 44°F. The chiller's efficiency is 0.56kW/Ton.
- Hot water enters at 160°F and leaves at 180°F. The boiler's efficiency is 80%.
- Calculate pipe and duct sizes based on volumetric flow rate and maximum head loss using McQuay software.
- Implement mechanical plans of HVAC equipment following FAA's standards.

Design and Analysis

Create an ASHRAE 90.1 and 62.1 compliant **baseline model** in eQUEST

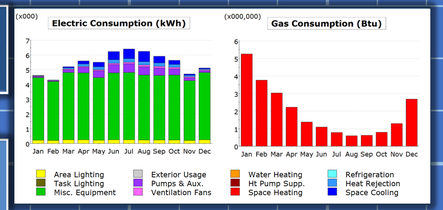
Create three new proposed models in **eQUEST**

Our proposed models:

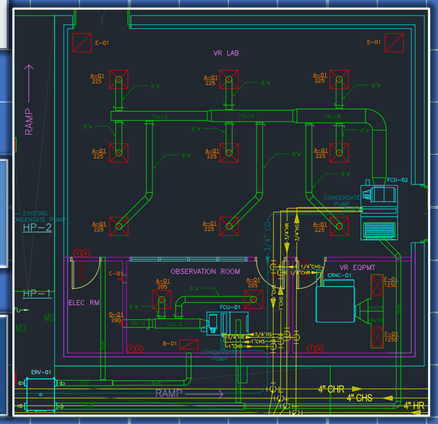
Variable Air Volume with Reheat	4-Pipe Fan Coil Units	4-Pipe Fan Coil Units with ERV

FAA selected **4-Pipe Fan Coil with Energy Recovery Ventilator** based on energy analysis and existing floor plans

Incorporate selected system design into CAMI building plans using **AutoCAD**

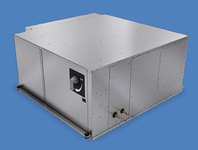


Cooling	price/ kWh	kWh	Heating	Price/ MCF	MCF	Total Cost Per Year
Baseline	$0.06	62,810	Baseline	$5.42	23.5	$3,896.13
VAV w/ RH	$0.06	61,860	VAV w/ RH	$5.42	24	$3,841.79
4PFC	$0.06	68,260	4PFC	$5.42	9.42	$4,146.66
4PFC w/ ERV	**$0.06**	**67,960**	**4PFC w/ ERV**	**$5.42**	**6.03**	**$4,110.28**



Equipment Selection

Vertiv MiniMate 2 (MMD92C)



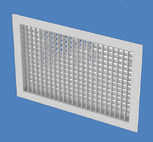
TRANE Fan Coil Units (BCHE090/BCHE024)



Lossnay ERV (LGH-F300RVX2-E



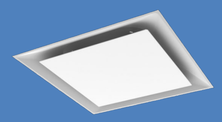
Titus Return Grilles (350 RL)



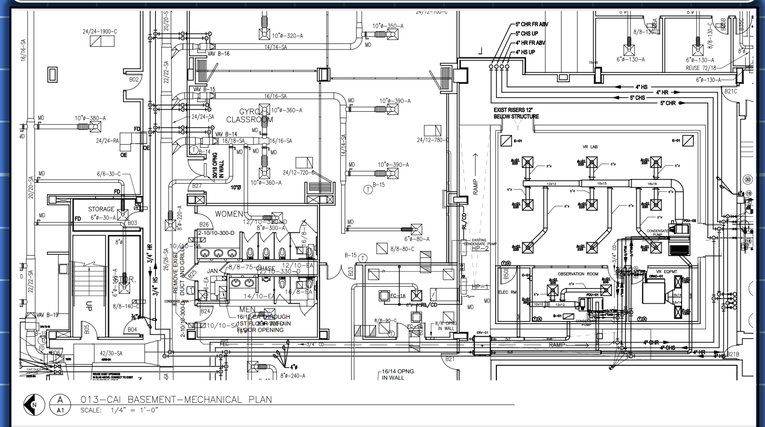
Titus Supply (300 RS)



Titus Diffusers (OMNI)



Plans and Equipment Schedules



AIR DEVICE SCHEDULE

MARK	DESCRIPTION	MFGR/MOD No.	MOUNTING	REMARKS
A-01	SUPPLY AIR DIFFUSER	TITUS OMNI	CEILING	24x24, LAY-IN, 8IN ROUND NECK
B-01	RETURN AIR GRILLE	TITUS 350RL	CEILING	24x12 FACE, 22x10 NECK, STEEL, 35° BLADES, 3/4" SPACING
C-01	RETURN AIR GRILLE	TITUS 350RL	WALL	12x12 FACE, 10x10 NECK, STEEL, 35° BLADES, 3/4" SPACING
D-01	SUPPLY AIR GRILLE	TITUS 300RS	WALL	12x12 FACE, 10x10 NECK, STEEL, DOUBLE DEFLECTION, 3/4" SPACING
E-01	RETURN AIR GRILLE	TITUS 350RL	CEILING	24x24 FACE, 22x22 NECK, STEEL, 35° BLADES, 3/4" SPACING
F-01	SUPPLY AIR GRILLE	TITUS 300RS	UNIT	24x12 FACE, 22x10 NECK, STEEL, DOUBLE DEFLECTION, 3/4" SPACING

FAN COIL UNITS

				COOLING DATA				HEATING DATA			FAN MOTOR DATA				
MARK	MOUNT	CFM (MAX)	E.S.P.	TOTAL	SENS.	GPM	P.D. (FT)	CAPACITY (MBH)	GPM	P.D. (FT)	FLA	HP	VOLT	PH	MANUFACTURER MODEL NO.
FCU-01	CEILING-HORIZ	700	1.0"	19.94	15.41	3.79	2.04	18.98	0.63	0.13	7.46	0.496	115	1	TRANE-BCHE024
FCU-02	CEILING-HORIZ	2000	0.5"	55.2	42.03	7.68	1.8	51.73	1.73	0.08	1.75	0.563	460	1	TRANE-BCHE090

COMPUTER UNIT AIR CONDITIONING UNIT SCHEDULE

MARK	MOUNT	CFM (MAX)	COOLING DATA					HEATING DATA			FAN MOTOR DATA							MANUFACTURER/ MODEL
			CAPACITY			GPM	P.D. (FT)							COOLING		HEAT/HUMIDITY		
			E.S.P.	TOTAL	SENS.			CAPACITY (MBH)	GPM	P.D. (FT)	HP	VOLT	PH	FLA	OPD	FLA	OPD	
CRAC-01	CEILING	2500	1.0"	13.8	12.8	10.3	9.7	19.6	1.5	1.5	1.5	460	3	5.6	15	43.2	60	MMD92C, 16.4KW

ENERGY RECOVERY VENTILATOR SCHEDULE

MARK	EXHAUST SIDE		RETURN AIR CONDITIONS			OUTDOOR AIR/SUPPLY SIDE		OUTSIDE AIR			ELECTRICAL DATA			MANUFACTURER/ MODEL
	FAN AIRFLOW (CFM)	ESP (IN. H2O)	SUMMER DB/WB (°F/)	WINTER DB/WB (°F/)	INLET FILTER TYPE	FAN AIRFLOW (CFM)	ESP (IN. H2O)	SUMMER DB/WB (°F)	WINTER DB/WB (°F)	INLET FILTER TYPE	V/PH/HZ	MGA	MOCP	
ERV-01	195	0.5	97.6/74.2	14.6/10.7	MERV 7	215	0.5	100.6/73.9	14.6/10.9	MERV 7	208/1/60	4.3	15	LGH-F300RVX2-E

Summary and Future Work

An ASHRAE baseline model was created and used for comparison to other systems. Three proposal models were made and compared to the baseline. Despite the energy analysis results, the sponsor decided the 4-Pipe Fan Coil with ERV would be more practical to install based on the existing equipment. Ease of installation can lead to significant savings during the construction process. Another factor is that the existing air handling units were not sized for the additional loads. Once the equipment was selected by the sponsor, the mechanical plans were drawn in AutoCAD, accounting for the physical space of the building. Finally, an official drawing and schedule were produced to present to the sponsor.

- Plans and schedule must be approved by professional engineers at the FAA before finalization of construction plans.
- A contractor will be given the approved mechanical plans and equipment schedules to start construction work.